Explorations on an

Urban Interventions Management System

A reflection on how to deal with urban complex systems and deliver dynamic change.

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Urban Interventions Management System

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Contents

List of figures 11

List of tables 12

Abstract 13

Personal statement and motivation for the research 14

Research approach 15

Chapter 1: Introduction 19

Introducing the research 19

The importance of studying the city 19

Positioning the thesis in the context of two important debates related to city planning today 20

Human actions and urban development 22

Positioning the thesis in relation to existing research areas 24

Hypothesis, aims and objectives 25

The research hypothesis 26

Thesis structure 27

Chapter summary 28

Chapter 2: The city 31

Introduction 31

The relationship between humans and the built environment 32

The importance of the public space 32

Urban character and urban change from the perspective of top-down and bottom -up interventions in the building environment 34

The *natural city* and the *planned city* from the perspective of planning process and human interventions in the building environment 34

The *natural city* 34

The *planned city* *35*

Bottom-up and top-down interventions; roles and contributions for the characterisation of urban development 37

Chapter summary 45

Chapter 3: Human and urban change

This thesis approaches cities as complex systems in evolution 49

Introduction 50

Complexity Sciences, evolution and the study of cities 50

Complexity sciences: Relevance for the research 50

Key authors 51

Contributions and weaknesses 53

Evolutionary theory: Contributions to the research 56

Contributions to the research's methodology 57

Connecting with the whole of science 57

Connecting with the context 59

Contributions to the research's theoretical background 60

Identify the role of interventions and design in the process of change 60

Justify the need for a new kind of top-down planning and help to identify some of its key characteristics 61

What is common to all cities?

Urban form and urban development from the perspective of complexity sciences 63

Introduction 63

Understanding emergence to intervene in emergent systems 64

Understanding the emergence of urban order 66

Implications for urban management and urban design 71

Discussion 73

Why are cities unique?

Urban form and urban development from the perspective of evolutionary sciences 74

Introduction 74

The role of human actions and design in urban and human evolution 74

The need for a new paradigm 75

The city as an ecosystem 75

The evolutionary paradigm 76

Human and urban evolution 78

Different approaches 78

The speed of the human evolutionary process 83

Human Interventions in the context of human and urban evolution 84

Potentials and risks 84

Design and *Artificial Selection* as tools to guide and speed up human and urban evolution 88
Natural and artificial selection 88
Design as a form of adaptation and as a reproduction tool 90
Implications for urban management and urban design 94

Introduction to *Intervention Management and Design.*
Managing complexity, unpredictably and dynamic change 97
The need for top-down planning 98
The relevance of nested hierarchies 98
The need for cooperation would therefore be the need for norms? 102
Creating the environment for cooperation to emerge 102
Creating the environment for innovative solutions to emerge 104
Nudging change as a new approach towards urban planning 105
Do we have to fully understand complex systems to act on them? 107
Relating the *intervention management* system to governance 109
Relevant principles to plan and manage dynamic and unpredictable urban change 110
Make each step viable now 110
Proceed with small steps and avoid leaps in the dark 111
Search for novelty but avoided suppressing 'unsolicited novelty' 112
Discard moribund models 112
Dissolve decision-making 113
Chapter summary and discussion 114

Chapter 4: Categorising Interventions
The role of interventions in urban change 117
Introduction 117
General categorisation of interventions 119
Interventions as an action or a reaction 119
Natural interventions and artificial interventions 120
Are *artificial interventions* a form of technology? 121
Interventions as *Events* and interventions as *Space* 122
How can Alexander's patterns inform intervention management?
Patterns as the basic elements of the system 124
Acute interventions and chronic interventions 126
Strategic Interventions 128

Short-term actions with long-term intentions 128
Intentionality and the common good 129
Top-down, bottom-up and strategic interventions 131
Bottom-up interventions 131
Top-Down interventions 131
Strategic intervention 132
Interventions as a product of the tension of top-down and bottom-up forces 133
Categorisation of *Strategic Interventions* in the built environment 135
Isolated interventions or in a system 135
Interventions according to the predictability of the system's reaction 138
General or Contextual 139
General interventions as conceptualisations of action/ Strategic interventions as unique and contextual 139
Hierarchies of interventions 141
The relevance of *Micro-Interventions* 136
Chapter summary 149

Chapter 5 - Research methodology
Research explorations and research strategies 157
Introduction 157

Qualitative inquiry 157
Why use qualitative research? 157
Qualitative research, sustainability and evolutionary theory 158
Qualitative research: The objective study of subjectivity 159
Packer's alternative way of enquiry 160

Case studies as a research methodology 163
Why use case studies? 163
Exploring ways to conduct a case study and to collect data 164
Focus groups 164
Data collection 165
Explorations in the academic environment 165

Research design: The *Exploratory Interventions management system* (The EIMS) 167
Introduction 167
Models and the oversimplification of complexity 169
Models as an abstract tool to study contextual urban environments 169
The EIMS models 170
The EIMS basic model 172
System internal and *system external* 173
Nested hierarchies and EIMS-models 176
Interventions in the context of the EIMS 181
Who would use the EIMS basic model and for what? 183
Summary 185
The EIMS dynamic model: *From a picture to a film.* 187
Representing interventions in relation to time 188
Representing interventions in relation to a context 188
Operational and methodological approach 189
Summary 195
Chapter summary 196

Chapter 6: Studies 199
Introduction 199
Introduction to study 1 and study 2 200
Research context: *The Union Terrace Gardens* 200
Context of selection 202
Option 1: The micro-intervention system: (MIS) 202
Option 2: ACSEF's Intervention; The city square: (CS) 205
Option 3: The Peacock Visual Arts' centre :(PVAC) 205
Study 1 209
Key features of the study 209
Aims of the data collection 209
Methods to collect data 209
Research findings and discussion 212
Research findings regarding the MIS project and use of micro interventions as a tool to nudge urban change 212
Research findings regarding the use of the EIMS models as a selection tool 213
Emergent findings and discussion 214

Study 2 217
Key features of study 2 217
Aims of the data collection 217
Methodology and data collection 218
Research findings and discussion 219
Research findings regarding the MIS project and use of micro interventions as a tool to nudge urban change 219
Research findings regarding the use of the EIMS models as a selection tool 220
Implications for the research process and for the models' design and the methodology to operate them 222
Adjustments made in the EIMS basic model 223
Adjustments made in the EIMS dynamic model 224

Study 3 225
Context of the research 225
Key features of the study 227
Aims of the data collection 227
Methodology 228
Research findings and discussion 229
General findings 229
Research findings related to the acceptance and applicability of the EIMS-models 230
Emerging findings 232
Chapter summary 233

Chapter 7: Conclusions 245
How do we relate the city, its complexity and its dynamic character with human interventions? 245
How can we use "urban interventions" to nudge urban and social change? 248
Limitations of the research 254
The objectivity and relevance of the conclusions taken from the use of the EIMS models 254
Relationship between the relevance of informed interventions and the unpredictable character of complex systems 256
Defining, selecting and designing an intervention based on the conclusions taken from the EIMS models both as an individual and as a group 256

The use of micro-interventions as explorations to find more appropriate permanent interventions 257
Recommendations for further research 258

Endnotes 261
Personal statement and motivation for the research 261
Chapter 1: Introduction 261
Chapter 2: The city 263
Chapter 3: Human and urban change 264
Chapter 4: Categorising interventions 268
Chapter 5: Research methodology 271
Chapter 6 – Studies 273

References 276

Appendixes 291
Appendix 1: Categorisation of interventions according to their size (Table) 292
Appendix 2: Table of the interventions suggested by the micro-interventions system project for the Union Terrace Gardens in Aberdeen 295
Appendix 3: Questionnaire- Study 2 301
Appendix 4: Written assignment - Study 2 302
Appendix 5: Written coursework for Module 2 / PgCert Research Methods: Research aims and objective 306
Appendix 6: PgCert Research Methods - Module 2 Grade Descriptor / Grade and feedback comments sheet 308

List of Figures

Figure 1: CTC as a solid theoretical background able to join together areas of research which were fragmented until recently. Portugali, J. (2012). Complexity Theories of Cities: Achievements, Criticism and Potentials. Complexity Theories of Cities Have Come to Age. J. Portugali, H. Meyer, E. Stolk and E. Tan: 49
Figure 2: Von Koch Curve. Walffram mathworld, http://mathworld.wolfram.com/KochSnowflake.html
Figure 3: Street Syntax.
Figure 4: Space syntax from a dimensional perspective. Marshall, S. (2009). Cities Design and Evolution. London and New York, Routledge: 78
Figure 5: The history of Ford's cars. National Motor Vehicle Co., http://www.chuckstoyland.com/national/history/
Figure 6: Ideal cities. Marshall, S. (2009). Cities Design and Evolution. London and New York, Routledge: 224
Figure 7: Hilary Berseth's honeycomb. http://nymag.com/arts/art/features/51163/.
Figure 8: Matryoshka dolls. http://en.wikipedia.org/wiki/File:Russian-Matroshka_no_bg.jpg
Figure 9: Interventions as a result of the tension between top-down and bottom-up forces. Adaptation of a diagram used by Terry G. McGee in ARI Singapore (2013)
Figure 10: The city garden project. http://www.thecitygardenproject.co.uk/
Figure 11: The Micro Project System (MIS).
Figure 12: Alexander's conceptualisation of the components of form. Alexander, C. (1964). Notes on The Synthesis of Form. Cambridge, Massachusetts, and London, Harvard University Press: 153
Figure 13: The EIMS basic model.
Figure14: Relation between the heart of the system and its intervention areas. The heart of the system is based on the *World System Model*. Hodgson, A. (2011). Ready for Anything. United Kingdom, Triarchy Press: 13
Figure15: The EIMS multilevel model. Based Geels and Kemp and the SCENE-model. Loorbach, D. (2007). Transition Management - new mode of governance for sustainable development. Utrecht, International Books: 20, 135
Figure 16: Nested hierarchies organisation implicit in the EIMS basic model.
Figure17: Methodology to characterise the EIMS basic model and the system of analysis.
Figure 18: The EIMS models and the representation of the macro-system.
Figure19: The EIMS models and the representation of interventions in relation to hierarchical levels of social organisation.
Figure 20: Summary of the research explorations to design the EIMS basic model. (Draft)
Figure 21: Relation between the EIMS' operational phases and the process of urban and social change.
Figure 22: Relation between the EIMS' operational phases and the process of urban and social change.
Figure 23: North view of the Union Terrace Gardens. Street perspective taken from Rosemount Viaduct. Image taken from http://www.heraldscotland.com/
Figure 24: Aerial view of the *Union Terrace Gardens*. *Google earth*
Figure 25: The MIS project's strategy
Figure 26: The MIS project's interventions
Figure 27: EIMS basic model before study 2
Figure 28: EIMS basic model after study 2
Figure 29: EIMS dynamic model before study 2.
Figure 30: EIMS dynamic model after study 2
Figure 31: Image of Denburn Road taken from the Union Bridge. Daniel C. Doolan's News Updates, Posted on March 24, 2012, http://dcdoolan.wordpress.com/tag/union-terrace-gardens/

List of Tables

Table 1: Relation between the intentionality of an intervention and its origin.
Table 2: Summary of the general characterisation of bottom-up, top-down and strategic interventions.
Table 3: Relates two kinds of strategic top-down interventions in the building environment: one isolated, big- scale intervention in and a system of small-scale interventions.
Table 4: Categorisation of interventions according to their size. This categorisation is based on the theory of nested hierarchies and on Alexander's (1977) patterns of space and levels of social organisation. (Appendix 1)
Table 5: Categorisation of interventions in the building environment according to their size.
Table 6: The example of Broomy Hill Railway. Relation between the scale of one interventions and the scale of its influence in a social environment. The example of Broomy Hill Railway was given by one participant in study2.
Table7: Characterisation of interventions according to the categories explores in chapter 4.
Table8: Relation between hierarchies of social organisation and hierarchies of interventions in the building environment.
Table 9: Relation between long-term intention and short-term action.
Table 10: List of interventions suggested by the MIS project and the intentions behind them. (Appendix 4)
Table 11: Characterisation of the three interventions investigated in studies 1 and 2 in relation to the categories explored in chapter 4.
Table12: Relation between hierarchies of social organisation and the hierarchical position of the interventions investigated in studies 1 and 2.
Table 13: Relation between long-term intention and the short term action regarding the interventions investigated in studies 1 and 2.
Table 14: Characterisation of the interventions investigated in study 3 in relation to the categories explored in chapter 4.
Table15: Relation between hierarchies of social organisation and the hierarchical position of the interventions investigated in study 3.
Table 16: Relation between long-term intention and the short term actions regarding the interventions investigated in study 3.
Table 17: Relation between the pedagogical process of design and the phases and methods of data collection.
Table 18: Summary of the research studies' design
Table 19: Relation between the research aims and the studies' explorations
Table 20: Summary of the findings which emerged from study 1
Table 21: Summary of the findings which emerged from study 2
Table 22: Summary of the findings which emerged from study 3

Abstract

How we plan and manage urban development has become an increasingly complex challenge due to unpredictable and rapid conditional changes in postmodern cities. This in turn calls for a paradigm shift in the way we understand and practice urban planning and design.

A resilient urban planning system has to be open and flexible rather than restrictive and rigid. It has to respond promptly and adequately to the fast and diverse ways cities are reorganising as a response to globalization, environmental challenges and advances in technology.

The need for a new kind of urban planning, which is able to embrace the complexity and unpredictability of the postmodern city, has been explored by several planning theorists. However, these theories were often developed from the perspective of urban planning and the city itself. In this thesis the complexity and evolutionary theory are used to approach the subject of planning process from a perspective whereby the city is considered as the emergent and self-organising product of a sequence of interventions in the urban environment.

This research suggests a planning approach focused on the design and selection of human interventions. Within this, the strategic roles for both top-down and bottom-up interventions are investigated in relation to the formation of urban character and urban development.

The research presents exploratory models, to help recognise, understand and mediate between a complex range of urban managers and external pressures derived from urban conditional changes. Findings from this exploratory study yield useful insights into how society should perceive cities in transition, as well as adopting an ideological shift to deal with contemporary and future city planning.

Personal statement and motivation for the research

This MPhil thesis is a product of who I am as a person and of my experiences as an architect and as a researcher. It combines both my practical experience as an architect and the theoretical knowledge I have obtained while undertaking this research. It is a consequence of my questions and doubts as a human being and as a professional searching for answers in this world.

Today it is commonplace to ask architects to engage with urban design. In fact, today we cannot isolate or clearly define the role of professions such as architecture, urban design and urban planning (Koolhaas, et al., 1994). Regardless of the fact that my academic background as an architect focused on the “objects” rather than their context, I had several experiences of using the design and function of a building to introduce a bigger change in its surrounding environment. In other words, I was very often engaged with the task of using buildings for the requalification and improvement of social and urban fabric.

This represented a great shift of focus for me.

First, throughout my professional experience as a designer, I have looked at “the city” through the eyes of an architect. My academic background was focused on the design and conceptualisation of beautiful buildings and the science of materialising them. Nevertheless, real life and circumstances often asked me to use the design of an “object” or of a system of objects, as a strategy to address a bigger reality. In other words, in my daily practice as an architect I have often used design as a tool to solve urban problems.

The second shift of focus had to do with the fact that instead of concentrating on the object and it’s inside world I had to focus on what was outside; the context.

The building, whose basic function is to divide public and private, in and out, became something much bigger than that; it had to not only relate to its direct environment but also to contribute to the regeneration of a community, to the development of a neighbourhood, a city or even a country.

This shift in focus slowly led me to look at a deeper relation between “the building” and the city.

But buildings are not the only things that can be used as a catalyst for urban and social change. What other *interventions* can we use to nudge urban change? A new legislation, a new policy, a new education topic, a new advert on television… Aren’t “urban interventions” of endless kinds and scales? Are the most adequate interventions to address a given issue unique and contextual or can we generalize them?

As a result of my experiences and my new ideology a major question started to formulate in my mind:

Can we use interventions or human actions as a strategy to manipulate urban change?

In light of this, it’s easy to see how the concept of interventions, of city and of urban dynamics gained a new relevance in my work and I felt the need to broaden my knowledge on the subject. My research on these topics became the heart of this research’s literature review.

Research approach

This research stems from the relationship between urban dynamics and its intervention at a human level – which is the fundamental to contextualise urban actions.

I have used theories of complexity and evolution to learn more about the role of interventions in urban change. These theories helped me to understand better, the dynamic and complex character of the urban form and to understand the nature of human actions.

I believe that to relate human beings with their context and with the dynamic character of change we need to venture forward with a multidisciplinary approach; “*In order to understand cities we need to venture out beyond the nominal limits of urban studies, to visit architecture, geography, history, social sciences, physical sciences and even occasionally the life sciences*” (Marshall, 2009: xii).

Perhaps some urban theorists would consider some fields of knowledge used in this thesis as inappropriate to establish the relationship between interventions and urban change. Still, as argued before by authors like Alexander (1966, 1979, 1977, 2003, 2006); Jacobs (1970, 1972); Wilson (2011); Batty (1994) and Marshall (2005, 2009). I believe that they can inform a more solid and more appropriate framework with which we can base our understanding of the city and urban interventions. Areas of research related to complexity sciences, emergence and evolution, have already proven to bring light to the understanding of human and urban change.[1]

There is the risk that this literature is seen as an over simplification of some subjects. Nevertheless, these subjects are not my area of competence and they are studied on a much deeper level in their fields of knowledge. Due to the extent of domains referred in this text, in some cases, I will just give a partial glimpse of the subject. I will do this to aid the understanding of how cities evolve and develop and to explore how *intervention management* can prove to be efficient to guide urban change. In other words, it is not my intention to develop these subjects further beyond my field of research. My aim is to convey the idea and to invite others to collaborate and research further if they wish.

I hope that readers from others fields forgive my simplification of their subjects and correct me if any inaccuracy is detected. Still, I believe that it is precisely the embracement of so many different perspectives that adds novelty to this literature review and this thesis as a whole.

Together, evolution and complexity theories helped me to understand *urban interventions* as a consequence of the tension between top-down and bottom-up urban forces. Furthermore, they helped me to draw a picture of the city as a dynamic and open complex system but from the perspective of human actions.

This definition of the city and of human interventions is very much consistent with the way I experienced the several cities where I have lived and worked. In other words, it illustrates my urban experience both as an every-day user of the city and as a professional architect aiming to manipulate urban development.

I hope that the findings of this research will inform other professionals who intervene in the city on a daily basis.

This research is not on urban planning, urban design or architecture. It is about the "*management of interventions*" as a tool to efficiently address the constant challenges of urban change. The result of my work aims to benefit anyone who is interested in the city regardless of professional background. It aims to invite everyone to define and understand the character of a context in relation to their own interventions and therefore participate in the transformation of a city from their own position.

With my research I am not questioning what architecture is today. I am putting it in the general context of interventions. I wondered to what extent an architect could use the concept and the design of the building to improve urban development regardless of the specific constrains of each assignment. In light of this, other questions emerged: Are architects aware of urban complexity? Do they have to be, in order to intervene in the urban form more adequately? To what extent do the aesthetics of design matter?

There are some fantastic solutions emerging from unconventional urban settlements; Settlements where the building environment grows house by house, or shelter by shelter. Here, buildings as well as many other kinds of interventions are creative and in direct response to the people's needs. There are no architects or planners involved but there is still a lot to be learnt from them.[2]

Finally, it is important to reflect on the fact that during this research, I was exposed to emotions which eventually influenced the interpretation of the research findings. These emotions relate to the evolvement of the researcher in the context of the study and they are openly expressed and form part of the data collected. Opinions, emotions and interpretations are human tools to survive; they are part of the human condition and no researcher can escape their human character. Therefore, it is better to acknowledge our human character than to try to detach ourselves from it. In the case studies of this research the ethical positions and world views of the researcher were shared with all the participants and from that, several deep, honest and meaningful discussions arose.

Taylor's (1971) ideas about social sciences support this research position:

"*These sciences (*social sciences) *cannot be wertfrei (valued-free); they are moral sciences in a more radical sense that the eighteenth century understood. Finally, their successful prosecution requires a high degree of self-knowledge, a freedom from illusion, in the sense of error which is rooted and expressed in one's way of life; for our incapacity to understand is rooted in our self-definitions, hence in what we are*."

(Taylor, 1971: 57 in Packer, 2010: 123)

In light of this, as argued in chapter 5, we used Packer's philosophical arguments to define both the research methodology and to collect and analyse the data. The studies happened within the system composed by: the researcher, the physical context of the study, the subject of research and the participants. The elements of the system and the dynamics they have created make the study so complex that only when one is part of the system can one fully understand and interpret the information that it produced. Only when the researcher embraces himself also as a person experiencing a phenomenon in a specific context can he can engage fully with the complexity of the social and cultural background on which the research takes place. Only then can one fully understand both the system of the study (researcher, context, object of research and participants) and the dynamics created between the parts of the system. Furthermore, only when the researcher is part of the system can he fully understand how the actions of the participants initiate other actions which, in return, influence both the elements of the system and the evolutionary process of the phenomena.

Eventually, the researcher can translate that knowledge into words but those words might be interpreted as opinions. Still, no one can say that these opinions are not relevant. They are profound once they are a product of experience. They can be seen as valid knowledge which emerged from a case study or from a study of a phenomenon in a context and therefore they have the potential to be generalised and applied to other contexts.

Chapter 1: Introduction

Introducing the research

The importance of studying the city

Cities can arguably be regarded as the ultimate triumph of man over nature (Ihde, 1990), and today we live in a world which holds an almost endless variety of urban settlements (McGee, 1971). Although there are settlements where communities live as they used to live centuries ago, or indigenous tribes relying on the rainforest to survive, there are also cities which change and evolve so quickly that they are difficult to manage (Allmendinger, 2001). Rapidly changing cities normally accompany rapid progress in transport and communication technology, with one feeding the other (Augé, 2008).[1]

Due to the complex dynamics and the rapidly changing character of postmodern cities, concerns over how we plan and manage city development are increasingly becoming everyday challenge (Allmendinger, 2001). This phenomenon urges better informed urbanism.[2]: an urbanism that better understands and manages the fast and diverse ways cities are reorganising as a response to globalization, human migrations and advances in technology.[3]

Communication technology, for example, is having a greater impact on the way we live in the city. Like the use of motor vehicles did in the past, use of the internet is rapidly changing the ways in which we use cities. The internet has changed the way we work, the way we trade, the way we communicate and the way we socialise and have fun. The internet, and technology in general, is re-shaping today's cities in ways that we could never imagine. Today, with the fast emergence of new technologies it is even more difficult to imagine how the city will be in the future.[4] But is this a problem? Could urban planners and designers ever predict the future of our cities or were they being hopeful imagining perfect urban scenarios? Did this approach to planning work? [5] Why does it regularly seem that modern planned environments are often not necessarily better than traditional unplanned ones? After so much effort, resources and technology applied to develop new and more modern urban areas, modern planned environments are often perceived as worse than the unplanned ones (Jacobs, 1961; Alexander, 1966; Anand Wadwekar and Kobayashi, 2009). Very often, planned environments from the 1950s onwards are considered inhuman, ugly and brutal 'concrete jungles'.[6] Is this image related to the modernism movement in architecture and planning or is it a consequence of planning itself? Does the urban planner still have a role to play? (Koolhaas, Mau, et al., 1994) and, how can we manage the unpredictable development of the city in a sustainable and efficient way? Do we even have to manage urban change? (Dixon, 2001).

Positioning the thesis in the context of two important debates related to city planning today

In the past, cities were comprised of defined physical areas with a clear edge. It was not only their shape but also their general common political ground and culture that gave them coherence and a sense of unity. It was that physical and political unity as well as a kind of cultural magnet that gave solidity to the urban structure. It was this sense of unity and of belonging that constituted the basis for urban expansions and exploration of new more distance areas. It was this unity which was inherent to each individual as part of a community which was extended and exchanged throughout history between different urban groups and which created the diversity we have today.[7] This inspired the traditional view of the city as a closed and controlled system. This view inspired planning approaches throughout history which designed the city from the top-down as a coherent, finished whole (Marshall, 2012). In other words, historically city planning is associated with large scale interventions; it is associated with master-plans , blueprint planning or "physicalist" planning (Taylor, 1998) and the design of cities (Geddes, 1915/1949; Gibberd, 1967; Lynch, 1990). Modernist planning is one example of such an approach (Marshall, 2009). Today, conclusions reached from the misfortunes of top-down creationist approaches raise questions regarding how and whether we should design and plan our cities (Marshall, 2012).

In light of the uncertainties related to urban change and planning itself it is relevant to establish the position of this thesis in the context of the two key debates on city planning today.

The first debate regards Modernism and Neo-Traditionalism. This debate is not only present in planning but also in Art, Music and Architecture.

One of the major lessons learned from modernism was that the future is unpredictable and people take time to adjust to large scale changes in their surroundings. In other words, the concept of trying to simulate the perfect future city as a finished design form and build it as a whole can bring serious urban problems (Jacobs, 1961; Jencks, 1981; Coleman, 1985; Panerai, Depaule et al., 2004; Pearson, 2006).[8] There are many other key lessons planners learned from the misfortunes of modernist planning but this is the most significant for the argument we wish to explore in this thesis.[9]

Neo-traditional planning is normally associated with the *New Urbanism* movement.[10] Many authors see neo-traditional planning as a reaction to modernist planning.[11] In fact the neo-traditional kind of planning appreciates urban diversity, it has greater ecological concerns; it values the organic character of the traditional "unplanned city" as well as valuing the human scale of its building environment. Modernism and Neo-traditionalism, in stylistic terms, are two completely different movements. Yet, from the perspective of urban design and management process they both emerge from similar basic principles. On the one hand, the ideal city behind the neo-traditional movement is the traditional "unplanned city" or *natural city*, as coined by Alexander (1966). Natural cities emerge from individual initiatives which together form the whole of the city. On the other hand, both modernism and neo-traditionalism embrace a top-down creationist approach (Katz, 1994:19).[12] Both modernism and neo-traditionalism conceptualise and design the city as a final product and do not embrace the emergence of a city as part of a longer term process (Allmendinger, 2001).[13]

Jane Jacobs (1970) and Christopher Alexander's (1966) criticisms of the modernist movement - which in a sense inspired the neo-traditional movement - have yet not been acted upon. Their criticism was not so much about the kind of buildings or the infrastructures used by the modernist movement but rather about the process and the conceptual way of dealing with city design and evolution (Marshall, 2009).[14]

In this thesis, it is argued that the problems urban design and urban planning face today are not related to aesthetic concepts or kinds of infrastructure. Rather, the problems lie in their approach towards top-down design and planning. The problem is related to the scale of interventions and the strategy of creating a "coherent whole" at once (Marshall, 2012). Following Jacobs and Alexander, this thesis is an exploration of an alternative kind of city planning and design; one that is emergent, flexible and more resilient.

Following this, the second debate concerns the question of whether we should plan the city or if we should let it develop organically. This question has significant consequences to the way the state and other top-down forces should interfere in the development of cities and communities.

Today we perceive the city as a complex, unpredictable and open system. In the light of such an image of the city, master-plans, development plans and other large scale and long-term projects in a city do not make much sense (Portugali, 2011; Marshall, 2012). Actually, today we build modern architecture and modern infrastructures but in most cases planning has no grand-plan. Some argue that this lack of a grand-plan as in modernist times is precisely a consequence of the great modernist failures (Sorkin, 2000).[15] Nevertheless, the consequence is a mix of forms in the city, 'urban sprawl' and other dysfunctional social organisations (Batty, 1994).[16]

> *"We now have a scatter of urban forms all over the place: a hundred miles sprawl of edged cities and out of town 'centres', industrials and office 'parks' and 'campus' ... We today have cities without downtowns, suburbs without cities, neighbourhoods without neighbours, 'communities' without civics, and many other combinations that do not seem to fit our understanding of what a city even was."*
>
> Marshall, (2009: 5)

The *let it happen* contemporary approach of urban planning or the lack of a traditional modernist planning or city design lead to what we address today as urban sprawl, social segregation and crime (Batty, 2005). Nevertheless, from the perspective of complexity sciences in the understanding of urban morphology and urban development, such kinds of phenomena can be seen as a natural emergent consequence of human adaptation to new realities or new technologies.[17]

In light of this, this thesis argues that we can neither plan and design the future form of the city, like in the creationist approach, nor let it grow as it pleases. It is argued here that design is always, at some level, part of the urban morphology (Marshall, 2012) and phenomena such as urban sprawl and social segregation highlight the need for top-down management of some kind. Following this argument it is suggested that the complexity and self-organising character of complex systems as a strategy are used to reflect on a new kind of urban planning and city design. In other words we suggest using the capacity of the elements that compose complex systems to find their optimal function and position in relation the other elements and to the system as a whole. It is suggested that a kind of planning and city design that rather than attempting to simplify the urban form tries to generate and maintain its functional complexity (Marshall, 2012). Several theorists and researchers are working on more dynamic ways to deal with the unpredictability of urban complex systems. Nevertheless, the exploration on this theme in this thesis is from the perspective of human actions rather than from the perspective of planning.

Human actions and urban development

Imagining and creating things is inherent to human beings and determines not only the speed but also the path of our evolution (Lane, Maxfield, et al., 2009).

Since the beginning of our history we have manipulated our environment in a continued attempt to master the unpredictability of nature. It is in our nature to try to create a world we believe we can control. The result of such effort is the environment where we live and who we are as humans today. During the relatively short period of human existence on the planet the built environment became our natural environment (Ihde, 1990; Akkerman, 2007). Ihde even argues that we are “technological beings”. In other words, we can only perceive the natural world through technology; through the clothes and shoes we wear, the glasses we put on or the house and the city we live in (Ihde 1990). [18]

We consider *Technology* as one of many kinds of human interventions in the urban or social environment. In this thesis *Human interventions* are defined as *the rational product of an individual in a specific socio-cultural context put into-practice*. This concept of human interventions relates to the human activity on the planet; it relates to the innate human nature to change and adapt the natural world to an artificial one which is more suitable for our needs. In other words, human actions or human interventions emerge from the need to relate and adapt to the environment.[19] They can assume the shape of a tool, a building or an art piece. They can be related to sports, events, cultural or religious practices and habits. *Human interventions* in the urban and social environment do not necessarily need to be something physical or tangible; an intervention can be a new topic at school or a new legal system or music. It can be a new colour given to an old building, planting a tree or cleaning a lake. *Interventions* are of endless kinds, but this research will focus on *human intentional interventions in the building environment*, especially those related to architecture (Lerner, 2012).[20]

There are two main reasons why human actions or human interventions are central to this thesis. These reasons are interrelated but are named separately for the sake of clarity.

First, a key aspect of interventions is their potential to induce change. The word intervention comes from the Latin word "*intervenere*" which means "*to come in between, to interrupt*". It implies an action which modifies the natural course of things. This thesis explores the concept of interventions, as something that occurs, intentionally or unintentionally
"*between events or points in time. Something that disturbs or hinders a course of action.*"

(Collins, 2009)

In this thesis it is argued that in a complex system such as a city, some interventions have the potential to change the system as a whole. Intentionally or unintentionally, one apparently small action, might influence every element of the system and their relations changing the system completely (Batty, 1994). The consequences of an intervention can be so great and complex, that they are, to a great extent, unpredictable (Marshall, 2012).[21] Nevertheless, in this thesis ways of using interventions as tools to intentionally guide urban development are explored.

The second reason why interventions are so relevant for this research is the fact that we consider the city and the city's development as a product of a sequence of interventions. This thesis argues that ideas translated into interventions are the engine for innovation and technology, and determine the essence and character of the places we live in. In other words, ideas become interventions or action in the city. Interventions become urban layouts which in turn become the background to our ways of knowing and doing things. That background becomes the basis on which we centre our perception of the world and on which we continually build new worlds. When one intervenes in the city it determines the way in which we experience things. This experience will in return determine the way we envision the world around us and will influence the way we act on it in the future (Read, 2005).[22] In urban planning, human behaviour and human needs constitute the base which is then translated in written strategies and master plans for the city. These will then serve as guidelines for development and therefore will shape the organization of the space in the city and the urban network systems. They shape how, where and when people socialise, work or pray (Lang, 2005).

This leads us to argue that the process of human interventions in the urban environment is parallel to the process of urban development and one feeds off the other. In light of this we consider human interventions as 'urban building blocks' and as a link between human and urban evolution. Therefore, it is suggested that human interventions can eventually be used as a tool to guide urban change.

Positioning the thesis in relation to existing research areas

The needs and motives for human actions are complex [23] and this adds complexity to urban systems (Portugali, 2011) .

"What is specific to such cultural self-organizing categories (such as the city) *is that their elementary parts are human agents, each of which is itself a self-organizing system. The result is a double self-organizing process: the agents participate in the self-organization process of the city as a whole, which in its turn participates in the specific self-organization process of each individual agent*

(Portugali, 1999)

The need for urban planning to embrace the complexity of urban systems has been explored by several planning theorists. Salingaros (2013) approached the subject from the perspective of form, Healey (2006) reflected on alternative planning processes, Portugali (2007;2012) related planning and urban complexity with social theory, Marshall (2009) related the subject to evolutionary theory and Batty (2005) explored strategies to simulate urban development. All these studies informed and inspired this research; however, the subject is approached from a different perspective. The work of these researchers' is built upon to investigate how to generate and maintain urban complexity but from the perspective of human interventions in the urban environment rather than from the perspective of the city or from the perspective of city planning.

This research relates particularly with the work of Marshall and Portugali. Affinity with the work of Stephen Marshall is due to the fact that he uses a similar theoretical background to sustain a similar world view.

As with Marshall we argue that rather than designing an image for the future we better accept an open end and we base this argument on evolutionary and complexity theory.

'... the well-intended targeting of a precise optimal outcome may be no better than choosing an incremental approach which is still very likely to reach roughly the same kind of form, but which may more surely maximise the change of each intermediate step being viable and adding immediate value.'

Marshall, (2009:267)

In addition, Marshall inspired our reflection on the relation between design and human interventions. He helped us to link design and human action to urban development and human evolution.

The work of Portugali was particularly relevant for this research because he explored complexity theory in the understanding of cities from a social and human perspective. As well as that, during the last 14 years, Portugali explored principles for a planning system driven from the dynamics of the city and its self-organising character. These principles and ideas were published in a variety of publications which were relevant for this research. Portugali is convinced that a dynamic planning system focused on the human capability of self-organisation would allow a flexible and resilient kind of urban planning and would allow innovation to emerge from the bottom-up. Portugali's first attempt to explore the components and structure of a kind of planning which is not dependent on predictions and speculations and that genuinely emerges with the city, was in the year 2000 with the book *Self-Organization and the City* (Portugali, 2000).[24] Another attempt was in 2007 (Portugali and Alfasi, 2007) with the article *Planning Rules for a Self-planned City*. The last one was in 2011 with the article *Complexity, Cognition and the city, Understanding complex Systems* (Portugali, 2011). In this article, Portugali established a relation between the city, human actions and human cognition and explained the way these evolve simultaneously. Portugali theorised on the relationship between urban dynamics and urban evolution from the perspective of how human cognition shapes human actions.

In this research such planning approaches for cities is further explored, but from the perspective of human actions. We suggest a planning focused on the design and selection of human interventions. We will investigate strategic roles for both top-down and bottom-up interventions and we explore ways of designing and selecting them more appropriately, eventually avoiding undesirable collateral damage.

Hypothesis, aims and objectives

Stafford Beer (1983)[25] said that we have to switch from the management of things to the management of complexity. According to many, our survival as species is directly related to our ability to master urban complexity. This thesis is therefore a reflection on more appropriate approaches to guide urban change.

Even if the research is based on urban complex systems, its focus is not on mathematics or on systems technology. The research is focused on the exploration and conceptualisation of a paradigm shift in the management and planning of cities rather than on its application.

The research aimed to test the applicability of the findings among scholars, designers and decision makers and add feedback to the theoretical research. In other words, the results and concepts which ground this research emerged from both deductive (from the hypotheses) and inductive (from the studies) research.[26] We started by investigating the research hypothesis in the literature review aiming to explore possibilities for new strategies to manage urban change. Nevertheless, the studies gave us evidence that lead to readjustments to the initial aims of the thesis and to the reformulation of the research hypothesis. In addition, they demonstrated strong evidence that the research hypothesis deserves to be considered and that further studies should be conducted to test further this research's assumptions and conclusions.

This research does not intend to suggest a way of planning the unplannable as so many other attempts have been made throughout history. The research explores forms of emergent management

grounded on each context (Marshall, 2012). Following this, we suggest managing complexity through the management of a process of selection and design of human actions or *Strategic Interventions*.[27]
In other words, this thesis argues that strategic interventions can be utilised as a tool to nudge change and address urban problems within the modern complex urban environment. With "nudging" we imply the manipulation of urban change and character. This urban planning philosophy implies the nurturing of the self-organising strategies which naturally emerges from everyday human action in the city and use top-down interventions as a tool to nudge urban development and improve human quality of life.

The research hypothesis

The research hypothesis is as follows:

If we design, understand and manage human intentional interventions adequately we can manipulate urban emergent change towards a sustainable development.

In order to test and explore the hypothesis, the research carried the following aims:

- To investigate urban change from the perspective of human actions.
- To explore the possibilities of a kind of urban planning focused on the selection and design of human actions rather than on the management of the urban space.

This is expanded upon through the following two main research questions which guided all the research process and the strategies used:

1) How do we relate the city, its complexity and its dynamic character with human interventions?

2) How can we use "urban interventions" to nudge urban and social change?

In order to satisfy these aims, a series of objectives were formulated:

a) To investigate how cities emerge from the perspective of human actions. Establish a relationship between urban evolution and urban character.

b) To establish the role of top-down and bottom-up actions in relation to urban and social development? Establish their risks and their potentials.

c) Explore the meaning of *strategic interventions*. Are strategic interventions a synonym of *Catalyst interventions?*

d) Investigate the relationship between the scale of intervention in cities, and the scale of their effect. Can small and discreet interventions induce great changes in urban complex systems?

e) Explore the relationships between short-term actions and long-term visions.
f) To explore how can we design top-down interventions more efficiently.
g) To postulate an operational framework based on the research's theoretical approach that would lead to the design and selection of more appropriate and sustainable interventions and strategies.

Thesis structure

All research objectives were investigated through the literature review, and in addition objective c), d) e), f) and g) were also explored in the research studies.

In chapter 2 we have addressed the first two research objectives. We have characterised the bottom-up and the top-down kind of cities from the perspective of interventions in the building environment. We have concluded that there was the need for some kind of top-down management. In addition, we have established the role, the dangers and the potentials of both top-down and bottom-up interventions in relation to urban development.

In chapter 3 we have evaluated the conclusions reached in chapter 2 from the perspective of complexity and evolutionary theory. In addition, we have addressed objective c) d) and e). These objectives were also explored in studies 1 and 2. The conclusions taken from chapter 3 and the findings which emerged from our studies helped us to define strategic interventions and allowed a way to explore how they could be used as tools to nudge urban change.

In chapter 4 we explored further the notion of interventions. We have explored their nature and different ways they could be materialised. We categorised interventions in order to be able to contextualize *strategic interventions in the urban environment* in the broader context.

In chapter 5 we have explored objective f) and g). We have resumed the findings of the literature review in the form of an exploratory framework which was used as the basis of the research methodology. This framework was tested in the research's studies (chapter 6). Study 1 aimed to test the acceptance of the thesis theoretical approach in a real 'applied' situation. The intention of study 2 was to improve and establish the relevance of the exploratory framework. Study 3 served to test the framework's potential to influence the design of interventions in the building environment.

Tables 18 and 19 on pages 228 and 229 outlines how case studies and qualitative research were used in the three different studies to shed light on the explorations conducted during this research.

In short, we have organised this research in four main parts: Chapter 2, 3 and 4 are the research's literature review. Chapter 5 explores the methodology, the research tools and design. Chapter 6 describes three case studies and discuss their findings. Finally, chapter 7 outlines the main conclusions of this research. In addition, it explores the research limitations and gives recommendations for further research.

Chapter summary

In this introduction we have started by defining our position in relation to two main arguments related to urban planning today. On the one hand, we have expressed our reservations in relation to both the modernist and neo-traditionalist approach towards planning. We have described the post-modern city as dynamic and diverse complex system; a system difficult to control or predict. In light of this we have argued that today's modern cities do not respect any creationist approach to deal with urban development. Complex urban systems do not respect the rigidity of fixed designs defining future realities; such as zoning plans, master plans and others. Actually, according to Batty (1994) the longer the term, the less suitable it is to attempt any kind of 'creationist design'.[28]

On the other hand, we have also argued that there is the need for some kind of top-down urban planning; we still need to interfere when things go wrong or when we predict that problems will emerge. In other words, we can neither plan the future form of the city nor let it grow in an uncontrolled manner; Phenomenon such as social segregation and urban sprawl calls for top-down intervention of some sort (Batty, 1994).

We argue the need for a new paradigm in urban planning. Urban planning is understood and practiced differentially in different parts of the world (Friedmann, 2011). Nevertheless, we consider that most approaches share two key common problems. First, (as we will see further in the research) is the fact that there is little communication between urban theory and practice (Friedmann, 2011). Second, is the fact that we still try to define how the city will be in the future. As a response to the unpredictability of urban complex systems, this thesis encourages a kind of planning that guides urban change rather that imposing it. Inspired by Portugali's findings through his many years of research, we suggest a kind of planning which is not focused on imaginary final forms or on predictions of the future, but rather is focused on solving things now as a continuous process parallel to urban change. (Portugali, 2000; Portugali, 2004; Portugali and Alfasi, 2007; Marshall 2009; Portugali, 2011). It is important to emphasise the fact that this thesis has no arguments against urban planning or urban design. It just acknowledges the need for a new concept of planning based on the need to be realistic about the things we can actually plan (Marshall, 2009).

In this introductory chapter we have also introduced the notion of *human interventions*. We defined them as a link between human and urban evolution and we suggest that they have the capacity to influence the speed and the direction of urban change (Lane, Maxfield, et al., 2009). We argued that all interventions (such as a new technology or a building) normally emerge as a response to human needs at that time. Furthermore, we argued that they will inevitably trigger the emergence of new possibilities and needs. These new possibilities and needs will, in turn, be the basis for further interventions and technologies to emerge (Haken, 2012). In other words, when a human action responds to a human aim or need it reinvents the world around us, which in turn will influence a new human behaviour and new human needs. Consequently, changes in human behaviour and human needs will influence the way we conceive and use our building environment and therefore will determine the way we create new things (Allen, 2012).[29]

In light of this deep relationship between human actions and urban development we suggest that a resilient and adaptable urban management could consist of continuous management of human actions. In other words, we suggest the management of urban change through the recognition of human interventions. We argue that a sustainable top-down management of an urban system could consist of the nurturing of bottom-up interventions and the design and selection of strategic top-down ones.[30] In other words, we suggest that there is the need to facilitate the emergence of adequate interventions in the urban environment and that these interventions can be used as tools to guide urban change. In this new framework of thought, the impossibility to predict change is not a problem once urban solutions arise from the emergence of problems or from concrete predictions of social imbalance (Portugali, 2008).

In short, this research is concerned with the sustainable management of urban change. Related to this, there are issues about the city, urban evolution and about city planning and design which need to be addressed.

We consider that a city, as any complex system is far from equilibrium. It self-organizes and is characterised by phenomena of nonlinearity and uncertainty (Portugali, 1997). The aim of this research is to explore ways to improve such kinds of systems and influence their emergent development. In other words, this research explores ways to nudge complex systems and direct them to become independent, self-regulated systems with the ability to evolve sustainably (Marshall, 2012).[31] We will investigate urban systems from the perspective of human actions and we will try to identify ways in which these can be used as tools to manipulate emergent change. We suggest an urban planning focused on the design and selection of appropriate interventions in the urban environment. Interventions that cause as little collateral damage as possible and that can work as catalysts to improve the urban system or direct urban development when necessary.

Above all this research is a reflection on *in what kind of world we want to live in* and on ways how to make our cities ready for the future challenges they might face. Implicit in it is a deep and continuous reflection on what we mean by concepts such as resilience and sustainability (Ehrenfeld, 2008).

Chapter 2: The city

Introduction

We will use this chapter to frame the research's object of study - the *City* - from the perspective of interventions in the building environment.

This reflection on the relationship between people and their building environment will serve to introduce two relevant ideas for this thesis.

First, we will introduce the idea that even if all cities are built with the same ingredients, each city is unique. This idea relates to the relevance of public space in the formation of urban character. It relates to human life and human interactions with other humans as well as with the environment around them. It relates to climate, culture, history and religion.

Second, we will characterise the city according to who intervenes in it as well as according to the nature and purpose of the interventions in the building environment. We will characterise the emergent kind of city which has no grand plan or idea for the future and we will characterise the top-down kind of city which normally emerges from creationist approaches.

The distinctions made in this section will serve as the objectives:

a) To characterise the top-down and bottom-up kind of city.

b) To define the roles and potential of bottom-up and top-down interventions in the urban environment.

c) To identify these findings with kinds of city formation and city management.

d) To frame the research's argument on why urban interventions should be preferably gentle and discreet.[1]

The idea we want to put forward in this chapter is that humans shape the city with their unique ways of intervening in it. Interventions in the city are a consequence of either our daily lives or greater scale top-down actions. Nevertheless, all interventions are shaped by their physical and socio-cultural context. The uniqueness and character of human interventions shape the city, and the city shapes the people who experience it.

A city is "*... a complex collective dynamic entity: a super*-unit *composed of components that are themselves units'. Each unit is a human being who in himself is a mirror of his surroundings."*

Marshall, (2009: 135)

"*Each person, besides its natural characteristics is shaped by society, by culture in other words by the environment with which it relates*"

(Ponty, 1962)

This dynamic relationship between people and urban environment emerges over long periods of time and is delicate. Intervening in it can bring dramatic changes to urban and social development. Such changes are unpredictable due to the complex character of the city. They can improve the system or damage it. They can interfere with human identification with the urban environment (Ponty, 1962; Marshall, 2009) therefore the research explores the potential of small and delicate interventions to nudge urban change.[1]

The relation between humans and the built environment

The importance of the public space

Cities are all made of the same ingredients. They are made of buildings, plots and public spaces such as squares and streets, nevertheless all cities are different (Batty, 1994; Marshall, 2009). On the one hand ”*buildings plug into plots, plots plug into routes, and routes all connect up to form a single system*.” (Marshall, 2009) It is the way these urban ingredients are put together that forms the shape of the city. In other words, the unit formed by these elements and the way they are put together contributes to the sense of 'city-shapeness' that unites all sorts of cities. Nevertheless, even if cities are all made of the same ingredients we can always identify each city as unique; we can easily identify Paris, Barcelona, London or Lisbon. So what makes each city unique?

Each of those components is designed and implemented in the urban fabric to serve human life in all its shapes and forms. The uniqueness of each city is a consequence of history, culture, religion and climate; it is a mirror of the unique ways people perceive themselves and adapt to the world around them. It is such factors that shape the perception of who we are and of the world we live in. Such perception is what makes the "general" so unique. In other words it is our social-cultural background as humans that shapes the things we do and our interventions in the building environment; it shapes the unique ways we build things, the events we perform and how we relate to each other (Ponty, 1962). Cities are not only made up of buildings; they are made up of people. Buildings are just an expression of the people who built them and their needs, and these vary according to the environment.

"*Cities may be all different insofar as their contexts are different; they are similar insofar as humans' beings are similar.*"

(Marshall, 2009)

Context in this sense implies not only the physical setting of the city, but also political and social contexts (Benevolo, 1980).[2] Even if we are all the same regarding our basic natural needs such as the need to eat and shelter, culturally we have different ways of dealing with each other and with the public space of the city. The way we choose to participate in public activities or to be away from them defines the design of our buildings and defines the relationship between interiors, private areas and external public space. Buildings are ideally shaped around those human needs, which in turn, as a whole give character to the public space of the street (Till, 2009). In short, one can argue that " … *a building is a visible, concrete manifestation of a social group or social institution'* (Unwin, 2009: 117).[3] The social and cultural aspects of a society influence the sizes of the rooms in a house, the way these rooms relate to the street, form and structure of rooms, buildings and settlements'(Marshall, 2009: 96).

This complex interrelation between urban and social structure connects individual needs with culture, design and with urban life and economy. It is something which is built by generation after generation. When one breaks this very delicate order, it touches profound human values which rest deeply in whom individuals are and how they relate to each other and the environment. People need time to adapt to new concepts and new ways to experience the city (Alexander, 1979; Alexander, 2003-2004; Portugali, 2004; Marshall, 2009).

But where does social interaction happen? Where is the social, cultural and political character of the city formed? Traditionally, human encounters happen in public urban places. The traditional shelters for human life and social activity are public buildings and outdoor spaces such as streets and squares.[4] Streets and squares are where all kinds of people meet. They are cultural places and the political arena. In other words, streets are the places "for political expression and struggle, and loci of cultural identity... Streets are not only a continuous public accessible place which links together all the public spaces of the city, but they are part of the social fabric of the city" (Marshall, 2009: 105, 106).

Today, humans have extended social and culture interactivity to virtual meeting platforms and to a variety of emergent communication and transportation networks (Augé, 2008). Augé suggested what he calls as *Non Spaces* as a new meeting place for the post-modern society. There is a great deal of literature exploring the relationship between advances in technology and emergent places and possibilities for human interaction. There are also explorations on how media and transport networks will influence the building environment and human perceptions.[5] Increasing technological development will re-shape the city and the concept of public spaces as we know it today. Nevertheless we argue that humans are social animals and it is in their nature and in their evolutionary path to interact with each other and with the environment around them (Dennett, 1996). Based on human nature we believe that public space can be shaped in endless ways but there will always be a space for human interaction.

In short, even if cities are all made of the same ingredients, each city is unique. Their uniqueness emerges from a sequence of interventions in the urban environment made one generation after another. The uniqueness of each action in the city is shaped by human interactions with each other and with the context around them. Public spaces are the places where people interact with each other and the building environment around them. Spaces such as a street, are social containers (Dennett, 1996: 454), they are where human diversity and interaction happen (Jacobs, 1972: 3; Anderson, 1978; Marshall, 2005). The public space is where humans form a sense of the self and the world around them (Ponty, 1962). The character of the city and the way the city is organised reflects the people who live in it and their way of living.

'*In effect, cities, streets, buildings are the way they are because they are human shaped on the inside, and moreover, socially constructed in their relations*.'

(Marshall, 2009: 90)

Urban character and urban change from the perspective of top-down and bottom-up interventions in the building environment

In this section, we will define two kinds of cities both regarding their character and their formation process: The *natural city* is the kind of city that emerges from people's everyday life and choices – 'the city from the bottom-up'. This nominology is used either to address cities or parts of a city.

The *artificial city* is the city that emerges from economic and political power and from organisations – 'the city from the top-down'. We will define the characteristics of these kinds of cities in relation to the interventions from which they emerge. We conclude that there is no such a thing as a pure *natural* or *artificial* city. All cities are a result of the tension between both bottom-up and top-down forces.[6]

The *natural city* and the *planned city* from the perspective of planning process and human interventions in the building environment

The *natural city* [7]

Natural cities are "… cities which have arisen more or less spontaneously over many, many years…" (Alexander, 1965).

The *natural city* is a product of a *bottom-up kind of planning*. The city is not planned or designed as a whole but from its independent small parts. Interventions are normally small and aim to address the needs of an individual rather that the needs of a group. Such a planning approach has no grand plan or image of the ideal city of the future. The *natural city* self-organizes and it is highly complex, therefore, it exhibits the phenomena of non-linearity (Portugali, 2012).

In other words, the *natural city* is an open, diverse and very complex system which emerges from an *open system* planning process. It grows side by side with its inhabitants (Kostof, 1992). The form of the natural city is a consequence of the immediate response to the citizen's needs. The city shape is normally diverse and irregular because it emerges from small bottom-up, everyday interventions which are not part of a grand-plan for the city. They are focused on the self, they are a product of the political and cultural reality of a place and they respond to specific contextual restrictions. They are not a part of a designed composition for the city. They are a representation of the whole itself (Bortoft, 2010).

"*…The 'natural city' is presumed to develop without the benefit of designers, subject to no master plan but the passage of time, the lay of the land, and the daily life of the citizens. The resultant form is irregular, non-geometric, 'organic', with an incidence of crooked and curved streets and randomly defined open spaces. To stress process over time in making of such city-forms, one speaks of 'unplanned evolution' or 'instinctive growth'* "

(Kostof, 1991)

Arguably, the emergent character of the *natural city* gives it continuity and coherence. Its irregular character, the small scale of the interventions in the building environment and the time they take to be implemented, give the city its human scale. In other words, the character and development process of the *natural city* give humans a sense of place and a sense of home (Jacobs, 1961; Alexander, 1966; Marshall, 2009).

The *planned city*

With designed or planned cities we refer to "… cities or parts of cities which have been deliberately created by designers and planners…" as a finished whole (Alexander, 1965).

The *planned city* is a product of a top-down kind of planning. Top-down actors involved in the planning process are: urban managers, designers, planners, decision makers, representatives of private and public organisations and institutions, among others. The *planned city* it is a product of larger scale interventions which normally serve the good of a group or a community and which are normally planned and implemented as a whole. In contrast to the *natural city*, the *planned city* emerges from a "closed system" planning process (Portugali, 2012). In other words, it emerges from a rational imposition of how things should be rather than an emergent self-organising process.

Top-down organisations can normally finance larger scale interventions which involve and serve a vast number of individuals. Due to the larger scale of top-down interventions and the use of geometry, *planned cities* or *designed cities* usually look more regular; they show the control of Man over Nature through technology and geometry (Alexander, 1966; Marshall, 2009). The morphology of such urban organisations tends to be based on straight lines and geometry in opposition to a more organic character of the *natural* kind of city.

The top-down kind of city can be a fast and efficient way to address emergent needs of the population; such as the building of a university campus or a highway. Nevertheless, due to the scale of these kinds of interventions, they normally change the urban character of the place and influence the way people use and move in that area. They normally break the continuity of emergent change and they establish new directions of development (Marshall, 2009).

This is not necessarily wrong, especially when the natural emergent development of the city is not going in a good direction. In fact, this research argues that such characteristics of top-down interventions could be used as a strategic tool to nudge urban change when necessary. Nevertheless, as we will see, taking into consideration what it takes for a community to fully adapt to the urban environment, one needs to be more careful with the scale and range of influence of urban interventions in general.

In short, the *planned city* tries to bring order to what is up to now considered to be imperfect. Marshall illustrates this with the idea of a pile of sand: In the *planned city* top-down agents try to make a perfect cone out of a sand pile, while for the *natural city* '*the roughly conic shape comes naturally, according to the laws which apply to every sand pile*.' (Marshall, 2009:83). This has great implications for the morphology and aesthetics of the city. The *planned city* is a consequence of top-down interventions which involve the mobilisation and coordination of much larger quantities of resources. These characteristics of the 'designed city' are reflected in the aesthetics and scale of the elements which compose it; in the 'designed city' urban elements are normally more standard and greater in size. In contrast to the *natural city* the *planned city* shows little or no negotiation. Streets are not irregular; they are made of straight lines. The design of a *planned city* is normally based on geometry (Alexander, 1966; Jacobs, 1970, 1972; Batty, 1994; Marshall, 2005, 2009).

At the first glance the distinction between 'natural' and 'designed or planned cities' appears quite straightforward. Nevertheless, even the earliest cities show evidence of straight streets, ordered land, division of functions, great temples and monuments associated with religious and political power (Braudel, 2002). Greeks and Romans left a legacy of planned cities largely due to their efforts to colonise and spread. The military camps which could be assembled in hours proved how efficient a grid plan could be. With time, the technological developments enabled larger scale interventions and 'pure geometry' was imposed upon larger areas of land. Since Greek and Roman times, the formal knowledge of geometry is dominant not only in the design of cities, but also in the design of buildings of whatever scale and function. This extreme abstraction has influenced the human mind up to today.

The *designed city* is so related to the human way of reasoning and the need of imposing order on things which goes as far back in time as the first cities. For this reason it is almost impossible to dissociate one kind of city from the other, they merge as one. In most cases, both kinds of city grow together and reflect different realities of a society. Together they create the different characters that compose a city as a whole. Most of today's cities have highways, university campus', hospital complexes and airports, but they thrive through their emergent force; through the choices of each individual when choosing a place to live, to work to have fun; when one builds its private house or uses the public space. Furthermore, the layout of the city is an expression of those two forces working constantly together.[6] In light of this, we argue in this thesis that the city is a consequence of interventions which emerge from the tension between top-down and bottom-up forces.

This image of the city reflects the theoretical background of this research. As we will see in chapter 3, evolutionary theory explains urban order without design and is able to include *design* in the evolutionary process as a human adaptation to the environment (Marshall, 2009; Wilson, 2011). For complexity theory, the differentiation between the natural and planned city is not very relevant. From the perspective of fractal geometry, the designed city can be seen as a natural emergence and therefore, 95% of the general form of the cities " *which exist and have existed, would be seen as being more organic than purely geometrical*" and so can be studied from their *organic perspective* (Batty, 1994).

Bottom-up and top-down interventions; roles and contributions for the characterisation of urban development

There are four structural differences between the *natural* and the *planned city* which are relevant for the understanding of urban quality of life and urban development from the perspective of human actions. These relations between kinds of urban development and kinds of interventions in the building environment will frame the theoretical and practical explorations of this research.

The following characteristics of bottom-up and top-down interventions and consequently *natural* and *planned* cities are interrelated. Nevertheless, they will be addressed separately to make the arguments more clear.

First, is the fact that the bottom-up interventions give continuity and coherence to the urban development (Alexander, 1966; Jacobs, 1970) and top-down ones shift and speed up the path of urban change. Bottom-up interventions are normally small; therefore they merge easily with the city as a whole (Marshall, 2009). A family house influences the dynamics of the urban environment around it much less than a hospital or a school building. Top-down interventions, due to their scale and function, have the capacity to completely change the dynamics and character of the urban environment around them (Lane, Maxfield, et al., 2009).

The nature of urban development is not only related to the scale of human interventions it is also related to the way designs evolve and adapt to urban change. The evolution of bottom-up designs is normally more continuous than top-down ones and this emphasises the characteristics of urban change mentioned above. In the *natural city* new interventions are often adaptations of previous ones to better serve a specific need. People select, reproduce and slightly adapt an old design to create a new one that better serves their specific needs (Marshall, 2009). Because one intervention is a direct adaptation of a previous one its character remains recognizable and therefore people identify easily with it (Alexander, 1979; Akkerman, 2007).

Top-down interventions are also to a great extent a direct adaptation of a previous one but they tend to be more exploratory. Humans have the capacity to imagine new realities and to create different ways of doing things. On the one hand, this gives us the hope to re-invent solutions when the ones we use prove not to work (Wilson, 2011).[8] On the other hand it opens the door for the creation of '*Hopeful monsters'* (Marshall, 2009)[9]; designs that are so innovative that people require time to adapt to them if they ever are to. The modernist city can be regarded as a '*Hopeful monster'*. "*Instead of a gradual improvement in streets, and blocks of flats we suddenly leap to 'streets in the air" as a solution…. If they are lucky they* (these great innovations) *just might work; but they are nevertheless a leap in the dark*" (Marshall, 2009: 236).

In short, change in the *natural city* is incremental; it emerges over longer periods of time. Change in the *planned city* is discontinuous; top-down interventions have the capacity to speed-up and redirect the path of urban development (Lane, Maxfield, et al., 2009). As cities are highly complex systems, the consequences of such interventions are highly unpredictable; they can improve the urban system or damage it significantly.

Second, is the fact that we can consider the *natural city* as a consequence of a genuine kind of participatory planning (Marshall, 2009).As we have seen, the *natural city* is planned and designed from its parts and, these parts are all individuals that participate in the urban life. In the *natural city,* individual interventions are a direct consequence of human aims and needs, consequently the *natural city*, as an aggregation of these individual buildings, expresses the character and the individual choices of its citizens.

Conversely, the *planned city* expresses the will or a vision of a selected group of people in relation to a group, a problem or an ideal of what the city should be. The *planned city* is planned and designed as a whole; designers and policy makers (no single individual because normally they have not enough resources to support such investments) plan and design entire urban areas. Areas that include the design of multiple buildings, multiple streets and gardens which are organised to form a finished urban composition (Mumford, 1961; Alexander, 1966; Jacobs, 1972; Hall, 1988; Batty, 1994).[10] These greater scale top-down interventions try to serve the interest of a greater number of people, therefore they are not customised. Because top-down interventions are rather standardised humans have to adapt to them.

Arguably the *natural city* expresses the needs and nature of the individuals who live in it while the *planned city* expresses the intentions or visions of a few (Marshall, 2009). In other words, bottom - up interventions are an expression of an individual's needs while top-down interventions express a vision of the common good, or a vision of what the city should be. Bottom- up interventions construct the continuity of urban change and they characterise a process where all inhabitants take part including designers and architects (Marshall, 2009). The *natural city* deals with different ideologies through time and with specific negotiations between different actors of the city.[6] These contextual interrelations make the history and tradition of a place and they contribute to the urban diversity and innovation (Loorback, 2007). The variety of solutions and urban forms are one of the key factors that render each place unique (Kostof, 1991). In addition, this diversity adds complexity to the urban fabric, increases potential interactions with people and improves quality of life (Alexander, 1966; Floriada, 2002).

Third, is the fact that arguably the n*atural city* tends to be more adaptable and resilient than *planned* ones. The *natural city is* more contextual and therefore more adapted to landscape features and contextual dynamics than *planned cities*.

Natural cities work as urban environments even without the over-view of a planner or designer. Despite the fact that there is no grand-design or grand-plan, the city still has a structure and an order which emerged spontaneously (Batty, 1994; Marshall, 2009). Lewis Munford (1885-1990) analysed several layouts of medieval cities, and concluded that even if they were not deliberately designed as a whole, they were all similar. The functionality of traditional towns fits their form so well that it seems that they were designed (Mumford, 1961; Marshall, 2009).

"*… organic cities do not display obvious signs that their geometry has been planned in the large, although they may well be a product of many detailed and individual decisions which have been coordinated in the small*."

(Batty, 1994)

The emergent form of natural cities is often an inspiration for creationist top-down designs, such as new-urbanism designs; nevertheless, in terms of the process of formation they are completely different. *Natural cities* are made up of several small scale elements, or small scale interventions, which are a direct response to their environment. The variety and complexity of their small scale interventions compose the whole of the city and reflect the local and specific concerns of the place

(Jacobs, 1970). Creationist approaches see the city from the perspective of the whole. They see it as a finished design. When the design does not work it fails completely, while from an emergent perspective only individual parts will fail. In other words, in the natural city, each part emerges as a direct response to a need or a circumstance. If that need or circumstance changes that part will be replaced or will change and the city will self-organize and adapt to it. The city will not fail as a whole; as with any complex system it will search for new states of stability and it will adapt (Batty, 2005).

Fourth, is the fact that small scale interventions can be seen as a tool to test the emergent development of the city. Following this, there are things to learn from bottom-up interventions which can inform top-down ones.

One important characteristic of the *natural city* is the fact that its development is not systematic. Cities that grow organically deal constantly with success and decline. In the *natural city* the success or failure of individual interventions tests and adjusts the natural motion of urban change. Due to the normally small scale of individual actions in the city their inadequacy is normally not of key relevance for the development of the city as a whole (Marshall, 2009) but they can give an impression of how adequate a certain intervention is in relation to specific time and place in the city (Lerner, 2012). In a gentle manner, small-scale interventions can also determine the speed and the direction of urban change as a whole. This is a delicate and continuous process that does not necessarily happen for long periods of time (Wilson, 2011). Nevertheless, if the strategy does not work others can easily be tested. Larger scale interventions are obviously not as flexible. Due to the greater amount of resources used to implement them they are seen as fixed solutions rather than explorations.

It is important to take a closer look at the process of formation of the natural city's morphology not only because they are more adaptable and resilient development processes but also because often they function better than the modern planned cities. People still like to walk in pedestrian friendly streets, have a drink on a cosy terrace and enjoy public piazzas and courtyards. This is partly because of their aesthetics and their specific historical and physical contexts, but, it is also related to the emergent and continuous character of their evolutionary process (Alexander, 1966; Jacobs, 1970, 1972; Batty, 1994; Marshall, 2009).

Jacobs (1970) suggested a new and exciting way of looking at cities. She criticised authors like Ebenezer Howard, who influenced the *Garden City* movement, as well as 'decentrists' like Mumford and Stein and Bauer. She showed how their designs and visions were dissociated with everyday human needs and therefore created spaces where life became difficult to live. In her book "*The death and life of great American cities*", Jane Jacobs presents case studies that show systematic evidence that *natural cities* do work and that *artificial cities* have a lot to learn from them. She shows examples of overcrowded buildings and narrow streets as recipients of lives and lifestyles with which people are comfortable. Jane Jacobs challenged planners' assumptions and her new way of looking at the urban life proved of great importance because it opened doors to the use of new scientific approaches for the understanding of urban character, formation and evolution. It opened the doors for the conceptualisation of the city as a complex self-organising and emergent system (Jacobs, 1970; 1972).

Alexander (2003 and 2006) also tried to create frameworks for explaining the diversity and richness of the urban form in the natural city. Nevertheless, he approaches the subject from the perspective of the designer rather than from the sociological perspective taken by Jane Jacobs. Like Jacobs, Alexander also aimed to change the way architects design. He aimed to make them think more socially rather than to seek a “fancy image” which looks good on an architecture magazine cover. He aimed to lend architecture more depth and emphasised the superficiality of the forms designed during the last years, especially since the 1990s. He argued that architecture walked hand in hand with developers, who rely on images to sell their buildings, and use architecture as a way of increasing profit and acceptability. Above all, Alexander emphasised systematically in his work the dissociation between modern architecture and human perceptions and he showed the consequence of that in relation to human adaptation to space (Alexander, 1966, 1977, 1979, 2003-2004).

When authors like Jane Jacobs and Christopher Alexander describe a city thriving with life, they describe it as a complex and open system which hosts a diversity of people, places and functions. Both authors recognise that the *planned city* is missing ingredients which give them the quality of life present in the *natural city*.

In his article ‘*A city is not a tree’*, Alexander debates "*What is the inner nature, the ordering principle, which distinguishes the artificial city from the Natural city*?” and shows why according to him, the *natural city* is more human friendly then the *artificial* one.

There are three arguments in this article which are essential for this research; therefore we will explore in more detail the findings which emerged from it.

The first relevant argument Alexander introduced in the book ‘A *city is not a tree’*, is related to the idea that interventions in the urban environment can be understood as a form of human adaptation.

Alexander argues that the generally friendlier character of the *natural city* is related to the fact that its morphology is the direct consequence of who we are as people and of our needs both as individuals and as groups. This intrinsic relationship between people and the environment they produce is what he calls ‘*deep adaptation’*.

“*Deep adaptation is the process whereby the landscape, or a system, or a plant, or a town, proceeds by a series of spatially organized adaptations in which each part is gradually fitted to the parts near it: and simultaneously fitted by the whole, to its position and performance in the whole*.”

(Alexander, 2003; 15)

This concept was explored further by Stephen Marshall (2009). Based on the work of these two theorists, in chapter 3 we used the evolutionary theory to describe both the natural and the designed city.

The second relevant argument Alexander introduced in the book '*A city is not a tree'*, was that the process of urban formation is directly related to the quality of urban life.

To relate urban character and the process of urban formation with quality of urban life, Alexander introduced terms such as '*tree*' and '*semiattice'*. He used these two terms to theorise the difference between *planned cities* and *natural cities* on the basis of their different structural patterns. According to Alexander, these patterns relate to different kinds of urban formations which consequently relate to different levels and kinds of adaptation. On the one hand, he shows that *planned cities* are the result of what he calls a '*tree-like'* spatial organization. *Tree-like* spatial organisations often produce dissociation between physical units and social systems because they separate urban functions. On the other hand, Alexander states that the *natural city* has a more complex conceptual model; a model he calls a '*semilattice'*. The '*semilattice'* pattern, though not as easily understood by the human mind as the *tree* structure, allows the overlapping of functions and uses. Alexander argues that the complexity generated by the multiplicity of aspects which emerge from this overlapping is necessary in the creation of a 'living city'.

The third relevant argument Alexander introduced in the book '*A city is not a tree'*, was that the form of the building environment determines the way we perceive and use urban spaces. He describes the building environment as a container of life, therefore changing the built form of the city will influence the way we use space and the way we feel in it.[11]

For Alexander, the city is composed of unchanging and changing elements. The 'physical unchanging elements' which compose the city can be seen as the context or the scenario where the city life happens; they are the buildings and the city's infrastructure. The 'changing elements' of the city are the 'actors of the play', the ones who create the tale. The 'changing elements' are a consequence of the human interaction as well as of interaction between people and a specific environment. These elements relate to each other and form a synergy or a deep-inter-relation. In other words, as a whole these elements are much greater than as individual parts of the system (Marshall, 2012).

Alexander used the arguments above to explain:

a) How a complex structure, such as the 'natural city, can emerge naturally.
b) How the organisation of that structure - which is a direct reaction to human needs- emerges naturally with it.
c) How there is an automatic interrelation between the physical and the subjective aspects of the city.

To help the reader to visualise his argument Alexander uses the example of a man selling newspapers near a crossing, and a traffic light. Alexander considers the crossing where the newspaper man is standing and the traffic light as the "*physical unchanging*" elements of the system. Those elements are the ones designers take into consideration when they are creating the *artificial city*. The changing elements of the city system are the people who buy the newspapers, the newspapers, the money they deal with, the information they exchange when they meet; those elements are beyond the capacity of the human mind to predict.

Alexander defines the example above as a *set*: "… *a collection of elements which for some reason we think as belonging together…*" According to him the city system is composed of millions of different sets which interconnect with each other. The complexity and diversity of the *natural city's* system is a consequence of the interactivity between the changing parts of the different sets which compose it: for example, if one of the clients of the person selling the newspaper meets one of his friends in front of the stand and they decide to go for a drink together, two different sets overlapped and created a new one, which in the future will overlap with another set and originate other new ones. For Alexander it is this interaction of people or of the changing elements of the city which makes the sets overlap and it is this overlap that gives complexity, character and quality of life to a city. This infinite complexity of relations is something that happens spontaneously and the *natural city* is a mirror of that complexity. Alexander calls the system which expresses the complexity of the *natural city* a *semilattice*.

For Alexander (as for Jacobs), in contrast to the complexity and variety which characterises the organization of the *natural city*, the *artificial city* is rigid, simple in structure and segregated. Planners, when designing an urban area, normally focus their attention on the design of the '*scenario*'; on the physical aspects of the city, and on grouping things or '*sets*' in distinctive areas. They design housing areas, business areas, areas for schools, enclosed playgrounds, shopping areas, hospital areas and so on. In the artificial city those specific and distinctive areas don't overlap. They are divided and subdivided by networks which themselves are part of a hierarchical structure. In other words, the planned city is based on the geometrical order and division of functions. Such kinds of urban structure suggests a linear and hierarchical organisation of closed elements which are not related to one another. There is no overlapping, no interaction and no opportunity for exchange. Alexander defines the structure of a *planned city* as a *tree structure*.

In Alexander's definition of a tree, for one element of a set to interact with an element of another set, the sets have to relate as a whole. It would be as if one member of a family would only be able to make a new friend when the family meets this person as a group. As Alexander shows in his article '*A city is not a tree'*, in the *planned city* different groups of people (*sets*) can only meet accidentally or if they actively search for that encounter. The city does not support spontaneous and casual interactions.

"*I believe that a natural city has the organization of a semilattice; but when we organize the city artificially, we organize it as a tree*" (Alexander, 1997).

The tree structure is simple and linear in contrast to the structure of the 'semilattice' which is complex and subtle. For Alexander "*It is this lack of structural complexity, characteristic of trees, which is crippling our conceptions of the city*" (Alexander, 1997).

This segregation of people and functions increases the need to travel. In a planned city one person has to travel through the whole town to be able to fulfil their everyday basic needs, such as the need for work, food, health or entertainment. Every day a cleaning lady needs to travel hours by bus to work for a rich family living in a fancy neighbourhood and travel back to her home in the suburbs. In this kind of planned city all humans float daily between hierarchies and functions and that increases reliance on the car as a hypothetical fast means of transport. There are many studies which prove that the need to travel daily and the need for a car raised ecological concerns and reduces the quality of human life significantly.

The need for a car is just one example that illustrates the argument that planners tend to give priority to the needs of certain groups of people and therefore the shape of the *artificial city* is a mirror of those unbalanced preferences. Both Alexander and Jacobs, even if they come from different theoretical backgrounds, argue that standard environments cannot answer equally to the different kinds and groups of people who make up part of the city. The so called "*tree structure*" way of organizing the physical form of the city goes against normal human behaviour and normal human interactions. For this reason it becomes something imposed on people; something to which they have to adapt. This contradiction between the physical or unchanging aspects of a city and the changing ones creates a friction between the city and its users and it is the reason why, according to Alexander, *natural cities* are more human friendly than *planned* ones.

To support his theories, Alexander analysed the tree structure of urban areas like the greater London plan by Abercrombie and Forshaw, Mesa city by Paolo Soleri, the Tokyo plan by Kenzo Tange, Chandigarh by Le Corbusier, Brasilia by Lucio Costa and others. With his study he proves that traditional urban planning does not allow a place for interaction to happen, not only of hierarchies, as mentioned before, but also of functions. Spaces are not a mirror, nor a consequence of real social interactions and real social needs. "*Neither the Columbia plan nor the Stein plan for example, correspond to social realities. The physical layout of the plans, and the way they function suggests a hierarchy of stronger and stronger closed social groups, ranging from the whole of the city down to the family, each formed by associational ties of different strength*."

Batty used Alexander's *tree* and *semilattice* concepts as well as his findings to study the city from the perspective of complexity theory. Like Alexander, he acknowledges the complexity inherent to the 'changing elements' of the city, and therefore uses the support of fractal geometry to study the dynamic evolution of the urban form. Just like Alexander, Batty arrives at the conclusion that from the top-down perspective, urban networks and hierarchies are two sides of the same coin and are related to the concept of "*tree*". On the other hand, when analysing the same structure from a bottom-up perspective the idea of distinctive hierarchies immediately collapses. When analysing the city's structure from the bottom-up perspective, its network's organisation is what Alexander calls a semilattice. The semiattice is a much more complex way of spatial organization than the hierarchical way planners used to conceptualise them. It is "… *thicker, tougher, more subtle and more complex*"

(Batty, 1994). This idea is the fundamental ground for the use of complexity sciences to study the city change.

Chapter summary

In the first part of this chapter we started by looking at the relationship between the material city and the individuals who populate it. We have addressed the city as something made by human beings for human beings.

We have identified that the street and public spaces, in general, are the places of human encounter and exchange. This exchange happens both between people and between people and the environment around them. The public space is where human diversity and interaction happen; it is the place where people form a sense of self and the world around them (Ponty, 1962). It is the place where people shape each other and the environment in complex and interconnected ways which make both humans and the city evolve together.

The uniqueness of the context (its geography, culture, climate, history) shape people, and people shape the buildings and the city as a consequence. In other words, we have argued that the physical city is a mirror or a consequence of different human ways of life and different needs. In return the form of the physical city shapes each individual who uses it.

"*Each person, besides its natural characteristics is shaped by society, by culture in other words by the environment with which it relates*" (Ponty, 1962).

This explains why every city is composed of the same elements such as buildings, plots and streets, but each city is unique.

The second part of this chapter investigated how the city morphology is formed and the ways people intervene in the city to give it shape. To do this we divided urban settlements in two categories: the *natural city* and the *planned city*. The *natural city* is emergent and self-organizes. It has little or no evidence of planning on a large scale. The *planned city* is planned and designed from the top-down. It is formed upon the growth of entire areas. Both emergent and top-down interventions are designed. Still, the small scale interventions of the *natural city* emerge from the perspective of the unit rather than the perspective of the whole.

We can conclude that the nature of human interventions in the built environment characterises the process of urban formation and urban morphology. We argue that the size of urban interventions is one of the key characteristics which influence not only the morphology and character of the city but also the way the city evolves. In the natural city interventions in the building environment are expressions of individual aims and needs. As they are small by nature they merge rather fast with the morphology of the city as a whole. The natural city is therefore made up of many small parts that merge as one. Each part emerges to serve a specific individual need and the city includes it and adapts to it. This emergent and self-organising character of the natural city gives urban spaces a human scale and a more organic character. But above all makes urban spaces deeply fit to serve their purpose and very often adaptable to accommodate new uses which might eventually emerge.

The emergent and the top-down way of intervening in the city is reflected in key differences not only from what affects the city's morphology but also its development. One of key differences is related with "Time" and another is related to “Continuity”. Organic cities develop slower and generally more continuously. Conversely, the top-down kind of city can develop faster and change direction of development more suddenly. A third relevant difference between the natural and the planned city has to do with the complexity and diversity of the urban environment: The emergent way of intervening in the city creates the ground for human interaction and diversity (Jacobs, 1961; Alexander, 1966).

Finally, we have concluded that *natural* cities and *planned* cities merge. Today it is almost impossible to dissociate one kind of city from the other. They grow together and reflect different realities of the same society. Cities are made up of interventions at all scales. Some interventions are emergent and come from individual bottom-up initiatives and other are imposed and planned. Emergent interventions give continuity to urban change and a complex character to some urban areas. Top-down interventions address the needs of the population or ideas for future urban developments. They are translated in greater designed areas and buildings such as universities, hospitals, stadiums... In short the *natural* and the *planned* cities are two sides of the same coin; they reflect different kinds of urban areas which together make the city as a whole. Together, both kinds of urban areas are a mirror of the character, the values and of the organization system of a specific society. They are both the consequence of a culture, a period of time in history and of the technology available in a specific place.

In short, emergent urban areas reflect a continuous process of urban evolution and the planned ones reflect breaks and readjustments of that continuous change. Because of this deep interconnection between the *natural* and *planed* city, Batty (1994) argues that both kinds of urban settlement can be seen as part of the emergent development of a city and therefore they can be studied from the perspective of complexity sciences.[13]

Overall conclusions taken from chapter 2:

- The city holds human life. The city shape is a mirror of the people who live in it; therefore each city is unique and should be treated as such. In other words, each strategy to address urban problems should be contextual.
- The city shape and character is a consequence of human actions or interventions. Emergent small scale interventions tend to fabricate a more complex and organic environment. Top-

down larger-scale interventions tend to form a more organised environment where morphology is based on geometry.

- The way cities evolve can also be related to the nature of human interventions in the building environment. On the one hand, small scale bottom-up interventions give continuity and character to the city. They reflect a normally slower process of change. On the other hand, top-down interventions are normally larger in scale. They can speed up and manipulate the direction of change; therefore they are normally more risky. If they don't work as expected the waste of resources is much greater as well as the impact on the urban morphology and urban life.
- All cities include both the *natural* and the *planned* kind of city. In other words the city form emerges from the tension between top-down and bottom-up forces.

The city is a complex system. As with all complex systems the city is unpredictable by nature. In this research we suggest looking at the characteristics of urban interventions in relation to urban character and urban change to inform a more sustainable urban design and management system. The arguments made in this chapter suggest that on the one hand small scale interventions give continuity to urban development and complexity/diversity to the urban fabric; factors which are relevant for the interaction between humans and their environment. On the other hand, top-down interventions have the capacity to shift the direction of change and have to take into consideration the good-of the whole rather than the self.

These findings help us to contextualise the research's hypothesis:

Can top-down and bottom-up interventions be combined and used to create a more sustainable urban management system? Can we imagine a system which allows the *natura*l city to emerge and still intentionally adjusts its change?

Chapter 3: Human and urban change

This thesis approaches cities as complex systems in evolution.

Complex systems are *“ (a) ... a configuration of any given number of interconnected elements, parts or individuals, communicating with each other in non-linear ways; (b) The patterns of interactions form a collective net-work of relationships that exhibit emergent properties not observable at subsystem or individual parts levels; (c) When new contingencies occur, the network self-organizes in often unpredictable ways, and new properties emerge; and (d) By exchanging information with their environment, complex systems modify their behaviour as regards to it - they are adaptive. Concerning complex systems' processes, understanding the manner in which they communicate, respond to contingencies, self-organize and adapt requires studying the dynamical processes through which they evolve over time.”*

(Leiba, Zuzovsky, et al., 2012: 166)

This chapter aims to achieve a number of goals:

- Explore the meaning of strategic interventions. Are strategic interventions a synonym for catalyst interventions?
- Investigate the relationship between the scale of intervention in cities, and the scale of their effect. Can small and discreet interventions induce great changes in urban complex systems?
- Explore the relationships between short-term actions and long-term visions.

In this chapter we will use complexity theory to understand how small scale interventions are able to trigger more adequate and eventualy great changes in urban systems In other words, we will use complexity theory to explore how changes in the building blocks of a system or changes in the way these basic elements are organised induce changes in the system as a whole.

We will explore the relevance of emergent change, that is, change that emerges from within the system; a self-organising process where each element of the system finds its role and optimises its potential within it.

We will use evolutionary theory to explain why there is the need for top-down management and we use the concept of norms and nested hierarchies to explore forms of cooperation and social organisation. Furthermore, we will use evolutionary theory to explore the role of design and artificial selection within human and urban evolution.

Introduction

Complexity Sciences, Evolution and the study of cities

"Why have cities not, long since, been identified, understood and treated as problems of organized complexity? If the people concerned with the life sciences were able to identify their difficult problems as problems of organized complexity, why have people professionally concerned with cities not identified the kind of problems they had?"

(Jacobs, 1961)

Since Jane Jacobs (1961) introduced us to an alternative way of looking at the urban form and urban dynamics, our understanding of the city as a kaleidoscope of complexity has hardly changed. Complexity sciences see the city as a complex organism evolving and changing according to specific rules and conditions. The study of cities today is much closer to biology than to economy or art.

The study of cities from the perspective of complexity theory broadly accepted that changes to either the rules or conditions on which urban systems operate influences macro scale changes, across many elements which compose the city. In addition, as argued by Alexander (1966) complexity sciences indicate that the natural growing city is indeed more workable, more human friendly, more sustainable and more democratic.

Following on from the arguments above complexity sciences was used to study urban change from the perspective of urban syntax. Nevertheless, evolutionary theory was used to reflect on the relationship between human perceptions and human creations in relation to the context where they emerge.

In other words, this chapter explores how, complexity sciences and evolutionary theory contributed for the understanding of the urban form and the emergent process of urban and human change.[1]

Complexity sciences: Relevance for the reserach

There are at least two main reasons to use complexity theory to investigate urban morphology and urban change:

First, over the course of many centuries, planners produced simplistic plans to try to implement order to the organic growth of cities. Designs were created with the idea that the designed cities would perform better than the chaotic cities which grow organically (Mumford, 1961; Benevolo, 1980; Lynch, 1990; Kostof, 1991; Taylor, 1998). Until recently, planners looked at what is not designed as something chaotic disordered and dysfunctional. However, contemporary urban theory and complexity sciences are challenging that preconceived idea and argue that emergent cities, even if they apparently might seem chaotic, are not necessarily dysfunctional and in most cases work better than the planned cities (Jacobs, 1961; Alexander, 1966; Portugali, 2008).

Second, each city is unique both as a whole and in its parts; nevertheless, there is a general pattern that is present in all cities which gives them some sort of similarity in terms of their morphology and growth (Marshall and Batty, 2009). General patterns present in most cities include town centres, neighbourhoods and suburbs, as well as the streets' morphology. *"While these will be manifested in different ways in each city, there will be kinds of order which will be common to all, to a greater or lesser extent"* (Marshall, 2009). It is this common order or organised complexity that is at the heart of complexity sciences applied to the study of cities

A central problem with complexity is that it can be applied to many things and in many contexts. On the one hand that is what makes it so appealing, but on the other hand makes it difficult to define and sometimes it can become distant from practical applications (Haken, 2012; Read, 2012).[2] Nevertheless, even if there is still no consensuses about what exactly *complexity* is and whether it is a distinct scientific field, "complexity" has been absorbed by well-established fields of science such as physics and biology. In addition, despite all arguments, complexity sciences give at least a *'common ground for an approach to what one might call "theory of the city" even if it remains an open ended story'* (Haken 2012).

Key authors

Patrick Geddes (1915/1949) was a pioneer in identifying the deeper order of the *natural city*. He was the first to address the city's complexity and to relate it with nature. He was a pioneer recognizing that there was a deeper order in traditional towns: '*the seeming chaos was of our imagining – the product of the western addiction to mechanical order'.* Instead he recognised 'the order of life in *development'*.[3] Geddes was the first one to argue against traditional town planning and to address planning from an ecological perspective. He argued against the importance of understanding cities and cities evolution before intervening in them. Furthermore, he defended the delicate and gradual approach to intervene in the delicate structure of the city, which is the main argument of this thesis.[4]

Jane Jacobs helped traditional urban theory to question its view of cities: Building on Warren Weaver's work, she recognised the problems of the city as problems of organised complexity. In other words, Weaver's contributed with the framework where he identified three kinds of scientific problems:

(I) Ability to deal with problems of simplicity; Problems which deal normally with two variables in a sterilized environment. According to Weaver this is the subject of study of science from the seventeenth to the nineteenth century.

(2) Ability to deal with problems of disorganised complexity. Weaver gives the example of gas pressure, where the whole of gas mass can be studied in a relatively simple way but the trajectory of the gas particles are not known.

(3) Ability to deal with problems of organized complexity. Jacobs recognised the city problems as falling in the third category (Jacobs, 1965: 442-443, 445).[5]

Jane Jacobs helped frame urban problems as problems of organised complexity, which until then were being framed as problems of simplicity or as a problem of disorganised complexity (Marshall, 2009: 130).[6]

Alexander contributed to the understanding of cities as complex systems.[7] He acknowledged the fact that complex urban forms can be achieved as a product of individual small actions. Furthermore, he identifies the fact that the city's complexity comes from '*the interaction of the city's different parts at different scales, and over time'* (Alexander, 1979; Marshall, 2009). This statement is today the basis of the application of fractal geometry and complexity sciences to study the urban form.

As we have seen in chapter 2, Alexander also explained the reason why emergent cities are normally more human friendly than planned ones and he introduced the notions of patterns as a hierarchical organisation of urban and social systems (Alexander, 1977).[8] Alexander's patterns helped to frame the kind of organisations from which *organised complex systems* emerge from the perspective of urban morphology. In addition, they help link artificial and biological perspectives of urban organisation.

Finally, Alexander's critics on complexity sciences theory today helped frame the research questions and hypothesis for this piece of work; they raise questions on how human actions and the human condition relate to the urban environment (Alexander, 2003).

Marshall (2009) defined the city as an ecosystem and used evolutionary theory to back up his arguments. Marshall and Batty (2009a, 2009b; Marshall, 2012) defined the city as a system of ecological complexity which is a vision very much aligned with Jane Jacobs' observations (Jacobs, 1961).

Thanks to the contribution of these and other authors, we can argue that the *natural city* is optimal in countless ways and in ways that urban planning was never able to improve or even replicate through design. We come now to the understanding that the apparent chaos of the natural city is the manifestation of a deeper order. It took over one hundred years before Geddes' and Darwin's ideas were again considered in relation to urban theory, and combined would shed further light on an emergent way of managing the evolution of cities. Related to this, urban theory is increasingly turning its focus to complexity science and self-organising systems as possible frameworks for city planning development (Batty and Marshall, 2012). The input of those various fields of research in urban theory is leading to new perspectives of the city as well as of city planning and management (Marshall and Batty, 2009).

The study of complexity theory applied in the study of cities started in the 1960's when authors including Prigogine (1977) and Hermann Haken (1983) became aware of physical-material systems which self-organised and exhibit the phenomena of emergence.[9] Previously, this phenomenon was related only to organic systems or socio-cultural systems but not material ones. Soon after that, theories of emergence and of self-organising systems were applied to a variety of domains in the social sciences as well as to the study of the urban form. The metaphor of the city as a self-organising system was first used by Prigogine (Prigogine and Nicolis, 1977) and it was studied further by Peter Allen who also relates the idea of evolution with the understanding of dynamic complex systems (Allen, 1981;1990;1997; 2012). The consequence of this was the emergence of a new domain of study of cities which is commonly addressed as complexity theory of cities.

Notions of cities as complex open systems have been used by all key authors mentioned above and cellular automata has been intensively used to simulate urban dynamics. While the study of the city from the perspective of complexity theory is not new, the study of planning and design under this perspective is very recent. There is very little research relating complexity sciences with the features of urban top-down interventions made by the means of planning and design. Only recently we start seeing the implications for planning to the question of *how do cities work?* Portugali recently shed new light on this matter with the book *Complexity Theories of Cities Have Come of Age* (Portugali, 2012). This book acknowledges the work carried out not only by established authors in the field of complexity, but also authors who are engaged with complexity theories applied in the fields of planning and design.

Contributions and weaknesses

On the one hand, one of the greatest achievements of the complexity sciences in the study of cities is the shift in the understanding of the nature of cities. Today, cities are not considered as simple, closed, entropic, equilibrium-tending, linear systems as in the classical theories (Weber, 1922; Lösch, 1954; Thünen, 1966; Christaller, 1972). These days cities are considered as complex, open systems. Such systems are far from equilibrium and are highly unpredictable due to their non-linier character (Portugali, 2012).

Actually, the idea of the city as a highly unpredictable system is one of the great achievements of complexity theory applied to urban studies. It reinforced the idea that '*there are many situations in* *which the trajectory of a system cannot be reconstructed from the position of the system at the end of the trajectory.'* That is to say that the form of the city cannot be understood as a continuous predictable linear sequence of cause and effect. Complex systems are by definition non-linier and therefore are unpredictable (Portugali, 2008). In the article, *Learning from paradoxes about predictions and planning in self-organizing systems*, Portugali shows that there are three key factors of urban complex systems that make them highly unpredictable: First, is the non-linier character of all complex systems. This implies that predictions cannot be made in terms of cause and effect. Second, is the fact that often the factors that induce change mutate and therefore trigger other unsuspected changes in the system. Third, in a complex system the person analysing the models and intervening in the city is also part of the system and therefore it is influenced by it. As argued by Portugali "*some interesting implications... include self-fulfilling and self-falsifying or self-defeating predictions"* (Portugali, 2012:231).

The vision of a city as a dynamic and unpredictable complex system had significant consequences for planning theory, namely the fact that it suggests an urban planning practice as a process rather than the conceptualisation of the city as a final form. This new approach very much conforms to social theory's approach in the study of cities, namely it echoes Jane Jacobs' and Christopher Alexander's view of the urban form.[10]

A second great achievement is the fact that new valuable planning tools emerged from the complexity theory of cities. Fractal geometry and emergence theory are the basis of the world of cellular automata and computer modelling (Mitchell, 1990; Batty, 2005). Cellular automata helps "*in terms of visualizing urban form through computer models and computer graphics, and then through the measurement of patterns in real cities and their dynamic simulation*" (Batty, 2005). In addition, it helped us to understand better the process of urban formation rather than approach the city as a final form.

"Rather than starting with functions and proceeding to form, fractal geometry enables us to search out functions and processes which give rise to the man-made and natural patterns we observe in the real world, thus helping us not only to describe and understand reality a little better but to progress our forecasts and predictions of how the real world might evolve."

(Batty, et al., 1994)

Above all, complexity theory in the study of cities brought new tools to look into the future rather than constantly looking at the past as a base for our decisions. The increase of literature in complexity sciences and progress in computing and technology, led to the creation of computer models which became attractive tools to envision the future of our cities and support urban management and the management of human interventions. Computer models enable us to look at possible consequences of our interventions in the long term rather than short-term consequences which we normally take into consideration.

These long-time predictions can enable us to view possible consequences of our actions but it is important to have in mind that urban systems are unpredictable, therefore predictions serve merely as indications (Portugali, 2012). In other words, all prediction tools such as (PSS) Planning Support System[11] (Klosterman, 2001) are merely tools with which a planner can play and learn from a variety of aspects related to a specific situation. They serve to better place professionals in the position of making a decision, which is always intuitive (Portugali, 2012). Models can serve us by showing the eventual consequences of our acts but they can never substitute reality. We should never underestimate reality's unpredictability (Batty, 2005).[12]

'*... it should be made crystal clear that this kind of modelling serves to scrutinize the implications of theories, of interventions and expectations, rather than to 're-create the dynamics of the real world.'*

(Batty, 2005)

A fourth great achievement of the complexity sciences in the study of cities is that it provided a solid theoretical background to a variety of subjects and properties of the city which until then were studied independently; studies like: patterns of land use, networks in the cities and between cities, demography, cultural, sociological and economical groups in the city, special hierarchies, etc.

CTC
(Complexity Theory of Cities)
A single and sound theoretical basis to a variety of urban phenomena

Jane Jacobs (Batty)	Central Place (Allen)	Rank-size/power low (Pumain)	Cultural segregation

Figure 1: CTC as a solid theoretical background able to join together areas of research which were fragmented until recently (Portugali, 2012:49).

A fifth achievement is the fact that it highlighted the impact individual interventions can have in the macro-scale of the city. In the 1970's and 1980's complex system models were already able to genuinely link the individual normal choices and actions (according to age, social group, family situation, etc.) with the macro-scale of the city and the way the city changed. Furthermore, some models are able to feedback that change to the individual and re-adapt its set of choices and interventions. The highlight of the importance of individual actions or interventions for the city development was a great contribution from complexity sciences. It brought new insight of emergence to the understanding of the city showed how a small portion of agents can influence the city as a whole.[13]

Complexity sciences make us question not only the way we are intervening but also who is intervening in the city. Complexity sciences make us wonder about the roles of architects, planners and managers in the management of urban change. Alexander (2003) defends that new methods and a new urban management process which is able to create healthier urban environments will have to be sustainably different from the present commercial ones. This transition would not only imply reconsidering the way architecture and planning is taught in most of the universities, but it would also need general willingness to effectively make changes in society.

Finally, it brings forward the relevance of micro-interventions as a tool to nudge change. It shows how strategic changes in the basic elements that form a complex system generate changes in the system as a whole. In this thesis we will use complexity theories to explore this characteristic further and we will relate our findings to the practice of urban planning and design.

On the other hand, Portugali (2012:5) highlights the fact that in the study of cities as complex systems there is little attention paid to their uniqueness: the properties that make them different from organic or material systems. In addition, complex systems pay little attention to the importance of the context as a key factor for the system's identity and development. Up to now cities have been studied as if the feedback from the environment is not an important factor for the general study of complexity. Furthermore, Portugali criticised the fact that complexity sciences did not pay enough attention to social theory and to the empirical aspects of urban life.

As a matter of fact, Alexander (2003) wondered "*how can we even say that we have a theory of complex systems, when we have so little to say about the most crucial point of all*"; the human condition in the world, human adaptation and human creations or interventions. According to Alexander, it is the complexity of the adaptation to the everyday world around us, which is potentially a rich source of science and worth a serious scientific effort.

Evolutionary theory: Contributions to research.

There are several definitions of *Evolution* more or less specific and focused on different aspects of the phenomena.[14] For the argument of this research we shall embrace the meaning of evolution as a generic concept like the concept of *emergence* or *change*. In the context of this research evolution means the gradual development of something in which that something changes into a different and usually more complex form.[15]

Darwin (1859:435), addressed evolution as '*decent with modification through natural selection*'[16] and there is nothing in this statement relating it exclusively to biological systems (Simon, 1996). From a theoretical perspective, the idea of evolution is implicit in the understanding of change in any complex system (Allen, 1981). Therefore, it is a useful theoretical tool to fill in some gaps left by complexity sciences.

We used evolutionary theory to inform both the thesis theoretical research as well as the research methodology.

With regard to the research methodology, evolutionary theory was used to connect different sciences and relate humans and change to a context. Many authors see the quantification, the specialization and the abstraction of the scientific methods as motives responsible for enabling humanity to take a step forward and find more sustainable and fulfilling ways of life (Alexander, 2003; Ehrenfeld, 2008; Bortoft, 2010). Evolutionary theory can serve as a common ground to join together findings from different fields of research and merge together qualitative and quantitative data (Wilson, 2011). This aspect of evolutionary theory was particularly useful to build the research models which were used as the basis of the research methodology.

With regards to the thesis theoretical approach, evolutionary theory helped, on the one hand to justify the need for some kind of top-down planning. After all *Evolution* has to do with organisms' adaptation to their environment. Survival is not about good or bad, therefore change does not necessarily emerge for the better of the system.

On the other hand it helped to establish the relationship between urban environment, human actions and urban change; it helped to identify the role of interventions and design in the process of change. In evolutionary theory it is generally accepted that some species and some things, - as argued by authors such as Wilson (2011) and Richard Dawkins (1976) - tend to survive and multiply better than others. This capacity is very much related to their adaptation to the environment. In other words the diversity of forms of adaptation is a consequence of the feed-back from specific contexts and environments. Following this argument Marshall suggests that it is adaptation and the fitness for a purpose that shapes human actions and the way we design our tools and our environment (Marshall, 2009: 161). Based on this we argue that evolutionary theory offers a solid theoretical background to relate human actions with urban character and urban change; it helps us connecting *human interventions* with whole complex systems. The analogy between the role of human interventions in the urban environment and the role of adaptation in the biological context is one of the reasons why we use evolutionary theory to support this thesis. In other words, we use evolutionary theory to relate humans to their physical and social context from the perspective of their actions in their physical environment.

Contributions for the research's methodology

Connecting with the whole of science

“One reason I am passionate about evolution is that it provides a common language for all scientific and academic disciplines that deal with the living process.”

(Wilson, 2011: 193)

By reflecting on the city in the light of evolution we are not only able to connect all urban problems under one theoretical perspective, - like what complexity sciences did - but we are able to connect the city with the whole; with all areas of knowledge and all problems related to human existence today.

“Most scientists aren’t that interested in the bigger picture. They become engrossed in their particular problem, which causes them to be more and more specialized. The entire structure of federal funding doesn’t see the bigger picture, either, and doles out money to solve specific problems, such as smoking, delinquency, or learning disorders. Scientists are selected by consequences, just like everyone else, and before long they become encapsulated in little groups, with their own specialized language and concerns. A few remain cosmopolitan (like Tony (and me)) but mostly by virtue of their personal preferences and not because they are rewarded for it by the system.”

(Wilson, 2011: 207)

According to authors such as Ehenefeld (2008) and Wilson (2011) this segration of kinds of knowledge isolates findings and world views into islands. According to Wilson, as long as those islands don’t find a common ground on which they can share information, they are unable to contribute to a holistic view of the world and therefore it will be difficult to contribute sustainable solutions to the world problems we face today: Problems such as the sustainable management of a flourishing of human life in a context of limited resources.

Marshall and Batty (2009a; 2009b) refer to *Evolution* as a key framework to understand and address urban problems. Wilson on the other hand sees evolutionary theory as a framework to understand not only the complex place where we live, but also as the common language all sciences should use to interact and exchange knowledge; a common framework to combine forces in a new and multidisciplinary world of science. Only this new way of science can allow a meaningful step forward and start addressing the problems of human existence (Alexander, 2003; Bortoft, 2010).

Connecting with the context

In his book *The Neighbourhood Project*, Wilson (2011) used the example of economical sciences to illustrate that isolation of knowledge is not the only problem of most contemporary sciences. The fact that numbers are considered to be more related to the scientific truth then human perceptions and experiences is a problem highlighted not only by Wilson but also by most of the key authors of this thesis. Economists such as the noble laureate prize winner in 1988, Maurice Allaias, and others engaged with emergent fields of economy such as experimental and behavioural economics also emphasise the fact that the gap between abstractions and the reality of human life is a major problem of economical sciences today. [17]

Abstractions are not reality. They are one of the endless possible interpretations of the world. They are always a simplification of things to enable humans to give a sense to the world around them. Abstractions, normally, take away the object of study from its context and therefore erase most of its complexity. The problem with science that studies human nature and are based on abstractions is that that gap between abstraction and reality sometimes becomes so big that the abstraction becomes the reality on which we base our understanding of the world and our decisions (Bortoft, 2010).

"A purely fictional world defined by mathematical equations acquires so much authority that it becomes the real world for the adherents. Aspects of the real world that cannot be related to the imaginary world are so dumbfounding that they are labelled as paradoxes by the faithful…Does this seem a little bit like religion?"

(Wilson, 2011: 339)

The abstraction and quantifications of sciences that study human relation such as economy can be very misleading. Economy for example is reduced to the idea of maximising self-interests without taking into consideration anyone else's interests. Mathematics is not able to deal with the human characteristics such as sense of fairness, the psychology of risk and the variety and complexly of human forms of cooperation. Besides that it reduces "human wellbeing" to property. There is a vast amount of literature in psychology and sociology proving otherwise. According to Wilson, it is essential to bring a regulating system such as economy back to reality and use common sense rather than operating on the abstract world of mathematics which has the incapacity to deal with the complexity of human life.

Complexity science is also based on geometrical and mathematical abstractions. It is focused on what is general; therefore one of its major limitations is to explain the uniqueness of things. In the urban context, one of the major limitations of complexity sciences is to address what is unique in each city and to relate that uniqueness to the human being and to its actions in the urban environment. In light of this, we have used evolutionary theory as a theoretical background to address the importance of the context, both physical and human. Evolutionary theory can explain humanity and human interventions in relation to a context and help relating this knowledge with a bigger meaning of human existence.

"*Evolution is all about differences in survival and reproduction."*

(Wilson, 2011: 21)

Evolution has primarily to do with change and with the relationship between organisms and their environments. Evolutionary theory is about adaptations not about good or bad. This idea suits nicely with the concept of emergent development. The work of Wilson was introduced in this thesis to understand more about the complexity of contextual human adaptations. In the evolutionary context, interventions are adaptations to specific environments and the consequences of interventions are the feedback of that environment. Evolutionary theory shed light on the relevance of contextual interventions as well as their relation with human and urban evolution.

Alexander (2002; 2003; 2006) relates the importance of the adaptation to the context with the importance of continuous change. He presents these as key factors for sustainable development. In other words, both evolutionary theories and Alexander's findings enlightened this research about the risks implicit in breaking the contextual, continuous and emergent character of change. Based on the evolutionary arguments we suggest contextual delicate interventions as the most adequate way to nudge urban change towards a sustainable development.

Contributions to the research's theoretical background

Identify the role of interventions and design in the process of change

As complexity sciences, evolution theory can not only explain the evolution of cities from the past up to now, but it can also offer a framework to set new ways of dealing with the cities' processes of change in the future. The question is *'how this understanding can help us do better urban planning and design'* (Marshall, 2009: 247). In this thesis we suggest that the answer to this question has to do with the role of human actions and design in the evolutionary process. In other words, this thesis suggests that the key is to focus on human actions and design rather than on planning.

Evolution implies the existence of functional order without anything or anyone planning it. It implies that continuous change and adaptation to circumstances will lead to a great variety of form in the long term, each one fully adapted to the purpose and the environment that stimulated their emergence in the first place. This process of change is in response to a need and an environment, therefore things seem to be designed to serve a specific purpose (Marshall, 2009). In other words, in the evolutionary context interventions are adaptations to specific environments; they are changes aimed to make us, as humans, fit better in the context where we live in. Evolutionary theory explains interventions as specialised tools used by humans to better address the challenges that are presented to us.

Moreover, evolutionary theory is a theoretical framework open enough to include and explain both unintentional interventions, originated by every-day life activities and intentional interventions, such as the designed top-down ones. It frames all human intervention as both the engine and the consequence of the process of evolutionary change.

In addition, the evolutionary perspective guided this thesis to suggest that gentle, small scale interventions are in general the most appropriate to nudge change in the urban environment. The evolutionary process does not have a goal or a supreme form to be achieved. It is just a continuous symbioses between a cause and an effect that travel through time together and shape the complex and diverse world as we know it. The continuity of such process gives us a sense of predictability or stability; therefore it is easy to understand why breaking such a process can have a negative impact in a social context. The relevance of an organism adaptation to the environment enables us to understand why humans can have problems relating to interventions which do not obey the evolutionary continuity. Drastic interventions might even be needed to readjust an unwanted path of urban change but they should be addressed with the awareness of the risks they might bring. They change the urban environment very fast and humans might take time to adapt to it. In other words, *Evolution* justifies the relevance of micro-interventions or the reason why interventions should be managed in a continuous and discrete way (Marshall, 2009).

'If it ain't broke, don't fix it; if it don't fit, adapt it; if it's new, try it small; if it's small, let the people do it; if it works, run with it.'

(Marshall, 2009: 277)

Justify the need for a new kind of top-down planning and help to identify some of its key characteristics

Similar to complexity sciences, evolutionary theory is able to justify why certain interventions are more unfortunate than others and it can bring light to the risks of the mismanagement of urban change. In addition, by making an analogy with other biological systems, evolutionary theory can not only justify the need for top-down management but also establish its guidelines and general structure.

"Evolution has no foresight. Genes and beliefs alike spread on the basis of local advantages, no matter what the consequences over the long term. Sometimes they spread by virtue of benefitting individuals compared with their immediate neighbours, sometimes by benefitting groups compared with other groups, and so on up a multitier hierarchy of groups."

(Wilson, 2011: 35)

"The great error of economic theory is to suppose that people automatically converge on the local rules that work at the collective level merely by following their own self-interest."

(Wilson, 2011: 353)

Evolutionary theory suggests that people, like other species, do not necessarily act in favour of a common good, nor does their own good necessarily add to the good of a community. It suggests that an overview of the system and cooperation are needed to effectively guide change. On the one hand this suggests a kind of brain or central system, like an improved version of the integrated system introduced recently in Rio de Janeiro.[18] On the other hand, as cooperation does not happen spontaneously (Ostrom, 1990), evolutionary theory suggests the need for regulations and norms to facilitate human participation and cooperation for the improvement of common good. In other words, evolutionary theory suggests the need for a top-down urban management of some kind. This regulatory idea is contradictory to the self-organising and emergent view of the world. But it addresses urban problems such as sprawl, human segregation, ghettos, crime, and so on.

Even if evolutionary theory implies the need for a kind of top-down management, is does not define it as a rigid or restrictive system. Top-down management and norms can be used to "monitor" people's good will. Certain kinds of norms can give identity to a group and give a sense to human actions. Norms can give group morals and ethical values. Values and trust are a powerful structure essential for a sustainable life on this planet. Some kind of regulative interventions are therefore essential to create the conditions for cooperation to grow which in consequence will influence urban development (Ostrom, 1990; Wilson, 2011).

In other words, according to the evolutionary theories both a monopoliser top-down management and a management based directly on the self-organisation of an individual are doomed to fail. *"Better to begin from scratch with a conception of human nature based on common sense, all branches of human sciences, and evolutionary theory"* (Wilson, 2011:360).

Evolution explains the need for a new kind of urban and social management. It explains the reason why, like organisms, complex systems such as cities need to intentionally gather information, process it and analyse it in relation to its environment or context. It explains why there is the need for such management system to create a variety of alternatives which are intentionally designed to address a specific problem. And it explains why, only then it is possible to choose the best option.[19]It shows why human cooperation does not always happen spontaneously and therefore justifies the need for a hierarchical control and the need for norms.

In short, top-down management suggested by evolutionary theory is focused on the nurturing of the continuous emergent process of change. In addition, it suggests the establishment of values and basic rules to support a sustainable development, nevertheless allowing space for emergence and self-organisation to happen: this is an essential factor for the human engagement with its surroundings.

What is common to all cities?

Urban form and urban development from the perspective of complexity sciences

‘A city environment is shaped not only by people who have an important influence, but by everyone who lives and works there. They shape it when they vote, choose a new front door, replace their windows, complain about broken pavement, organise a community festival, give their opinion on planning proposals, plant out their window boxes, commission building work to their business premises, or tell their children about local history.’

(Cowan, 1995)

Introduction

The ‘Newton's way of science’ and the use of continuous formalism in "sterilised labs” proved to be inadequate to deal with discontinuity and abrupt changes of the real world (Batty, 1994). Reality is full of examples of discontinuities and unpredictability and one of these is urban evolution.

During the last century in most fields of science the simplistic notions of ‘time’ as a continuous flow and of ‘space’ as composed by simple geometries is changing. Einstein was the first to show that space-time could no longer be treated as a continuum in which the universe existed, as if observers would see the same thing in different positions in time or space. A key factor which influenced the traditional idea of time and space was the discovery of more and more particles, much smaller than the atom. In 1927 Heisenberg introduced the notion of *uncertainty* in ‘rigid sciences’, once he proved that conclusion and measures were influenced by the parameters of the measuring devise. Physics theorists learned that the further the phenomenon is from the direct observation the more uncertain the outcome of the observation will be. Goethe defended this argument at the same time that Newton was defending reductionism. Nevertheless history, and the new industrialized way of looking at the world as a ‘machine’, supported Newton’s way of science (Bortoft, 2010).

Today there is a general growing idea that we need a more holistic view of the world to be able to study it. It is now commonly agreed that we are not likely to find ultimate explanations by "*knowing more and more about less and less*" (Batty, 1994, p36.). According to many a more holistic theory is needed not only to help scientists to put together the fragmented parts of reality that have been studied during the last centuries, but also to bring science to another level of understanding (Ehrenfeld, 2008;

Bortoft, 2010). Complexity theory offers, to a certain extent, the theoretical ground for a more holistic perspective on things.

There are different ways of naming the theory that emerges from fractal geometry and systems theory. Complexity sciences have been named differently depending on the author and the period of time. Complexity theory was previously addressed as chaos theory, bifurcations theory and probably more. Complex systems can also be called emergent systems, self-organising systems and more. Perhaps it was Philip Anderson in 1972 who the first to write the initial definition of complex systems in an article entitled *More is Different*. He was the first to clearly define why a system is greater than its parts. This idea is the basis of the theoretical background of complexity theories and relates to the notion of wholeness described by Bortoft (2010) in his book *The Wholeness of Nature*.

"The ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe...At each level of complexity entirely new properties appear. Psychology is not applied biology, nor is biology applied chemistry. We can now see that the whole becomes not merely more, but very different from the sum of its parts."

(Anderson, 1972: 393)

The key question in complex systems such as cities is how do they receive its order? In other words how can a system have an inner order without being designed?

Understanding emergence to intervene in emergent systems

In order to intervene in a complex system such as the city, we need to understand how its order emerges. Complexity theory rose from fractal geometry and from systems theory; therefore to understand the emergence of urban order from the perspective of complexity science we need to understand how fractals are formed.[20]

Self-similarity is, in the context of this research, the most important property of a fractal. Self-similarity means that each part of the fractal is similar to the others and to the whole (Mandelbrot, 1982).[21]

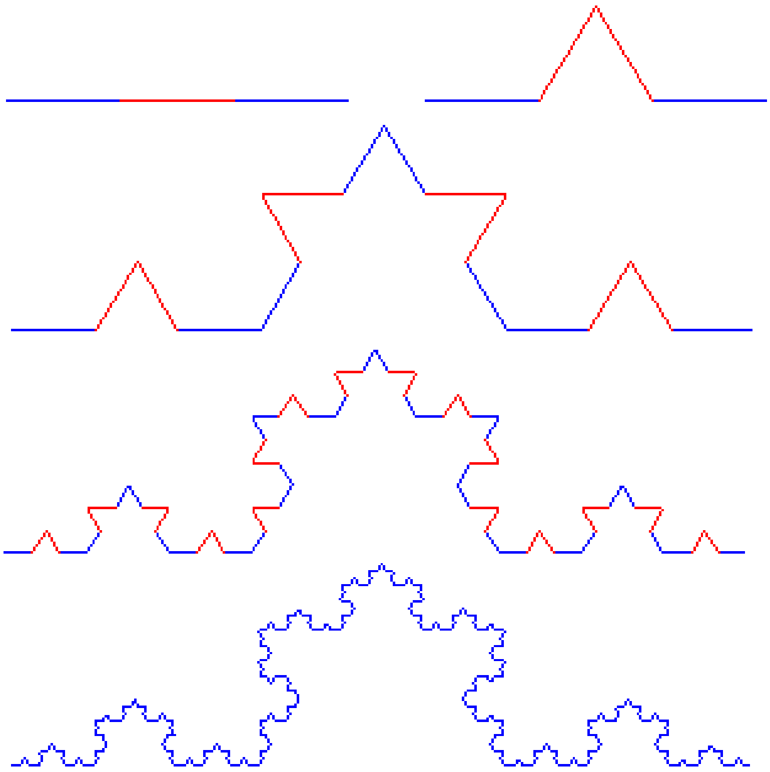

Figure 2: Von Koch Curve.

Figure 2 shows the *von Koch Curve*, a very well-known fractal which emerges from the division of each segment in three parts and the replacement of the middle segment by an equilateral "angle". These are the rules or conditions from which this specific fractal emerges. Any change in one of these rules would create a completely different fractal. The image shows us just the first four steps of division but the process can continue indefinitely. After just a few steps one can see the emergent form of the fractal and this is valid for most fractals. In light of this we conclude that once we acknowledge the rules from which fractal emerges we can influence the fractal as a whole. If the city emerges from a fractal this characteristic is also applicable to cities. Therefore, by manipulating the basic rules from which the city form emerges we can manipulate urban order.

As fractals are formed by the process of emergence, emergence is another concept related to fractals which is of key relevance for this thesis. Marshall used the example of the Mexican wave to illustrate the phenomena of emergence: The simple act of the public standing up and sitting down forms a wave which moves around a stadium. The form of the wave and its movement are way beyond the single act of the parts (Marshall, 2009). In this sense the whole of the effect is greater than the parts. It transcends them. The parts do not even have to be aware of the consequence of their collective efforts in order to make it happen (Cohen and Steward, 1994; Portugali, 1997; Cohen and Steward, 2004; Batty, 2005).

'An emergent effect is one that arises from the interaction of individual actions, which may have their own rules, but there is no overarching blue-print. As a result, an emergent effect is one

whose overall form or outcome is in some way surprising – that is, unanticipated from the (rules of) assembly of individual parts. Jack Cohen and Ian Steward have described emergent phenomena as 'regularities of behaviour that somehow seam to transcend their own ingredients.''

(Marshall, 2009: 15 1)

The phenomenon of emergence explains both natural and abstract fractals. It explains the internet network and the marked behaviour.[22] It explains the patterns in leafs, how a pattern of a zebra is formed from simple short logical rules of light and dark (Hansell, 2007) and it explains the regularity of patterns in a bees combs (Ramírez, 2000; Camazine, Deneubourg, et al., 2001).

Bees' colonies do not follow any grand-plan to build their "building environment". In other words, their design is not conceived as a whole. It is rather a continuous process which emerges from the efforts of the individual parts. Each bee is just doing their own thing and by all bees doing their own small thing they end up building rather complex structures. Such great structures emerge from simple rules such as picking up, carrying and depositing things (Hansell, 2007; Cohen and Steward, 1994:232; Marshall, 2009: 151; Batty, 2005:51).

"In the self-organization hypothesis, there is no need to evoke a blue print that specifies locations for brood, pollen, and honey, since the dynamic relationship among the component process of deposition *and removal are sufficient to organize a pattern on the combs. This means the bees need not have any 'grand plan', nor 'omniscient architect', but they just quip doing simple things. As Steve Jones* (Jones, 1999) *points out, for a concentric pattern to emerge, no more organization is needed than the ability for a bee to test the contents of what is in the neighbouring cell' and according to that, they will deposit or remove honey and pollen"* (Camazine Deneubourg et al., 2001:313-15).[23]

From the perspective of fractal geometry and complexity sciences the overall result of a structure is just a consequence of the strict execution of a simple set of rules. The characteristic order of the bees comb and other fractal patterns is given by the set of rules they play. That is to say, even if there might be random process involved, there is a strict set of simple rules which gives the overall image of its characteristic order (Marshall, 2009).

Understanding the emergence of urban order

Bees' colonies were related often to cities (Ramírez, 2000; Batty, 2005; Marshall, 2009). Just like bees' combs, the morphology of the *natural* cities is related to the emergence of an urban characteristic order. Like the bees' comb its process of ordering is originated from the bottom-up and works itself out to form the city as a whole. There is no grand design involved in the natural city. This is the main difference between the *designed* and the natural city or in other words, between city design and internal urban ordering (Batty, 2005; Marshall, 2009).

The idea of a deeper urban order originating from the bottom-up and a ‘characteristic structure’ of street patterns, can both be concluded from the analysis of the city syntax and from the analysis of emergent systems (Marshall, 2005). From both approaches we can conclude that there is no need for the agents to be sophisticated, they have to know the motives of their actions for order to emerge. Order emerges spontaneously as an effect of their interventions in the urban system (Portugali, 1997).[24] *The ‘result is hierarchically differentiated structures that might suggest central planning:’ But central planning there is not; there are only the actions of individual elements whose coordination results from the remorseless processes of competition and adaptation.’*

(Batty, 2005 cited in Marshall, 2009: 130)

But what are the generative elements or the human tasks which are repeated continuously and therefore generate the form of the city?

We will focus on two aspects of self-similarity and repetition across all urban organisations. We argue that these basic elements of the urban system can be used as *strategic interventions* to manipulate change. In other words, these elements are the building blocks of the urban system therefore they influence the system as a whole.

The first set of fundamental aspects which are similar to all human organisations are related to human aims and needs. The need to work, the need for a shelter, the need for food, the needs related to raising children, the need to socialize and have fun, these are all needs common across all human beings. The way cities grow is deeply related to the decisions humans make to satisfy these basic aspects of everyday life. In other words, humans make daily decisions on behalf of their survival and to improve their performance in the urban space. These decisions determine the urban morphology and urban development. They take advantage both of the potentials and of the deficiencies of the urban system and they are taken on different levels and scale (Smith, 1776; Kostof, 1991; Kostof, 1992; Cohen and Steward, 1994; Camazine, Deneubourg, et al., 2001; Akerlof and Shiller, 2009). From a bottom-up perspective choices related to the place one works or chooses to live have consequences on urban networks and the organization of the urban population. These can affect economy or political decisions which can in turn affect urban growth as well as the actual morphology of that growth. For instance one might choose to buy a cheaper house in a place with poor transport connectivity. Still, when this area is consistently populated it might make political sense to improve the transport network system in the area and therefore the value of the houses will most probably rise. From the top-down perspective, an organisation might decide to change its trade product because it sees a gap in the market. Following this choice the market gap will be filled and probably as a consequence other gaps will arise. This will give the opportunity for others to fill them in (Portugali, 2004). In light of this, this research argues that interventions targeting basic human choices and needs can influence the urban system as a whole.

In chapter 4 we will use Alexander's *patterns of space* (Alexander, 1977) to identify possible elements of the building environment that relate to the basic needs of human daily life and to the events that happen in the urban space. These elements are then translated in interventions which can arguably be used as tools to manipulate urban change.

The second similarity across urban organisations is related to the space syntax. Lynch (1960) pointed out five elements which make the image of a city: landmarks, nodes, paths, districts and edges. Golledge (1999) focused on more general elements such as points, lines and areas. Portugali (2012) elaborated on Golledge's work and showed how the understanding of the relationship between these elements could inform new tools to support decision making in the planning process. Marshall (2009) on the other hand considers buildings, plots and routs as the basic elements of the urban syntax. We will use the elements suggested by Marshall because they can easily be compared with the elements suggested by Portugali and Golledge and can be treated in identical ways.

These basic elements, like in *von Koch Curve or any other fractal* relate to each other in a systematic and predictable way. "*Buildings plug into plots, plots plug into routes, and routes all connect up to form a single system.*"

(Marshall, 2009)

Plots are normally rectangular shaped just because it is an efficient way to divide land; there are no wasted areas and the edges are clear. Rectangular shaped plots are easy to connect both to the street and the neighbouring plot. Their dimensions depend on their functions. Roads are linear and they serve to connect places. Generally speaking, their shape is related to the topography of the place, and the places they connect. Their dimensions depend on the functions within the plots adjacent to them and the kind of places they serve. Those variables will determine the amount and kind of traffic estimated for those roads which in turn will determine their dimensions. Buildings are finished objects which can be experienced by people both from the inside and the outside. They emerge based on the dimensions of the plot, its relationship with the road and the neighbouring plots and the function they are designed to host.

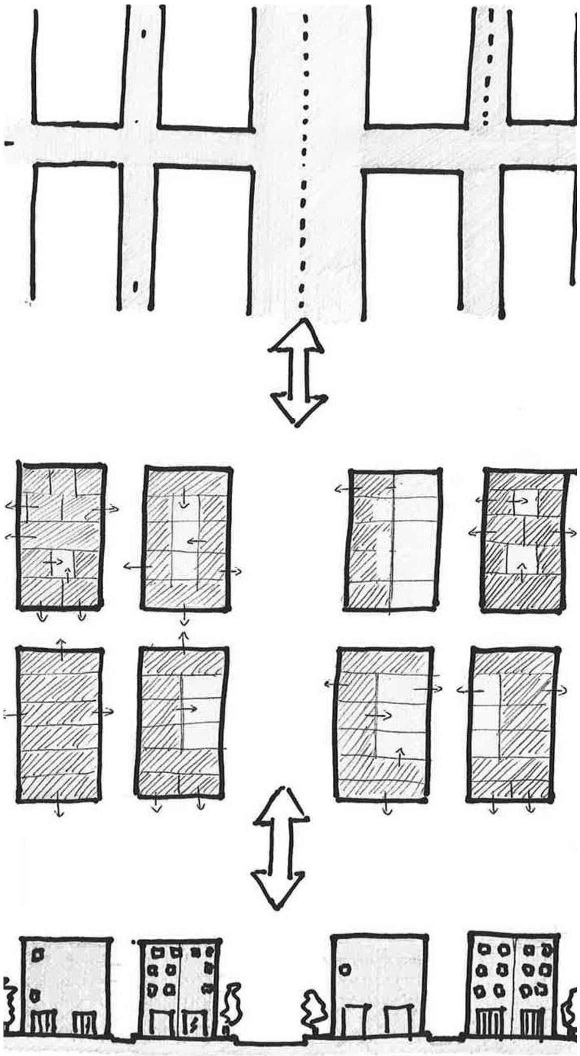

Figure 3: Street Syntax. a) All roads connected. b) Plots connected until a single building area. c) All buildings connected to the street each one with a direct and unique relation to it.

In other words, there are relationships between the position and the shape of the basic urban elements that determine a predictable urban morphology. Marshall tries to describe the urban syntax from a dimensional base. By doing that he shows the deep relationship between each of these elements and how the changes in one can originate predictable changes in the other as well as the city as a whole. In his book *Cities, Design and Evolution* (2009), he shows how the two dimensional linear characteristics of the streets create two dimensional plans and how two dimensional plans create cities with towers and trees and lakes.

According to fractal geometry and to complexity theory, the morphology of the cities changes once the basic elements of the space syntax change or the relation between them. This change can happen to meet different cultural needs or to support different urban functions. For example, the size of the plot to build a house is normally different than the size of a plot to build a public building. By changing the size of the plot we will change the character of the street. As a consequence of such intervention different buildings will emerge and consequently different urban structures will rise. These consequences are predictable before the buildings are actually built, as soon as we know the set of rules within which they operate. In other words, we can predict or stimulate predictable urban reactions by manipulating the basic elements which compose the urban syntax.

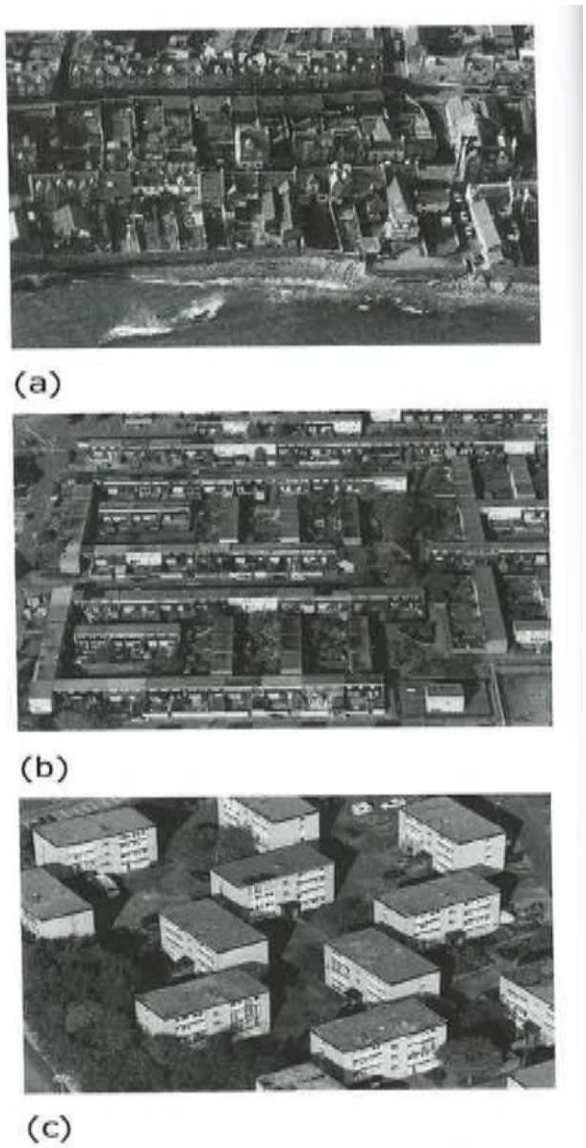

Figure 4: Space syntax from a dimensional perspective. a) Traditional Urban fabric. Cellardyke, Scotland; b) Modern architecture but with traditional street syntax, Cumbernauld, Scotland; c) Modern urban fabric, but with bending street rules, Cumbernauld, Scotland (Marshall, 2009: 78).

The emergent reactions of the city to an intervention of this kind are only predictable to a certain extent. On the one hand, complex systems are by nature unpredictable systems; they are composed of an infinite number of elements and infinite relations between them. Not only do these elements and their specific relations trigger unpredictable reactions to any intervention, but also both elements and their relations can change in time (Portugali, 2008). In other words, one the one hand it is impossible to fully understand a complex system because of its inherited complexity and to fully predict the effects of our actions. On the other hand, complexity sciences tell us that we cannot know what the optimal state of the system will be therefore it is impossible to plan for it, at least in the traditional way (Marshall, 2012). Nevertheless, by understanding the genetic code of the city and its building blocks we might investigate more dynamic ways of obtaining the functional complexity of a unban system. This research argues that changes in the basic units of the system can produce change in the city as a whole. Not only that, but changes in the basic rules from which the system emerged or changes in the external conditions of the system can also influence the general order of the system across its many hierarchical scales

Implications for urban management and urban design

As we have seen in this capture's introduction, the most obvious implication of complexity science for urban design and management is related to the development of computer models which simulate the city and its development. Still, cellular automata and computer models are not the only implications of complexity sciences in the urban planning and management process. They imply a different way of thinking; a paradigm shift in planning. Marshall (2009) summarises five lessons from emergence which can help us understand urban morphology and urban change from the perspective of complexity theory.

The first lesson is the fact that emergence shows us how order can be created without design or external intentions. The classical urban form – a continuous bounded settlement with an identifiable central core and annular suburbs- emerged from the cellular automata model without the introduction of any concept of centrality, suburbs, compactness, boundaries… (Marshall, 2009:206)

The second lesson is the fact that even if the individual actions are intentional and are concerned with the common good, one cannot forecast their emergent effect. Therefore, some of the probable effects of an intervention are not intended. In other words, there is a random element at play when intervening in a complex system once at the start there is no knowing what form will emerge.

Thirdly, urban form can be the result of individual actions; a characteristic order or pattern rises from the actors operating objective, simple and local rules. Those actors are not necessarily aware of the emergence of an overall order created on a larger scale. In other words, urban complex models emerge from local actions. These actions do not have to take into consideration what is happening in their surroundings nor have an idea of their position in relation to the whole.

Fourthly, it is not the independent actors who are creating the emergent order. That order emerges as an indirect effect of their individual actions. That emergence order can only be 'observed from a suitable zoomed-out spatial or temporal scale'.

Finally, emergence is something generic and abstract. To find emergence one just needs to find elements and their rules of interaction and analyse the emergent effect from a bigger scale. This means that emergence and self-organising systems are applicable to both organic and non-organic contexts.

The implications of these lessons for a new kind of urban management and urban design are profound. The study of cities from the perspective of complexity sciences implies a new vision of the city and therefore the need for a new kind of urban design and urban management. It implies a kind of design and management that:

Embraces the urban dynamic character and assumes its continuous and unpredictable change. A traditional city plan - the most common working tool and the basis to exchange information across most urban actors - is a picture of the city in a specific time (Lynch, 1981).[25] In contrast, the city is not a picture, it is dynamic; it is always changing and self-organising sometimes in desirable way, sometimes not. Until recently we have studied the city from the perspective of the plan.[26] In other words, we studied the city from the perspective of its overall organization in a specific time and place, but complexity theory defends a kind of management and design focus on the process rather than on a final form.

- Acknowledges the system by its parts rather than as a complete whole. Complexity theory suggests that urban management and design should approach the city from the understanding of its components and the nature of the relation of its part. Until recently the focus of the study and of the design of cities was on their final form. It is as if to understand a human wave in a sports stadium we focus on the wave itself rather than focusing on the set of rules by the individual spectators used to produce it (The continuous process of standing and sitting). In the context of cities this means perceiving the city from its general form rather than by according to logical of individual actions and choices (Marshall, 2009:187).[27]

- Acts delicately in the urban complex system. From the perspective of design and interventions in the building environment complexity theory raises questions regarding the scale of designs as well as the motivations behind them (Marshall, 2012). Individual choices of millions of people' doing their own thing' can explain the syntax of a place. Individual small actions in the building environment explain how the city form emerges in the absence of large scale design and planning (Simon, 1996). From the perspective of complexity theory applied to the study of cities, human everyday life choices are the reason behind roads, plots and buildings which in turn generate complex urban forms and street patterns. Such images of cities implies designing the city from its most basic elements rather than as a finished coherent whole. This image of urban formation suggests on the one hand that interventions in the urban environment should be discreet because they are to a great extent random regardless of the intentions behind them. As the reactions of the system are unpredictable we can test it by interfering in it discretely and disturbing its self-regulation as little as possible. On the other hand it suggests the need to nurture the self-organisation character of complex systems acting on it only when and if there is the need for re-adjustments. This need might either emerge directly from the city or be predicted by cellular automata programs and by systems' analysis. This approach implies a kind of management which focuses on nudging change rather than imposing a finished designed shape for the city. In practical terms, in the probable eventuality of emergent urban problems such as sprawl, segregation and urban ghettos (Batty, 1994; 2005), rather than tearing the area down and rebuilding it according to new urban rules, complexity theory suggests to influence that problematic tendency by changing the rules which originated the problem in the first place (Marshall, 2009: 192, 200).

Discussion

Complexity sciences studies the City from the lenses of fractal geometry. It defines the city as an organic infinitely complex system, naturally organised in hierarchical similar patterns; a complex organism, evolving and changing according to specific contextual rules and conditions. Complexity describes a city emergence which in many points is similar to the description of Alexander's natural city and the notion view of semilattice (Alexander, 1966). From the perspective of complexity sciences, like all natural growths, cities evolve through the cumulative addition and deletion of basic units, cells or particles. In the urban structure, the basic units of the system are related with individuals and the ways we materialise their daily needs in the physic form of the city. In the building environment a basic unit can be households, firms, transportation links and so on, represented in terms of the immediate space they occupy. Those patterns exist at both lower and higher scales of social organisations. They emerge almost magically from the growth process of the city itself.

The reason why the fractal representation of the city can be so accurate is a mystery, but the fact is that it represents it well (Batty, 1994). Complexity sciences and fractal geometry can be applied to cities and help urban design and management in many ways. Above all they suggest new, refreshing and flexible ways of dealing with urban and social imbalances and invite us to think of new design approaches and methodologies to intervene in the building environment.

With regards to the research hypothesis, the most important concept to bring on board is that complexity theory offers the theoretical ground to suggest that one can change the city's morphology by changing the code that enabled its emergence. In other words, we can change the morphology and consequently dynamics of a city by manipulating the set of rules which created it, rather than dramatically changing the form of the city itself (Marshall, 2009: 188-193). In light of this the research suggests that strategic interventions can be used as a tool to nudge that change. Strategic interventions are actions that emerge from the understanding of the system's process of formation and from the awareness of the basic elements from which the system emerged.

We have now addressed what is similar and predictable across all cities; complexity sciences show that the process is based partly on random organisation and partly on a simple set of rules, such as the advantage of living near the place of work, can generate something coherent and can create something recognizable as urban form (Christaller, 1972; Batty, 2005; Marshall, 2005, 2009, 2012). Complexity sciences demonstrate that the forms of naturally growing cities are related even if there are no grand-planners involved. This happens because the rules which generated them are similar. In other words, cities emerge in similar ways because people have similar needs. Key differences emerge from the different emphasis each group gives to each individual rules and this difference in emphasis is normally related to a context and to its geographical and cultural reality (Ponty, 1962; Alexander, 1977, 1979). Next, with the support of evolutionary theory, we will investigate what makes each city unique. We will investigate the evolution of cities from the perspective of human actions and we will try to establish the role of design in human and urban change.

Why are cities unique?

Urban form and urban development from the perspective of Evolutionary sciences

From the perspective of fractal geometry and complexity sciences the overall result of a structure is just a consequence of the strict execution of a simple set of rules. Bees as well as termites demonstrate systematic behaviour; it is not something random. It is a behaviour inherited from previous generations, which was transformed and adapted through time according to their needs.

" *this amounts to say that the functional 'design' of the termite mounds is a product of evolution – just like the 'functional design' of the termites' bodies themselves.'*

(Marshall, 2009: 150) [28]

Introduction

The role of human actions and design in urban and human evolution

Allen (2012) states that urban change is related to human patterns and to the reasons behind them. The reasons behind the things we change in time according to our cultural, social and technological evolution. Therefore, any model used to understand the structure, the character and the development of the city has to be evolutionary. In other words, the city is a complex and dynamic system as well as a human creation. Like the bees comb it is a system that rises from the dynamic way its parts are put together and relate to one another. This relationship is dynamic in the sense that it changes over time whiteout being operated by any external factor. In addition, humans are also part of the city's system and change with it over time. These arguments amount to say that humans, human relations and human creations evolve together. One is a consequence of another.

We will use evolutionary theory to find out more about the relationship between human evolution and the evolution of the things we create. We will try to use that knowledge to establish a link between human interventions and human/urban development. In light of this we will explore the role of design in the context of human and urban evolution.

The conclusion taken from this part of the literature review will suggest ways in which design can be used as a strategic intervention to influence the path of emergent change. In other words, we use both notions of evolution and emergence to explain the design and apparent order of 'natural cities' as well as why they can give the illusion that they are planned. In addition, we explore ways how design could be used strategically as a tool to manipulate urban development.

The need for a new paradigm

The city as an ecosystem

The relevance of the use of evolutionary sciences to study the city is also related to the paradigms designers and planners use to act on the city. A *paradigm* in this context is just a simple way to understand the urban form and it justifies design concepts and urban decisions. In other words, the paradigm one chooses to follow to understand the urban form justifies the way one acts on the city. Consequently, finding a paradigm that envisions the city as a complex and dynamic system is essential as the basis from which sustainable urban interventions can emerge. Marshall (2009) suggests approaching the city as an ecosystem rather than the previous creationist perspectives. Creationist paradigms normally conceive the city according to three metaphors or combinations between them. These metaphors are: the city as a piece of art like Florence or Vienna; the kind of city suggested by Sitte (1889). The city as a machine like the modernist approach or the city as an organic entity with a centre as a heart, roads as arteries, parks and gardens as the lungs and so on. Such images of the city are restrictive and not applicable to define the kind of thing the city is. Namely, they do not take into consideration the urban complexity or its dynamic character. Above all they consider the city as nothing more than the sum of its parts; therefore planners design it in a congregative manner (Marshall, 2009:120-128).

In opposition to the creationist metaphors, the city as an ecosystem explains and resumes the city from its holistic and dynamic perspective (Marshall, 2009: 119, 139). The view of the city as an ecosystem makes it neither a finished designed object nor an organism evolving to a mature form. According to the ecosystem paradigm, the city is not composed of independent parts whose function is strictly to serve the well-being of the whole. The city is a collective entity where things evolve together and influence one another, partly through cooperation and partly through competition. The evolution of this ecosystem does not have a long-term target shape or state of development. As Wilson puts it "*the city has no foresight*". Change is normally made through small steps which aim to respond to short-term targets. Evolution just follows a continuous process of constant readjustments and adaptations in relation to continuous new environments. Its parts are not fixed and the city can always change in an unpredictable way. Such a view of the city can give life to new forms of urban design and management.

The evolutionary paradigm

In essence the evolutionary paradigm suggested by Wilson (2011) is similar to the paradigm of the city as an ecosystem suggested by Marshall. Wilson (2011), Simon (1996), Dawkins (1976) and others argue that it is true that "*cultural and physiological evolution differs from genetic evolution in their details, but once we take the differences into account, we can explain human diversity in the same way as biological diversity"* (Wilson, 2011). This view of humanity in the overall evolutionary context is what Wilson calls the *Evolutionary Paradigm*. The evolutionary paradigm relates human evolution to its environment; the city. It explains human evolution as the evolution of intertwined aspects of human existence which evolve simultaneously, and continuously influence one another. In other words, the evolutionary paradigm explains not only the complex and dynamic character of human, cultural, social and urban evolution but it also embraces the evolution of human creations.

Furthermore, according to Wilson, evolutionary science will only prove itself when it explains not only human diversity and human condition but when it also provides practical answers to address the urgent problems humankind is facing today. In other words, the evolutionary paradigm has the potential to relate theory with practice and serve as a common language between all people intervening in the city.

In addition, Wilson argues that evolutionary theory can offer the scientific ground to share knowledge across all fields of science. Therefore, it can inform a realistic and truly sustainable management system able to deal with the complexity of the human condition in this world. In other words, the evolutionary paradigm can be the common ground for all sciences engaged with life and complex systems. This common ground would enable us to exchange knowledge and eventually achieve a more holistic view of the human condition in the world.

Based on such integrative character of evolutionary sciences this research used evolutionary theory to inform the research's' theoretical background and the research methodology. So, on the one hand, evolutionary theory was used to explore one theoretical perspective the relationship between three key elements of a social complex system: humans, human creations and the urban environment. Like Alexander (2003) we argue that only after understanding better human interventions and the way they influence the character and development of the city can we start imagining a new and more sustainable way of managing our existence in this planet; only then we can design and select strategic interventions that can lead the natural evolutionary process towards a truly sustainable development.

On the other hand, evolutionary theory was used to explore and develop the framework which is the base of this research's methodology (EIMS).[29] Evolutionary theories inspired a framework which aims to bring together different perspectives of an urban and social system. Such a framework can then be used as a base to create a more realistic and holistic understanding of the urban challenges and therefore can be used to inform any urban intervention, especially interventions related to urban management and design. In other words, such framework is designed to acquire and exchange knowledge which could serve as the basis to select and design interventions which are more sustainable and efficient.

The evolutionary paradigm served as a base for the development of an exploratory framework which aims to:

- Serve as a tool to design and select strategic interventions; therefore relates the parts or the building blocks of the urban complex system with the whole. In addition, it perceives the urban form as something dynamic in a constant process of change.
- Cross information through all fields of knowledge and all kinds of potential users.
- Relate theory with practice.

In short, authors like Wilson (2011), Batty and Marshall (2009) and Simon (1996) see *Evolutionary Theory* as a solid and holistic ground able to support a kind of paradigm that would be able to:

- Accommodate urban complexity and its dynamic character.
- Explain the coherence of the *natural city* as a whole as well as its relation to its parts. Explain how the whole and the parts emerge together, or why the natural city is so fit for its purpose?
- Explain human actions in relation to a context and therefore explains both urban syntax and character.

From a theoretical perspective evolutionary theory is able to connect human nature to the urban context and the context of the whole planet. In addition, it explains the evolutionary process of human and urban change as well as the developments of human creations.

From a methodological perspective evolutionary theory can be used as a common ground reachable by all sciences and all urban protagonists. This opens the door for a possible new dimension of intercommunication and therefore enables the possibility of a truly holistic view of the city to emerge.

Human and urban evolution

Different approaches

Patrick Geddes (1915/1949) was perhaps the pioneer to relate biological and evolutionary ideas to 'city design' and civics. Still, he did not use those references to understand urban change, rather, he was more focused on civics and regional planning.[30] Geddes was interested in regional planning and the local-global conundrum. He is the father of terms like *conurbation* and *megalopolis*, and much more. His ideas were controversial and require caution when applied to cities or anything else. His ideas about planning came from a collective top-down perspective, but were based on his own view of biological evolution which suggested that the functionality or the fitness of purpose emerged from the bottom-up approach. According to Marshall and Batty (2009), this fact, together with his ideas of holism made its message seem full of contradictions .His book *Cities in Evolution* was written almost a century ago, before highways and the internet, television or shopping malls, before the new input from complexity sciences and self-organising systems. Today, urban theorists are looking again at his work and start to use renewed evolutionary thinking to study cities.

"*Geddes' ideas were underpinned by a coherent philosophy based on Homo sapiens being contiguous with nature, with human needs and behaviour rooted in our biology and evolutionary history*" (Marshall and Batty, 2009). Those ideas oblige us to have a look not only at ideas about biological evolution, but also at ideas related to cultural evolution and the evolution of artefacts and design as a product of mankind.

Geddes described cities as physical environments intrinsically connected with the social aspects of the human lives which lived in it and with their specific contextual environment. In terms of urban planning, this means to say that a city was not an artefact as a sculpture or a building that could be placed arbitrarily in space. On the contrary; for Geddes the morphology was the city was the product of its social and physical environment and should be planned according to it.

There are many similarities between the way we understand human evolution today and Geddes ideas applied to urban theory, namely the fact that humans are seen as part of their natural habitat and human behaviour is considered as something influenced by our evolutionary history. Besides that, cities are seen as products of specific circumstances. These days, complexity theory applied to study of cities adds the fact that urban structures can evolve in ways that are not predictable or under the control of planners.

Geddes generally agreed with Darwin's interpretation of biological evolution, but he thought that Darwin placed too much emphasis on natural selection and not giving enough importance to co-operation as a means to evolve. As an evolutionary theorist, Wilson (2011) emphasises the relevance of co-operation as a tool to help humanity to focus on the common good and therefore create societies able to emerge in a sustainable direction. He also argues the relevance of hierarchical organisation of social groups and rules to create the environment for co-operation to emerge.

Influenced by complexity theory applied to the study of cities, Marshall and Batty shifted from Geddes's perspective to a more Darwinian interpretation. As with Darwin, they give more emphasis to competition and the struggle to survive. '*Geddesian evolution implies that cities somehow evolve of their own accord. However, a more Darwinian interpretation implies that change is driven by a combination of random or 'blind' variations plus feedback from the environment. And third,' (*as also argued by Alexander *Geddes' philosophy seems to imply urban evolution as a sort of gradual unfolding, almost as if cities emerged and grew according to some kind of developmental programme. But Darwinian evolution offers no such programme: evolution is fundamentally unpredictable; change can go in any direction; today's model may well be obsolete tomorrow; and everything in the city system – businesses, technologies, land uses, building types – must be prepared to innovate and adapt to survive"* (Marshall and Batty, 2009).

From the perspective of socio-cultural evolution, Lane (Lane, Maxfield, et al., 2009) argued that it is a mistake to base our understanding of innovation in society and culture on Darwin's theories:

First, '*when shifting from biology to social sciences, the concept of population thinking, essential to biological evolution theory, has to be replaced by the concept of organisation thinking as the primary foundation in a theory of innovation and social change. Organization thinking requires that no description of a human organisation can separate structure, function and processes'.*

(Lane, Maxfield, et al., 2009: 481)

In other words, Darwin's theories are based on individuals while society evolves by means of organisations and groups.[31] For Lane, social and cultural change rather than being influenced by individual actions and struggles to survive is achieved by the means and will of collective organisations. Organisations are from several areas: financial, religious, medical, military etc. and have different targets of action: family, community, city, province, nation or even wider international interests. These organisations belong to different hierarchical levels, in which, the higher levels embedded the character and function of the lower ones. In order to survive and to develop, organisations have to relate to different levels and kinds of institution and the character of their relationship changes according to the evolution of the organisations (Lane, Maxfield, et al., 2009).[32]

Furthermore, according to Lane, the lower levels are 'culturelized' that is to say they act according to the written or unwritten rules of the higher hierarchies in order to achieve efficiency of time and costs. Thus, the culture of the higher hierarchies influences the lower hierarchical levels such as the single individual. On the other hand, the culture of the higher hierarchies is influenced by the general social culture, therefore from the bottom-up; by the people.

According to Lane, no theory of the city can only be based on emergence coming from the bottom-up, once the higher organisational levels influence the shape and evolution of the city as much as or even more the lower ones. *'The national or global urban system has a much greater impact on* *individual cities than the individuals, households and firms living in the city can have by themselves. It is easy nowadays to observe that cities are affected by the same kind of changes all over the world*' (Lane, Maxfield, et al., 2009: 481). Cities are not isolated. Cities are linked to cities; organisations of the same and different hierarchies are linked globally. As a consequence, global forces have the power to change a city shape, population, specialisation, etc. much faster than the individuals living in it by themselves. For example, an international oil and gas company who decides to invest in a certain region will most probably have an influence directly and indirectly on the country. It will not only influence the local community adjacent to the place of investment but also the country as a whole, at least from a political and economic perspective. In other words, there is no doubt that today as we live in a global world it is virtually impossible to dismiss or escape those global forces and therefore they have an important role to play in the socio-economic trajectory of the city.

'The emergence of a city's attributes and its socioeconomic trajectory are by no means resulting from the interactions of the local actors only. A Taking multi-level reciprocal interaction into account provides a much more nuanced epistemological position for social sciences than the commonly advocated methodological individualism.'

(Lane, Maxfield, et al., 2009: 483)

Second, according to Lane, in the features of sociological innovation it is hard to distinguish *variation* and *selection*. According to him, '*even when they can be distinguished, they frequently fail to be fundamental, since other kinds of process, negotiation, underlines both of them.*' *'Socio-cultural change in general – is nothing but a story of negotiations structured by rules structured by negotiation'.*

(Lane, Maxfield, et al., 2009: 12, 30)

For Lane, negotiation or the interaction between organisations and the rational ability of mankind to determinate the path through which he aims to evolve are of extreme importance to explain the way humans developed so fast (Lane, Maxfield, et al., 2009: 35).

Third, Lane argues that we as humans achieved so much in such a short period of time; we evolved socially and technologically so fast in comparison to other animal species, due to a new modality of innovation through which '*human beings generate new artefacts which are then embodied in our collective activities, which are in turn supported by new organizations and sustained by new values'.* According to him, this pattern gets a dynamic motion; it arises from a positive feedback dynamic between change and the environment which generated so many transformations in us over a short period of time, our culture and our environment. In summary, Lane argues that human artefacts are imbedded in collective activities which are supported by human organisations which in turn become new values and a new basis for further development.

In short, we can argue that there are at least three relevant distinctions between Darwin's approach towards biological evolution and Lane's approach towards social and cultural evolution:

Firstly, the fact that Darwin's approach suggests the understanding of macro-scale changes from the perspective of the micro-changes over a long period of time. In contrast, according to Lane, big changes in culture and society are mainly caused by larger scale actors, like organisations and institutions.

Secondly, for Lane, decision and interventions - rather than being a product of variation and selection - are a product of cooperation and negotiation. They are a product of values which are not necessarily related to functionality and are intentionally selected.

Thirdly, and perhaps the most important for the arguments presented in this thesis, Lane argues that human actions and human artefacts have the ability to speed up and re-direct the process of human evolution.

The biologist, David Wilson, does not see any great confrontation between *population thinking* and *organisational thinking.* Wilson was able to integrate both the emergent Darwinian perspective of evolution and the top-down intentional manipulation of change in one single description of the city. He was able to establish the roles and contributions both individuals and top-down organisations offer to the development of society. Just like Lane, Wilson also agrees with the need for hierarchical groups and the need for top-down management; according to him, the health of the different hierarchical groups from which a city emerge, is of key importance for any kind of sustainable human and social-cultural development. Wilson also sees cooperation, negotiation and group values as a key reason to explain why humans evolved so fast.

Wilson also does not see any contradiction between biological evolution and socio-cultural evolution. According to the latest ideas of evolutionary theory, cultural and social evolution can be seen as part of the very pragmatic process of variation and selection, even if the process of cultural variation and selections is different than the biological one. Humans try multiple ways to adapt and respond to their environment but only some of these achievements will live as an example for further generations to follow. The selected variety of solutions able to help humans to adapt better to the environment will survive in a variety of forms. Human adaptations or ways to respond to the challenges of the environment survive in the urban fabric (such as buildings), in the tools and technology we use, in our behaviour and our daily lives and in our minds. These adaptations survive in the way we perceive the world; our culture and in our belief system. As with Lane, he argues that in time these adaptations becomes part of our collective memory and are the basis on which we live and create new things.[33] The city can be seen as the ultimate human creation. It is therefore the scenario which emerges from this collective memory and the background on which we build our daily life and our dreams for the future (Read, 2005).

Because of this deep interconnection between the evolution of mankind and the evolution of the environments they create for themselves, it is impossible to study the evolution of humankind without studying the evolutions of the city, the evolution of human culture and the evolution of human social relations. There are of course very sophisticated studies made in the area of human “genetic evolution”, but most of them end up studying evolution of the genes in a lab, isolating the genes completely from their environment. But isn’t evolution all about the diversity of adaptations to specific environments? How can we understand the evolution of something without knowing the context that originated it in the first place? How can we study human evolution without studying urban evolution or the evolution of the human context? (Wilson, 2011) As a reaction to these questions Wilson developed several studies trying to relate DNA from people with their social and cultural background aiming to understand how one can influence the other.[34] For him, in order to become competent managers of our evolution we have to understand the interactions between our genes, our cultures and the way such interactions are materialised in our daily lives and on the things we produce.

From these studies he was able to relate an urban context, decisions made in life over a lifetime, the personality of a person with his/her DNA. With these studies, Wilson aimed to explain the variety of human behaviour and human actions not only in relation to different social-urban contexts but also within the same urban context. Based on his findings, he states that individual differences within a species can be explained the same way we explain the differences between species and they are a consequence of our genetic structure and our environment, and this phenomena is also applicable to the human species.

In short, Wilson proved that there is a direct relationship between human genetic change, human actions and behaviour and the context where humans live (both in terms of the social-cultural reality and the building environment). On the basis of these findings one can argue that changes in one of these aspects might induce change in the others. So, for example, in an urban context experiencing social segregation might be useful to interfere in the building environment and create a place for people to interact under certain rules. A basketball field, for example, could contribute to the improvements of the relations among teenagers as well as among the audience. The micro-social dynamics which would emerge around the basketball field could eventually generate macro improvements in the area. The question is how long it would take to see the changes created by such an intervention? In other words how fast the human and social evolutionary process really is?

The speed of the human evolutionary process

"Each person carries genes that have survived in an unbroken chain since a first mutation that occurred in the distant past, which might be 5000, 50,000, 5000,000, or 5 million years ago. They also carry cultures from their past that might trace back thousands of years, judging by the crosses and golden domes that grace the churches around our city. Genetic evolution is fast enough and cultural evolution is slow enough for the two to become entwined in a double helix of their own."

(Wilson, 2011: 204)

It might make us feel uncomfortable to think of evolution when explaining the human diversity as well as the diversity of the things we create due to idea that evolution is a slow process of change which occurs over long periods of time. The fact that humans are able to change themselves and their environment so fast makes it hard to relate the preconception of evolution with human change and human diversity.

Nevertheless, it is important to acknowledge that several time scales of change operate simultaneously and influence one another. There is *" ... the timescale of genetic evolution, which is usually regarded as slow but at times can be quite fast. Then there is the timescale of cultural evolution, which is usually regarded as fast but at times can be quite slow".* Then there is the timescale of the psychological process which according to Wilson "*can operate over the course of a human life time or even within a fraction of a second*",[9] such as when one takes a decision (Wilson, 2011: 6).

The neurological processes that make us decide something has the ability to redefine completely our path of evolutionary change are in contrast to biological evolution, where chance plays a big role in defining which species develop which tools to adapt to a certain situation, humans have the capacity to decide themselves who and how they will adapt to that change. Humans can design ways and tools to address a certain situation. Furthermore, humans have the capacity to choose the best designs and improve them or adjust them to other similar situations. Wilson adds to Lane's perspective and argues that this capacity induces a fast rhythm of change to human cultural and technological evolution and this can speed up genetic evolution.

Wilson undertook several field studies to understand the speed of human and cultural evolution and the factors which could trigger them. According to his field studies on the city of Binghamton, Wilson concluded that as long as the environment doesn't change the evolutionary outcome won't change or it will change so slowly that it is imperceptible to our eyes. But if we change the environment, humans will change and will adapt to it very fast. *"It will be hard to stop it from changing.*" That change can occur in a year, a week or even a day.

A group of problematic teenagers from Binghamton city responded to the changes in their environments over a period of three years. This proves the deep relationship between humans and their environment and proves that changes in the environment can trigger fast human evolution. In other words, if we change people's environment for the better we can expect to see people improving faster socially and psychologically. This conclusion is of key relevance for this research's hypothesis. With his study, Wilson explains the potential of human intentional interventions to re-direct change and to set urban development in new directions. In other words, he proves that we can intentionally manipulate human and social development by intervening in the urban environment.

"The key to change is to become wise managers of evolutionary process."

(Wilson, 2012: 206)

Human Interventions in the context of human and urban evolution

Potentials and risks

Biological evolution occurs by a cumulative genetic change which happens from generation to generation. This change is due to three basic factors: inheritance (replication and reproduction), variation (like mutation) and natural selection (non-random selection). Natural selection is the feedback from the environment which determines the direction of mutation. In other words, natural selection is the external factor which determines a path of change. It determines who is fit survive in a certain context and therefore has the opportunity to reproduce and replicate its genetic characteristics. Adaptation to a context, fitness for a purpose or functionality can be interpreted as the consequence of the combination of reproduction, variation and natural selection, which in the long term is recognised as *Biological Evolution* (Marshall, 2009: 162; Jones, 1999: 201; Vermeij, 2004: 24).

Still, if we can dare to say that humans as specie have evolved then our evolution is surely not only related to biological transmission. Human evolution is also influenced by culture and social relations among other things. In addition, it is shaped by the ways humans express themselves in the things they create (Douglas, 2006; Holzman, 2007). In other words, just by looking at human history, human achievements, the increase of human knowledge, technological developments, etc., it goes without saying that human societies are evolving as well as the things humans produce and need.

One of the arguments made by Lane (Lane, Maxfield, et al., 2009), questioning how appropriate the Darwinian perspective is to understand human and urban change, engages with the role of the things we create and our decisions in the urban metamorphosis.

He argues that social and cultural change is not necessarily continuous and smooth and he relates that discontinuity to human interventions in the urban environment. He argues that change can be sudden, abrupt; human actions and innovations can smoothly shift the direction of change or trigger great mutation unexpectedly. For him, emergent change often happens through the introduction of interventions or innovations which break the continuity of change. In other words, evolution happens through the introduction of new artefacts or ideas which suddenly shifts the path of human and urban mutation. Innovations such as the use of the car and the use of the internet changed our daily lives dramatically. Internet changed the way we communicate with each other and the car changed the way we move in the city. As a consequence of that the way we design cities also changed. Today, almost all cities have generous and smooth asphalt roads for motored vehicles. *Facebook* and other social platforms became a meeting place for people. These interventions shifted the pre-established direction of emergent change; they create new urban realities (Marshall and Batty, 2009). These new realities become the environment from which new things will emerge (Jellicoe, 1961).

Lane suggests looking at the discontinuities, at the great achievements to understand the macro perspective of social-cultural development. Because Lane observes human socio-cultural evolution from its discontinuities, he dismisses the analyses of micro-processes to understand large scale-socio-cultural changes.

‘*First it is unlikely that all or even most large socio-culture innovations proceed by the gradual accumulation of change induced by micro-processes. Second it is even more doubtful whether these micro-processes are themselves sufficiently stationary over long time scales that they could generate large-scale changes’ therefore it is argued that the 'observability' of this micro-processes is therefore irrelevant to predict long-term effects*.’

(Lane, Maxfield, et al., 2009: 20)

Lane approaches the role of *Interventions* in human and urban change from a long-term perspective. He looks at phenomena as an observer over viewing the evolution of mankind on earth. From a short-term perspective, Marshall (2009) and Alexander (1977; 1979) recommend caution when disturbing an established complex system. Both argue that people, just like organisms need time to adapt to the environment; therefore problems arise when we make unexpected and radical changes in the system. Drastic changes create discontinuities and therefore can create dysfunctional behaviours during a period of adjustment which is not even sure that it will ever end (Marshall, 2009).

Modernism is a great example of such a break in the continuity of emergent change in the building environment. Modernism emerged from exciting new technologies which changed the concept of a city but people and the way they deal with themselves and the environment did not change accordingly. In other words, instead of a gradual change, modernists suddenly started building roads in the air and demolishing entire city centres, without being sure if they would work. Dennet (1996) called these kinds of human aspirations as *hopeful monsters*.[35] Those blind steps can eventually work but in general they can be devastating for the city because they are very difficult to repair; a new model of a car can be replaced much more easily than a building. Modernist interventions, due to their scale and boldness, have destroyed entire urban ecosystems which in some cases are impossible to repair (Jacobs, 1961; Jencks, 1981; Coleman, 1985; Panerai, Depaule, et al., 2004; Pearson, 2006). This said, it is important to emphasise the fact that we are not defending that a leap in the dark is something necessarily bad. What we are saying is that it is much riskier than a gradual change.

Marshal argues that change should be perceived and directed as a continuous process. Due to the relevance of nurturing the continuity of the system's evolution, there are issues related to the scale of interventions which are important to consider. Besides that it is important to understand if the scope of urban change is related to the scale of the intervention.

We have already concluded that from the perspective of complexity theory and fractal geometry small changes in the basic elements from which a complex system emerge can create changes in the system as a whole. Changes in the system can be seen in just a few levels of self-repetition (Batty, 1994, 2005). In addition, we have concluded that due to the unpredictable character of complex systems small scale interventions are eventually less risky. In case of need, small scale interventions are eventually easier to adapt or replace and therefore they are more flexible to guide the system's development.

In the biological context small changes in an organism can create great changes in the long term and tend to be harmful in the short term. In other words, organisms are already fit for their function they just become more and more accurate eventually re-shaping themselves completely. Great changes, on the other hand, tend to generate dysfunctional beings in the short term; the so called *hopeful monsters*. *Hopeful monsters* generally don't succeed because they do not fit the present needs of the organism. From the perspective of human interventions, hopeful monsters do not fit '*the social, economic and built environment into which they were to be inserted, or there being no viable paths to a future successful fit'*. They are mere speculations of the future (Marshall, 2009).

In the building environment a hopeful monster, such as many modernist interventions, makes us feel '*as if we are in a forever-temporarily ill-fitting phase, like living in a building under construction: heroic in aspiration, perhaps, but uncomfortable for living in for the time being, and with an uncomfortable doubt as to whether it will ever be fit to live in'*.

(Marshall, 2009:234, 235)

The scale of an intervention plays an important role for human adaptation to the urban environment but the adequacy of an intervention is related to the understanding of the city from which that intervention emerges. Modernist planning, for example, tried to reconstruct a new urban order. They approached the city as a final finished object rather than from the perspective of the elements which makes the city emerge. It was as if the city was '*a fixed kind of organism, requiring corrective surgery, rather than something evolving with no knowable optimal destination'* (Marshall, 2009).

We suggest that manipulating the system from the perspective of its building blocks is changing the rules from which both the problem and the system emerged. The consequence is a new system operating according to different rules and eventually generating new problems. The system self-organizes according to the optimisation of each part in relation to the whole. Therefore, in this model there is no such thing as inappropriate solutions or inadequate designs. Building forms and social behaviours emerge for a reason when the elements that triggered that reason to exist change, the system will adapt as a whole and other building forms and forms of social organisation will emerge.

In short, from a long term analysis, Lane studies urban change from the perspective of its discontinuities. From that perspective he sees innovation and human interventions as a way to produce change. As the engine that drives human socio-cultural evolution further; the key to direct and speed up change. From the perspective of short-term analysis, Marshall and Alexander refer to the dangers of large scale top-down interventions and fast changes in the urban environment. They argue that humans need time to adapt to environmental changes.

From these arguments we conclude that top-down interventions have the potential to intentionally speed-up and re-direct change. Nevertheless, there are relevant conditions to quip in mind in order to intervene in the system efficiently.

First, an intervention should emerge from the elements that compose the system rather than from the perspective of the system as a whole. In other words, interventions should target the elements from which the city emerges to change the city as a whole. From the building environment perspective this would mean changing the dimension of the land plots rather than building a new neighbourhood.

Second, interventions should emerge as a process parallel to human and urban evolution as a response to a need of the present rather than emerge from imaginary forms of the city.

Third, interventions should be discrete; small scale interventions do not disturb much implemented systems. In addition, they have more potential to be adequate in the short term and still trigger great long-term changes.

The argument made here supports the research hypothesis which sustains that we can use interventions to manage urban change in a more efficient manner. In addition, these arguments start to identify the key characteristics of strategic interventions in the urban environment. But with it they also bring other questions, such as:

How can we create and select strategic interventions? Can we even recognize them?

Could the design and selection of strategic interventions be the basis for a new kind of urban planning?

Design and *Artificial Selection* as tools to guide and speed up human and urban evolution

Natural and artificial selection

Dennett (1996) suggests that the general definition of Evolution is based on a combination of variation, inheritance and selection, even if it is primarily related to biological evolution, it is not specific about anything related to biology or life. Evolutionary theory can be generally applied to refer to the evolution of non-biological things like artefacts, languages, organisations, technology, etc (Young 1988).[36]

'*... along with the evolution of physical forms of species, we have the evolution of organisms' behaviour, their social systems and artefacts. In this sense, termite 'skyscrapers', beehives, wasp pots, beavers' dams and spiders' webs can be seen as a product o evolution. In turn, the successful functioning of these artefacts helps the organisms that make them survives and reproduce, and are therefore part or parcel of their evolution*.'

(Marshall, 2009:156)[37]

The evolution of what we are and of what we produce is not the responsibility of natural selection rather it is related to intentional artificial selection (Mindell, 2006); the act of replicating and transforming something – even if it does not necessarily have to be intentional - is made by man itself by copying existing things and designing new ones. Humans, to a great extent, are responsible for the selection which will determine their path of mutation (Lane, Maxfield, et al., 2009). The ways we use to copy or adapt something which we consider to be worth copying can be various; it can be by the use of genetic manipulation, by design or others.

On the one hand, according to Marshall, from the organism's point of view this selection is no different from the natural one: '*It is only 'artificial' in the sense that the human has purposely become the controlling external influence on selection, and considers this process one that is part of Nature.'*

(Marshall, 2009:168)

On the other hand, Lane (Lane, Maxfield, et al., 2009) argues that not only the speed involved in the process of change but also the direction of change of the artefacts and the designs we create is not related to the Darwinian idea of '*fit for a purpose'* or functionality: it is not only not achieved by feedback from the environment - rather it is Man who artificially selects what is to be replicated and what it to cease to exist- but also the process and values used to make that selection are not necessarily related to functionality; they can be related to concepts of beauty, for example. According to Lane, this process is in itself always changing as a consequence of socio-cultural innovation. Since when do trends in faction have to be functional or the way we choose a dog or a horse to breed?

Based on the arguments above, we can view Darwin's evolution as a special case in which the subjects are self-reproducing living things. In Darwin's kind of evolution there is random variation and genetic transformation, and there is no conscious intention of purpose anywhere. Still, other versions of evolution can include the evolution of non-living things constructed by external agencies, such as cultural transmission, genetic-engineered variation and artificial selection. In such cases, the evolutionary process is related to human individual actions, but still with no long-term purpose.

But what kind of evolutionary process would emerge if there was a consistent long-term intention behind key strategic human actions?

Even if long-term intentions behind human strategic interventions change in time, they would still give a direction to change and a certain consistency to human intentional actions. In other words, artificial selection plays a significant role in defining the speed and path of social-cultural development. If that selection was systematic and consistent it could eventually optimise such a process.

From the perspective of the building environment, Marshall suggests that the public authority's selection upon what can and what cannot be built can be seen as a kind of artificial selection. That selection, if it is undertaken for the short and long term common good, will overwrite the "natural selection" - or emergent market forces- that may only optimise an individual's well-being. Of course this selection has a deep relation with design itself; therefore what we see in the building environment is a consequence of the combination of artificial selection and design (Marshall, 2012).

Design as a form of adaptation and as a reproduction tool

Marshall raises the possibility of seeing design as part of evolution and evolution as part of design as a paradigm shift both in urban design and urban management (Marshall, 2009: 177).

The relationship between *design* and *Evolution* can be interpreted in two ways:

On the one hand, design can be seen as a form of human adaptation. All things created by organisms can be seen as forms of adaptation or innovation to respond better to a certain need. In other words, artefacts and other creations can be seen as tools used by organisms to become fitter to address the challenges of the environment and therefore increase their possibilities to survive and reproduce. Adaptation occurs naturally in the development of any organisms and defines the path they take in the evolutionary process. Adaptation happens simultaneously in the evolutionary process of organisms, the tools they use and structures they create. Termites' nests, bee's hives or cities evolve with their builders once they are part of the condition for their survival as specie (Alexander, 2003; Hansell, 2007).

We argue that all things created by humans including their building environment can also be seen as a form of adaptation. Design is used as a method to create something able to respond better to a given challenge. Therefore, human and urban evolution are linked by the things we create and therefore by design. In other words, design can be seen as a mediator between humans and their environment; humans' evolutionary process, the evolution of human creations and design are intertwined in a simultaneous processes of change (Ihde, 1990). Lane (Lane, Maxfield, et al., 2009) calls this interrelation as the *reciprocally principle*:

'*... the generation of new artefact types is mediated by the transformation of relationships among agents; and new artefact types mediate the transformation of relationships among agents. In particular, the reciprocity principle implies that any causally convincing narrative about artificial innovation will constantly jump back and forth between transformation in the space of agents and transformation in the space for artefacts.'*

(Lane, Maxfield, et al., 2009: 28)

In short, we consider design both as a form of adaptation and a form of innovation. It provides us constantly with new tools and shapes always changing environments. In that process it changes us as people and our needs. As design has the ability to shape both humans and their environment, we argue that it has the ability to shape a human's evolutionary path.

On the other hand, design can be interpreted as a reproduction process even if design has little or nothing in common with biological reproduction. Design can be seen as a way to intentionally replicate and adapt something for a new purpose. As with reproduction, design is used as a method to achieve the next step of change. It is not related to the long-term time scale of evolution. Design, as with reproduction, is not *Evolution*, still both design and reproduction are part of different kinds of an evolutionary process (Marshall, 2009).

Designs can be reproduced, adapted and changed much quicker than humans' biology. One single human can produce dozens of different designs and, therefore, can create a motion of change faster than the biological one. Examples of the evolution of designs can be seen everywhere, from the design of cars, bicycles or planes. We can see the evolution of design; its long-term changes – in every tool we use in our daily life and we can also see it in the designs of cities (Stedman, 1979).

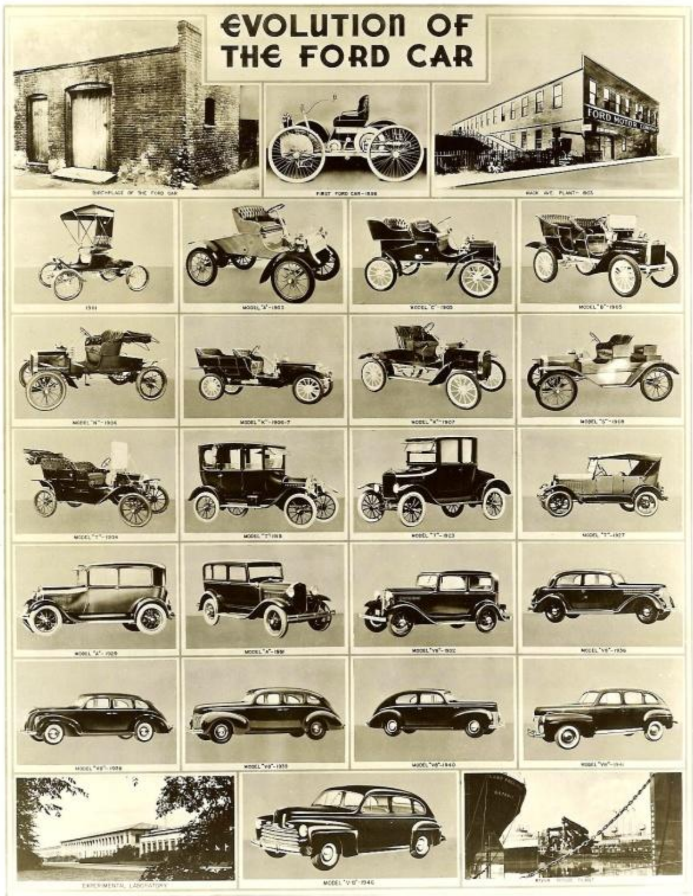

Figure 5: The history of Ford's cars

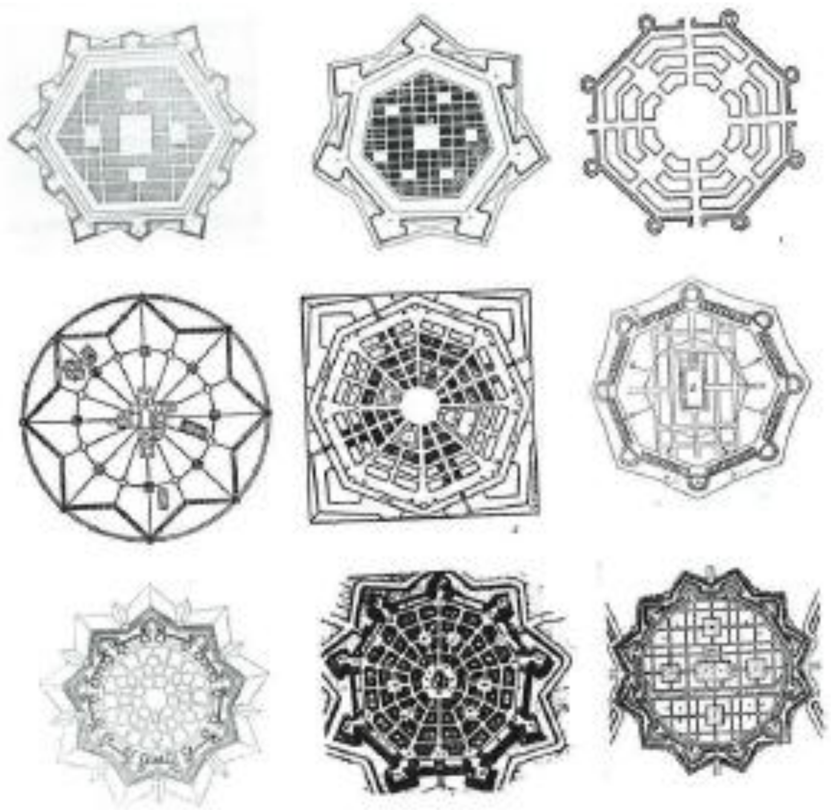

Figure 6: Ideal cities (Marshall, 2009: 78)

Figure 6 represents several representations of ideal cities which followed Vitruvius's first concept. As with the evolution of organisms, in the design of cities we can see:

a) Variation, probably to address different needs and to adapt to different circumstances. Variation in the non-biological context is a product of ideas and human imagination.
b) Reproduction of the previous model. Reproduction in the non-biological context is related to the human capacity to learn from the past.
c) Selection. A design will be selected among others according to its capacity to address a specific need. In all cases form is related to functionality. The form which will best perform its function will most probably be the selected one.

As we can see there are some common points between artificial and biological reproduction even if the differences are also clear (Marshall, 2009):

1- There might be more than two souses of inspiration to create a plan or a design and they can be different in kind.
2- Each design is a consequence of a deliberate selection, innovation and variation. Its shape is designed to satisfy, in the best way possible, the requirements of the context and the function of the object of design.
3- The selection can be made between one or two specific designs.
4- Not every design needs to be built to be successful and represent a source of inspiration for future designs. An example of that are the diagrams of Ebenezer's *Garden, City* or Le Corbusier's *Ville radieuse.*

Both look at of the role of design in the evolutionary process - as a form of adaptation or as a form of reproduction- open doors to conceive design as a relevant tool to shape, guide and speed up humans evolutionary process (Verganti, 2009). On the one hand, design can be used to create great variation; it can combine ideas which might even not be directly related and create new things from that. Design can adapt old things to new uses and imagine completely new ones. In addition, we are able to select and adapt designs to new uses without having to implement all options first.

In light of the arguments above we suggest that design and artificial selection have the potential speed up and redirect the path of change. Nevertheless, questions may arise related to the scale of the designs and to how we relate short-term interventions in the urban environment with long-term changes.

With regards to the design scale, the way we describe designs echoes the concepts of emergence but incorporates both the notion of a natural and artificial city. In other words, small scale designs, as most bottom-up interventions are, normally focus on the short term and the self, like the design of a single family house or a shop. Like all small scale interventions they easily merge with the natural development of the city. They contribute to the continuity or urban change and they influence the path of human and urban evolution un-intentionally; they go with the flow. Larger scale designs, like most top-down interventions are normally more focused on the common good and emerge from visions for a better city. These designs aim to change human and urban evolution intentionally and due to their scale and their short time of implantation they normally create abrupt change in the urban system (Abercrombie, 1933; Mumford, 1938; Hall, 1988).

With regards to design in relation to different time frames we argue that both artificial selection and design are related to short-term changes and urban development is related to long-term visions for the future. Specific short-term and local actions or interventions – as design - might be intentional and targeted to adapt to a new situation, but in general terms they do not have long-term intentions or take the whole into consideration. In this context, even if design is by nature intentional, the overall outcome is still unpredictable and therefore emergent as any other un-intentional bottom-up intervention. In other words, from the perspective of emergence, it is not relevant which processes took place to achieve a large scale or a long-term change once the small scale change, or the direct processes which induced it, might not be connected with the overall effect; the overall outcome of an intervention, regardless of its design or not, is unpredictable (Marshall, 2009: 172).

Nevertheless, even if the result is unpredictable, intentional design can serve as landmarks in the evolutionary road to guide the evolutionary path. This is only possible because in the short-term they define a direction of change. We argue that design can be used as a top-down method to shape interventions which aim to influence long-term urban and human change. These interventions will not determine the end result of what the city should be but they serve as landmarks to guide the path of urban change towards a sustainable direction. Design can be used to shape human intentions for the future "*Design is the term we use to describe both the process and the result of giving tangible form to human ideas*."

(Peter Lawrence, in Ehrenfeld, 2008:157)

In other words, design relates the present with the future (Banathy, 1996) ; it relates short-term actions with long-term intentions. Therefore, the quality, the scale and the adequacy of a design can have an influence on the direction human evolution might take. In light of this, to design sustainably is a key factor for healthy human and urban evolution. Because of this, in chapter 6 we explore models that inform *artificial selection* and *design*. In other words, are able to help designers and decision makers to relate short-term actions with long-term intentions and therefore help them to select and design more adequate interventions.

Implications for urban management and urban design

We started part two of chapter 3 by describing different ideas on how to relate evolutionary theory with urban evolution and the evolution of human creations (Verganti, 2009). In general, evolution implies the existence of functional order without anything or anyone planning it. It implies that continuous change and adaptation to circumstances will lead to a great variety of form in the long term, each one fully adapted to the purpose and the environment that stimulated their emergence in the first place. This process of change is in response to a need and an environment, therefore things seem to be designed in a way that they are fit to serve a specific purpose. This continuous purpose of change does not have a long-term goal or a supreme form to be achieved. It is just a continuous symbioses between a cause and an effect that travel through time together and shape the complex and diverse world as we know it.[39]

We suggested that design and artificial selection serve as a mediator between humans and the urban environment; we suggest that human actions are the link between human and urban evolution. In light of this we have described design as something related to artificial selection and as both a form of adaptation and a reproduction strategy. In addition, we argued that design is a tool for innovation (Verganti, 2009); it is a short-term local action that can define long-term changes in the system.

With regards to the scale of designs, we related small scale design with the general idea of small scale interventions and we frame those in the context of the *natural city* and continuous emergent change. We relate large-scale designs with large scale interventions and we frame them in the context of the *artificial* – top-down – city. We related them to intentional shifts in urban evolution and with urban discontinuity.

We argue that designs as a short-term intervention in the urban environment should have a common long-term intention for the evolution of the system. If the design's process of variation, reproduction and selection emerge from a common long-term intention we might be able to optimise our actions and move forward faster in a specific developmental path.

The intentionally from which a design emerges raises discussions in the academic world. First, as we have seen in the context of complexity sciences, regardless of the intentions behind human actions, the reactions of urban complex systems are by definition unpredictable. The second reason is related to the fact that intentionality is normally dissociated with biological evolution (Stedman, 1979). Due to time constraints we did not explore this discussion in-depth because that would imply a deviation from the focus of the research and emerge in scientific fields such as philosophy.

For the purpose of this research the relevant argument to keep in mind is that, as genetic manipulation, design and artificial selection can be used to manipulate or change something in the short-term with the rational intention of achieving or improving something in the long-term. In other words, if we regard cities as being a consequence of a process of evolution, we can use evolution to inform their ongoing planning and design. Design can be interpreted as a reproduction system or as a form of adaptation in the evolutionary process of non-biological things. Therefore, we argue that design can be used as a tool to influence short-term changes and, therefore, guide the process of evolutionary change. In other words, designs can act as landmarks to guide the process of urban development.

In short, we argue that if the intentions behind the designed form are focused on long-term changes we might be able to use that design form as an intervention to strategically nudge human and urban evolution towards a sustainable path (Banathy, 1996).

Introduction to *Interventions Management and Design*

Managing complexity, unpredictably and dynamic change

Figure 7: Hilary Berseth made this sculpture with help from bees. He constructs a basic framework made of wire and wax, after the bees add their honeycomb. The process takes time and the outcome is not predictable.[40]

The need for top-down planning

The relevance of nested hierarchies[41]

From the perspective of complexity sciences the city emerges from systematic actions of individuals. In other words, the whole of the system emerges directly from its individual parts and there is nothing in between the two. Authors such as Johnson (2012) define the city as systems, of a system, of systems. Portugali also used complexity theory to illustrate that ... "*the city is a dual self-organizing system: each agent operating in the city is a complex self-organizing system on a local scale, and the city as a whole is a complex self-organizing system on a global scale*" (Portugali, 2003). In other words, he defines a city as subsystem which is made up of other smaller subsystems and at the same time is part of a bigger system. Similarly to Portugali's conclusions, systems thinking theory biology and evolutionary theory teaches us that the equilibrium in self-organising systems is related to their scale (Wilson, 2011).[42]

From the perspective of biological sciences it is difficult to imagine a complex organism such as the human body operating directly from the individual work of independent cells. From an evolutionary perspective, large-scale organisations cannot be the direct consequence of self-interested individual actions. Multi-cellular organisms are structured in nested hierarchies; each part of the system is composed of lower level identical systems and at the same time is part of the higher level system (Miller, 1978).[43] Miller argues that such kinds of organisational structure is not only applicable to biological organisms abut also to social and political systems among others.

The American biologist, James Grier Miller, (1978) long aimed to establish a common ground where scientific knowledge could be shared.[44] For this he developed a methodology to look at living systems based on their hierarchical organisation. He was a pioneer in applying system's theory to human social realities. He related biology and evolutionary theory with human organizations such as cities. Miller used nested hierarchies to categorise systems, therefore he implied that higher and more complex hierarchies include and extend to the simple and smaller ones.

"Cells are composed of atoms, molecules, and multimolecular organelles; organs are composed of cells aggregated into tissues; organisms, or organs; groups (e.g., herds, flocks, families, teams, tribes), of organisms; organizations, of groups (and sometimes single individual organisms); societies, of organizations, groups, and individuals; and supranational systems, of societies and organizations." (Miller, 1978)

Photo courtesy of wikipedia.org

Figure 8: Matryoshka dolls

What is interesting in Miller's work is that he was able to relate different kinds of systems; such as biological, social or even systems of stars. *"Higher levels of systems may be of mixed composition, living and nonliving. They include ecological systems, planets, solar systems, galaxies, and so forth. It is beyond my competence and the scope of this book to deal with the characteristics - whatever they may be - of systems below and above those levels which include the various forms of life, although others have done so."* (Miller, 1978)

Regardless of the variety of systems he could integrate in his methodology, Miller focused his analysis on the subset of living systems - cells, organs, organisms, groups, organisations, societies, and supranational systems. This subset relates both biological systems with social systems which are the focus of our studies.

Miller emphasises the fact the neither the sub-sets nor the hierarchies of a system are rigid or fixed. They are just the result of a long scientific tradition of empirical observation of living systems. Still, these hierarchies could be divided differently.[45] As Miller stated, one might choose to subdivide tissue and organ into two separate levels. "*Or one might, as Anderson and Carter have suggested, separate the organization and the community into two separate levels - local communities, urban and rural, are composed of multiple organizations, just as societies are composed of multiple local communities, states, or provinces."* (Miller, 1978)

When one establishes a subset and a hierarchical organisation of a system and its subsystems, comparisons can be made between kinds and levels of living systems. These comparisons can generate new information and alternative ways of looking at things. *Inter-level generalization*[46] or uniformities across levels and across different kinds of systems can help us to predict and identify problems before they occur.

In short, based on his studies, Miller argues that just as in the biological context, in the social and political context, individuals need to function in small groups which in turn can be organised to form larger groups such as cities, regions and countries (Miller, 1978). He defends the relevance of integrative hierarchies for a system to flourish. Nevertheless he argues that these hierarchies should be independent and self-regulated.

As from the biological perspective, evolutionary theory also justifies a hierarchical organization of society and the need for a top-down urban management system of some kind. The need for some kind of hierarchical organisation and control emerges from the hierarchical nature of organisms adaptation. From an evolutionary perspective, local adaptations are a consequence of selection processes of the same hierarchical level. In the nested hierarchy model, higher hierarchies structure the ways the lower hierarchies organise and interact with each other. In other words, the lower hierarchy's general structure emerges according to the higher hierarchy's demands. Following the higher level demands, the lower-hierarchy elements self-organize in such a way that they are beneficial for the higher ones.

Making the analogy between human and other organism's mechanisms of adaptation, one can argue that public and urban policies, as well as economy, have to be structured hierarchically. Only then can individuals organize themselves within each hierarchy. It is futile to think that very high hierarchies such as a nation can regulate and manage the behaviour of individuals to induce them to cooperate and contribute to the common good.

According to Wilson, one of the problems of economy today is the fact that it misses intermediate links. It relies on individual choices to organize the world economy. In other words, the world of the neo-classical economics and the free-market is based on the idea that just like bees or ants, humans, simply by nurturing their self-interest, will inevitably build a society and its systems of human interactions. In this world-view, people just have to consider their own interests and their local environments to operate in a way which will contribute to the well-being of the whole. Just like the bee they don't have to have the whole colony in mind in order to add value to it. Nevertheless, reality has proven that good will is not enough and that regulations are needed to manage goods fairly among societies. People do not always put in practice the virtues needed for such a system to operate well without top-down external control (Ostrom, 1990). George A. Akerlof (Akerlof and Shiller, 2009), the 2001 economics noble laureate prize winner, refers to norms as the missing motivation for macroeconomics to work. But if economy is based on the complexity theory perspective of self-organization why does it need regulative norms? Most probably because it is not guaranteed that the well-being of the system emerges directly from the well-being of its individual parts.

It is not only can economy serve as an example of the problems emergent complex systems can generate when left without hierarchical top-down monitoring and control. From the urban perspective, urban sprawl is another example of how individual choices can harm a city as a whole.

In short, from the evolutionary perspective letting an organism self-organize without any monitoring from the top-down, or from the *higher hierarchies* can have either positive or negative outcomes, which we cannot predict. What we know though is that phenomena such as adaptations and cooperation are related to scales (Ostrom, 1990). From the arguments above, we suggest the need to create a regulatory system which is hierarchical, which nurtures the self-organisation within each hierarchical level and that establishes the ground for cooperation to emerge.

This regulatory idea is in a way contradictory to a self-organising and the emergent view of the world. Nevertheless in the *evolutionary paradigm* there is enough space for the elements to self-organise and to emerge spontaneously but self-organizations should only happen within each level. The elements within each level do not necessarily have to have the bigger picture in mind to act for the benefit of the whole.

"*Adaptations at a given level of the hierarchy require a selection process that takes place at the same level… Higher level selection structures the lower level interactions to result in outcomes that are adaptive at a higher level. The final product is emergent, self-organizing and usually decentralised. The lower level units obey local rules, do not have necessarily to have the welfare of the whole system in mind, and don't even require mind, (e.g., the cells in our body)… however, higher level selection is required to discover the local rules that don't work*" (Wilson. 2011: 353).

In other words, following the biological and evolutionary perspective, we argue that the city should be managed and organised according to hierarchical groups. Nevertheless, each element of the group should have the necessary freedom to self-organize internally and find its own role within the group and in relation to the whole. Lower hierarchical groups should be regulated by the needs of higher hierarchical levels. Nevertheless, as in any biological systems, the well-being of the individual elements which compose the system are as relevant as the well-being of the system itself. Therefore, any sustainable management system needs to constantly operate across hierarchies and constantly relate higher and lower hierarchical organisational levels (Beck and Cowen, 2006). In other words, it is worthless to try to solve global problems without addressing local ones. It is impossible to reach global cooperation without achieving it at a local level (Miller, 1978; Beck and Cowen, 2006; Wilson, 2011). Empowering and nurturing the small groups is therefore as important as empowering and nurturing the larger ones (Wilson, 2011: 36).

The need for cooperation would therefore be the need for norms?

Evolution is related to change and to the relationship between organisms and between organisms and their environment. It is about adaptations not about good or bad. There are those, like bees and ants, who profit from cooperation and those who profit from being what we call *selfish* (Wilson, 2011).[47] In the human population we have both. Generally speaking, we cooperate when it is in our interest to cooperate but, according to the circumstances, being selfish might prove to gain more advantages, at least at the short-term.

"Evolution has no foresight. Genes and beliefs alike spread on the basis of local advantages, no matter what the consequences over the long term. Sometimes they spread by virtue of benefitting individuals compared with their immediate neighbours, sometimes by benefitting groups compared with other groups, and so on up a multitier hierarchy of groups."

(Wilson, 2011: 353)

Both adaptations have strengths and weaknesses: On the one hand, cooperation generally does not maximise individual advantages relative to the group while *selfishness* might (Gibbons and Sherratt, 2007).[48] On the other hand, cooperation tends to maximise the well-being of the system as a whole. One of the reasons humans developed so fast as specie is exactly due to our capacity to cooperate. Individuals can learn and develop alone, but cooperation makes one able to profit from the achievements of many others and that makes us develop much faster. Besides that, cooperation is essential in the organisational system, such as the one described above, to work. First, only through cooperation can individuals self-organize within and across hierarchies in ways that are both beneficial for themselves and for the system. Cooperation aligned with individual autonomy within hierarchical groups enables individuals to find their own position in relation to the whole, maximising their individual contribution. Second, cooperation is essential for solving complex problems; it is essential for the nurturing of the process of creating variation and selection at group-level.

Creating the environment for cooperation to emerge

People have a natural capacity to care and cooperate (Ehrenfeld, 2008); nevertheless, this natural capacity is related to the scale of the group (Smith, 1776)[49]; it requires a different psychological setting to cooperate and help your colleague or friend to that of helping the unknown child who is being exploited to manufacture cheap clothing and shoes. Morally one might even feel bothered by the idea, but between this uncomfortable feeling to the decision of changing everyday life choices there is a great distance.

" *our minds are already equipped to do these things* (Cooperate) *spontaneously at a small scale when appropriate conditions are met, but tweaking is necessary for the same process to take place at the larger scale or even at a small scale when the appropriate conditions are not met."*

(Wilson, 2011: 366)

Elinor Ostrom (1990), the economics prize winner in 2009, made a rigorous study of several police departments and proved that smaller units normally are better integrated within their communities then bigger ones and they are normally able to respond to the community problems more promptly and adequately. She also showed that the scale of such organisations should depend on the services they provide and that each organisation should be studied case-by-case. In her studies about water management, Ostrom based her argument on the importance of decentralisation and emergence, but she also argued that positive emergent behaviours did not always arise spontaneously. They were a consequence of very structured interactions at a local level and conditions for this positive cooperation to arise had to be intentionally induced in some cases. Still, *"once the local rules that do promote the common good are winnowed from those that don't… then the common good indeed emerges from individuals who not necessarily have the common good in mind".*

(Wilson, 2012: 377).

In other words, both Wilson and Ostrom argue that cooperation is more likely to emerge in small social groups and when appropriate conditions are created. So, how can we establish the ground for cooperation to emerge? How can a complex organization acquire values if it does not have them in the first place?[50]

Wilson suggests that social groups need a *Mind*. Only some kind of regulation system can create a social environment where cooperation can emerge and keep that environment healthy. In addition, Wilson suggests that social groups need to establish an intention or purpose from their existence which justify and guides their actions.

According to Wilson, *Norms* can help a great deal in the establishment of human cooperation. Norms can be used to "monitor" people's good will and to give group moral and ethical values. Values and trust are a powerful structure and give a group identity therefore they are essential to create the conditions for cooperation to grow. Wilson suggested some general norms promoting critical engagement in dialog and respect for the common good.[51] Nevertheless, he builds on Ostrom's (1990) findings to establish the required ingredients to manage common good.

Ostrom's studies helped define the key elements needed to structure any group which requires coordination and cooperation. As result of her studies, Ostrom draws some suggestions to enable groups to self-organize and manage their own affairs successfully:

- Clearly defined boundaries.
- Proportional equivalence between benefits and costs.
- Collective-choice arrangements.
- Monitoring
- Graduated sanctions.
- Fast and fair conflict resolution.
- Local autonomy
- Polycentric governance

According to Wilson, if you follow Ostrom's recipe you will succeed in creating a cooperative group able to efficiently address complex problems.

Creating the environment for innovative solutions to emerge

An adequate problem solving process as suggested by evolutionary theory can be summarised as following:

- Firstly, monitor the area and the problem and gather as much information as we possibly can. For this, Wilson suggests a kind of urban *nervous system*; a single integrated database which help us to understand the city as a whole.[52]
- Secondly, establish the consensus that there is the need for a certain change so that, it becomes each individual's decision and not someone else's.
- Thirdly, establish the aims of the change in conformity with the common good otherwise cooperation won't emerge.
- Fourthly, establish an incentive system for bottom-up solutions to emerge. This can be either achieved by means of norms or compensations. As we previously argued, our minds are already equipped to cooperate when they operate in small groups. But most of the time, especially when we deal with large groups or with concerns that don't affect the participants directly, the appropriate conditions for cooperation and positive change have to be intentionally facilitated.

Ostrom's studies proved that by following such structure individuals or groups of individuals can design solutions for their problems (create variation) and decide (select) which are the most appropriate to implement.

Once put in practice, the interventions which best addresses the problems will be the basis for new designs, new ideas and new interventions in the future. This gives evolution its continuous character which in turn gives people a sense of belonging and of commitment.

Sense of belonging and commitment are ingredients of great relevance to engage people to participate actively in making their own environment and as grounds for cooperation to emerge (Wilson, 2011).

Nudging change as a new approach towards urban planning

Richard Thaler and Cass Sunstein (2008) argue that humans, through their innate characteristics and influences from their social environment, do not always take the most optimal decisions. In light of this, they suggest the need for a top-down *tweaking* of social dynamics to induce change when needed. Wilson (2011) goes further and says that *tweaking* is a necessary measure to manage a complex system such as a city.

Tweaking can be interpreted as the use of small interventions to nudge or adjust complex systems in order to improve them (Banathy, 1996).. Nudging change is a powerful and very relevant concept from both systems theory and the evolutionary perspective. This concept grounds both our vision for a more optimal form of urban planning and our research methodology. It is the basis of the research's *Exploratory Intervention Management System* (EIMS); the model used as a framework in the data gathering studies.[53]

Nudging change as a way of urban management implies that the purpose of city planning and of top-down interventions is to generate an urban form which is better than if there was no intervention (Hall, 2002: 3). This does not necessarily mean the depreciation of individual initiatives in the city. It can simply mean the identification of synergies between people and between people and places and unlock them intentionally, whereas naturally they could take longer or be difficult to emerge. To unlock those synergies we suggest the use *strategic intentional urban interventions.*[54]

According to Wilson (2011), we can nudge social dynamics and unlock unwanted synergies not only by monitoring and empowering individuals and groups but also by changing their environment. Wilson study shows that when you change an environment social change happens very fast and spontaneously. These findings support the idea that design can be used as a *strategic intervention* or as a tool to manipulate change in the overall urban system.

According to Marshall (2009) there are two ways of unlocking unwanted synergies: First is the proactive way of generating larger scale interventions which would be unlikely to arise from one individual or without coordination. An example is where an organization might design, coordinate and build a bridge, a school, a hospital, etc. Top-down interventions no not have to be necessarily big; they can be just the placing of traffic lights at the crossing of two streets, for example. Still it requires an analysis of the city from the perspective of the community rather than the perspective of the individual and requires the coordination of group efforts.

The second possibility is to intervene in the city to avoid emergent negative effects which can naturally emerge if people are left to act as they wish. An example of this is the emergence of ghettos, human segregation and sprawl (Batty, 2005).

Urban management and planning is not just a matter of designing the city; it has other physical and non-physical aspects and consequently other instruments which can be involved to manipulate change.[55] City management and planning include economical, political and cultural aspects of a city. It includes the management of both natural and the building environment as well as the networks people use to relate to each other and the environment.[56] The visions we have for our cities are mirrored in the building environment and in our economic and political strategies and in our culture and belief systems. Together, these aspects of urban life make up the city as we know it. Therefore, any change in one of these aspect of urban life, will change the development of the city as a whole. In other words, all aspects of society could be used as the source of strategic urban interventions; they could be used as instruments to nudge change responding both proactively in society as well as gently nudging change to avoid urban and social problems. In this research we will focus on *design* and *interventions in the building environment* as catalysts of change.

According to the evolutionary paradigm we cannot say that there is one correct way of intervening or designing the city. There is also no way to know in advance the effect an intervention will have in the urban environment. Solutions are contextual; they depend on specific protagonists and their environment; therefore, we cannot say that one urban model is better than the other. Rather than a manual on how to improve an urban system, we suggest a way to approach it. We suggest that urban planning can become a more sustainable and resilient practice if it nudges, manipulates, triggers or influences change in the city rather than imposing it. The idea is to give change an open end and to be flexible to be able to deal with its unpredictability.

We are not implying that there should be no planning. As we have seen, evolutionary sciences defend the need for some kind of top-down control. Ultimately, there is always the need to coordinate the design and building process of constructions of all scales, such house blocks, streets, squares…. What we are implying though is that the emphasis should switch from the finished grand scale design towards more generative forms (Portugali and Alfasi, 2007). For example, a city counsellor can approve a division of land and legalise the urban ground in a way that social housing will naturally emerge. This approach is fundamentally different than designing and implementing a social neighbourhood as a finished form.

The *nudging approach* should not be restrictive or impose directions of development, in case there is no risk of emergent urban dysfunctions. It should rather be supportive of self-organisation and the forms that emerge from that. In other words, the aim should be to help the emergent urban structure to perform better and to improve its living conditions rather than draw a path of development (Marshall, 2012).

Similarly, we should also take into consideration the time scale and the relationship between our proactive actions with the natural response of the city. It does not make sense to build a vast finished network and wait for individual actions to fill in the empty spaces. This could generate abandoned unfinished streets amongst other urban problems. The idea is to stimulate something to happen and then respond to the natural reaction of the city, whenever it will happen.

In short, the encouragement of nudging change as a continuous process parallel to the natural urban evolution can be a way to address the unpredictability and uncertainty of the future (Marshall, 2012). We cannot know today what the desirable city of the future will be, therefore, rather than shooting in the dark and designing what Marshall calls, *a hopeful monster* we can acknowledge what we do well and our needs of today. Again, this does not imply the end of urban design and of the emergence of new ideas for what the future city should be. What it implies is that non-continuous change, even if it apparently can be seen as a proactive way of '*taking care about the future'* is actually more risky (Portugali, 2004); It is more difficult for something completely new to find solid grounds to emerge and humans normally need time to adapt their daily habits to completely new urban structures (Marshall, 2009).

The emphasis on urban planning as a process rather than a finished design has to do with the difficulty of choosing the right path of change in such unpredictable grounds. Master plans would only make sense if we were to know the optimal form of the city in the future, but we do not. When we put a master plan in place we expect it to function well and to need just final adjustments and minor adaptations. Nevertheless, the essence of the so well-intentioned plan might not be able to support urban change and human life as it was initially expected. For this reason rather than having one single target form of the city it is better to have an open end; *'... the well-intended targeting of a precise optimal outcome may be no better than choosing an incremental approach which is still very likely to reach roughly the same kind of form, but which may more surely maximise the change of each intermediate step being viable and adding immediate value'* (Marshal, 2009:267).

Do we have to fully understand complex systems to act on them?

Even if during the 20th century science moved to a "higher threshold", in the sense that theories tend to deal with new orders of complexity, we still have the fear that we need to fully understand complexity to be able to deal with it and to apply it in our daily life. From the perspective of the city planning and city management we fear that without fully understanding the complexity of the city we won't be able to properly manipulate the path of its development. Because of this we tend to neglect the city's complexity and we continue to approach urban form from a rather simplistic perspective (Ehrenfeld, 2008).

The fact that we cannot fully understand complexity does not mean we cannot deal with it. We deal with complex systems on a daily basis. Intuition and common sense are the tools we use to navigate in this complex world without even being aware of its extreme complexity (Berkes, Colding, et al., 2000). A five year old child is probably able to read the time on a normal watch, which does not necessarily mean that the child or even most of the grown-up population is able to understand how the watch works. What matters is the fact that we know how to use it and that it helps us navigate through the complex world we live in.

Just as the clock is an abstraction of time there are other tools to help us to deal with urban complexity and dynamic change. Models and computer graphics are abstractions of reality which we use as a tool to help us operate in a complex world. They are often used as tools to support urban design and management. These models are not reality they are visualisations and simplifications of it (Batty, 1994; Alexander, 2003; Portugali, 2012). As with the clock they cannot help us to fully perceive and understand the implications of our actions and the complexity of reality: The notion of *time* is much bigger than what the watch can show us. The notion of *city* is much more than models or computer simulated realities can give us. Because models cannot show us the reality in its wholeness, managers and designers need to deal with the real city as the object of study.

We as humans are a product of social and urban complex systems and therefore we are used to dealing with complexity on a daily basis. We constantly intervene in the urban system without fully understanding it. Nevertheless, being part of the system, we know that certain behaviours are more probable than others and that some interventions are more adequate than others. Traditional and emergent knowledge are examples of our innate capacity to intervene in complex systems.

Simulation models help us to intervene in the urban system by showing us possible scenarios for the future. Practical and traditional knowledge show us how the urban system reacted to certain interventions in the past. The varieties of ways humans address their everyday challenges in different environments act as a library of information. They can inform us how to deal with the complexity of social systems and with dynamic change. According to Gunderson et al. (1997) they have the capacity to relate the past with the present and re-establish resilience.

"*Traditional knowledge may be holistic in outlook and adaptive in nature, gathered over generations by observers whose lives depend on this information and its use. It often accumulates incrementally, tested by trial and error and transmitted to future generations orally and by shared practical experiences."*

(Ohmagari and Berkers, 1997, in Berke, Colding, et al., 2000)

Combined, simulation models and traditional and emergent knowledge give us valuable recourses to act adequately in urban complex systems and create change across its different hierarchal levels (Gunderson et al, , 2002).

In light of this, there are three relevant arguments which are important for this research exploration relating to new forms of urban planning:

First, is the fact that humans have the capacity to deal with complex systems without fully and rationally understanding them.

Second, is that there is relevant knowledge generated by every-day-practices and by traditional knowledge which needs to be considered.

Third, computer models can help us look into the future but they are abstractions of reality.

Because of the fact that we cannot fully understand complexity and change in complex systems is unpredictable there is the need for an adaptive kind of management system (Gunderson, 1999). Due to the complex and unpredictable character of urban change we argue that urban management has to be a continuous process; a continuous dialogue between designers, policy makers and the city. It has to be a process of action and reaction because only then we can deal with uncertainty and unpredictability efficiently (Portugali, 2004; Portugali, 2008; Marshall, 2012). The kind of management we suggest has similarities with *Adaptive Management*.[57]

Relating the *intervention management* system to governance

Termeer (2010) compared three main orientations of governing in terms of paradigm, scale definition, problems definition and dominant responses. The kind of management system we are suggesting in this thesis (Intervention Management system), even if it has a lot in common with adaptive governance in terms of structural organisation, differs largely in terms of focus. The kind of management we suggest focuses on the management of interventions in an adaptive way.

Even if the focus of this research is on human actions rather than governance, there are some shared challenges with adaptive governance. Namely the fact that for such an adaptive response to work, top-down forces need to quickly form an *action group* and gather strategic actors to address a given problem. In other words, the system has to be able to identify and collect the individuals needed - from within and across the hierarchical levels of the system - to efficiently address a given problem. For this, human cooperation and flexibility is put to the test. Adaptive research faces challenges related to finding the right collaborations; the right cross-level and cross-scale cooperation in order to address a specific given problem. Therefore, we expect the same difficulties in the kind of management suggested by this research.

In light of this, in chapter 6 we explored a tool to help to relate issues with relevant scales and levels of aspects of society; a tool that serves to cross information across different actors, different scales and different levels of social organisation. And, above all, that it relates human actions and design to adaptive management and to complex social inter-relations.

In addition, it is relevant to emphasise the fact that we believe that there is no one simple right way of managing complex systems. Adaptive governance might not always be the most appropriate strategy. Governance is very much related to history and culture; therefore, different kinds of governance are appropriate to different places. *Monocentric governance* and *multilevel governance* can add relevant insight in terms of strategies and the notion of governmental scales. Nevertheless, we believe that the embracing of the unpredictable character of change is the path for more resilient management; therefore, we see adaptive management as a management approach that deserves serious consideration.

The exploratory tool we explore in chapter 6 is not related to one kind of governance. It aims to relate human actions with aspects of society and the individuals that both can address a certain problem and suffer from it. We suggest a tool to support the creation of strategic human actions within all kinds of governance. We argue that regardless of the issues related to each form of governance and the eventual mismatches of governmental scales, informed human actions have more potential to nudge urban change towards a sustainable path than an uninformed ones.

Relevant principles to plan and manage dynamic and unpredictable urban change

Most of the authors mentioned in this thesis defend a management system based on the process of change and argue the importance of respecting tradition. Both evolutionary science and complexity theories emphasise the relevance of proceeding by small steps and avoiding surprising novelties. Both scientific fields agree that individuals should be given the means of actively building their own city (Marshall, 2009; 2012).

Taking into consideration the dynamic and unpredictable character of the city Marshall (2009: 270-279) suggested five principles of managing urban change sustainably. These principles resume part of the arguments we made up now and also serve to illustrate the complexity around their implementation:

- Make each step viable now
- Proceed by small steps and avoid leaps in the dark
- Avoid suppressing ‘unsolicited novelty’
- Discard moribund models
- Dissolve decision-making

In addition, evolutionary theory defends that a sustainable self-organisation system should be structured hierarchically and supported by some kind of norms or regulations. Such regulations should establish the grounds for cooperation and for ethics to emerge.

Make each step viable now

Marshall argues that interventions should be valid from day one and that areas should not be sacrificed especially the ones which are functioning well. This statement is prescriptive but open at the same time allowing relevant urban protagonists to focus on issues which might not be a priority for the wellbeing of the public. In other words, Marshall's statement accommodates different perspectives on what quality of life is and the meaning of a "well functioning social system". Some might argue that a system works well because it is safe and clean other might argue that the same system lacks social interaction. The interpretation a "well functioning social system" defines the political strategies designed to intervene in the city; therefore they define the city itself.

Marshall argues each intervention should only be considered finished when it is fully operational otherwise it can create problems. He suggests that it might be necessary to reflect on the ways feasibility is achieved: Not only in terms of constructions and operationally but also in terms of adaptability to an uncertain future. It should also consider who it will benefit now and in the future.

New buildings and infrastructures should be integrated with existing ones and together they should form a whole (Portugali, 2004; Portugali and Alfasi, 2007). The question lies in the meaning of "finish, fully operational interventions" and on their ability to establish a coherent ground where innovation can emerge. It also raises questions on the nature and scale of such interventions. In other words, interventions regardless of their scale are not and should never be considered as finished. Buildings, neighbourhoods or cities constantly improve, change and add things to adapt to new users and their interrelations as well as to new relations between people and their environment. Fast growing cities are typically a permanent "construction site" nevertheless, in many cases inhabitants, based on their wages for example, might argue that they have a good quality of life. As we have seen, building a coherent whole not grounded on the present might be dangerous; therefore one might argue that eventually unfinished structures might offer the grounds for innovation to emerge.

Proceed by small steps and avoid leaps in the dark

'*... avoid urban interventions that are either too novel – too great departures from existing known, tried and tested formats – or that are applied at too large a scale, or too suddenly, in such a way that the urban system around it has no time to adapt*.'

(Marshall, 2009:271)

According to Marshal, greater leaps in novelty might be put in practice successfully in the smaller-scale increments. In other words, instead of building housing as a grand-scale plan (where no one is sure if it will work) one can choose to build each house independently. Then each designer or user can have the freedom to experiment at their own cost. That experiment can in the future be the grounds for new housing typologies but has already been tested and is therefore not a leap in the dark.

An example of this approach is Ijburg in Amsterdam.[58] Ijburg it is an open-ended unfinished structure from the start. Islands are planned, plots are divided before or at the same time that contractors and buyers express their interest. This is only possible with accurate knowledge of the urban demands and by the means of technology to foreseen possible scenarios of use. Nevertheless, the initial sterile land opens doors to imagine the future and test innovations. Its success lies on its proximity to the well-established old city, and the scale and diversity of the interventions.

Search for novelty but avoid suppressing unsolicited ones

Sometimes one might even consider making things differently but might be discouraged by restrictions and regulations, fixed design standards or simply by a short-sighted view of the ones in power (Friedmann, 2011).

From an evolutionary perspective we should be sensitive to spontaneous emergent novelty instead of discouraging it. Functional novelty should be proactively supported and encouraged. Not novelty for the sake of it but functional novelty borne out of necessity can represent new and better ways of doing things.

Both Marshall and Loorbach (2007), this time from the perspective of transition management, argue that there should not only be the nursing of functional novelty but also an active search for it. Innovation and creative ideas emerge and thrive more during periods of instability and transition. These innovations respond to the specific problems people are facing to overcome their difficulties and they might bring the solutions to common problems humankind faces today. In other words, we should look for new ways individuals respond to their aims and needs and consider whether their ideas, strategies or designs could be translated into urban interventions and therefore be applied for the benefit of a broader public. Small individual ideas or interventions might inform new ways of green mobility, improve general health or store energy.

As we have seen before we should not only look at new ways of using emergent novelties but also consider past ones (Berkes, Colding, et al., 2000). Eventually innovative interventions might emerge from the combination of the two. The general argument is to emphasise the relevance to reach for novelty and exploit its potential to serve a broader public.

Discard moribund models

'If something doesn't work, it will be 'found out' sooner or later. If no one wants to shop in the city centre, or sit outdoors chatting or playing chess, but people prefer to shop out of town and chat or play chess over the internet, then this may or may not be a matter for regret. But trying to restrict shops to the city centre, or contrive public vitality will be fighting a lost battle, unless – which is quite possible – people would actually wish to do those things.'

(Marshall, 2009: 274)

The idea is to allow emergent large-scale and long-term models to evolve rather than trying to force the urban form to follow our preconceived models. Following this, visions of a future city such as the ones expressed in zoning models or master plans should be disregarded. Instead of defining how things have to be one might better just say, for example, that heavy industry is not to be placed near housing and leave open all other possible emergent forms of organization. As stated previously, the idea is to stimulate development rather than imposing it (Marshall, 2009: 274).

In addition, as argued before, interventions related to human needs or to the basic elements of the urban syntax can be regarded as a valid urban building block which can be strategically used to create emergent social and urban organisations. This principle implies a moral judgment of the path we aim to follow as specie in relation to what we consider to be a "moribund model". For example, some argue that the use of smart phones and the internet is changing the way people socialise and have fun and this has consequences on the way we use the building environment. In light of this phenomena, should we consider a human physical interaction a "moribund model" or something worth preserving?

Dissolve decision-making

Marshall argues that individuals, local organizations and groups should be empowered. Attempts have been made in that direction in Europe. Nevertheless, until now in most cases we have consented to a kind of decentralisation of power where the responsibilities were decentralised but were not followed by legislation nor by economical support.[59] The empowerment of the individual and local organizations should be part of a new framework of thought and would only work when collective efforts are made in that direction. According to Marshall (2009:275), there are at least three good reasons for devolution.

The first has to do with democracy and giving back the people the responsibility of their own lives and choices.

The second has to do with diversity; diversity of choice but also diversity of solutions.

The third has to do with being better fit for purpose. It has to do with finding the best solutions to solve specific problems.

Devolved decision-making would mean giving people more freedom to do what they want with their private properties as well as to use abandoned spaces to serve their needs. This thesis implies that planning permissions should be more sensitive and less restrictive regarding individuals' initiatives. Nevertheless, such freedom should be followed by norms and rules to control public health and guide human cooperation.

Generally speaking, today planners and policy-makers try to block individual initiatives or adjust them until they fit the norm; they try to manipulate them until they can be integrated to the grand-plan of the city (Lang, 2005). The focus is then on blocking emergent ideas and creativity rather that nurturing them. The emphasis should shift from blocking individual initiatives to nurturing them. Not giving permission to build something in the urban area should only happen when the object, for some reason, creates problems for the neighbouring surroundings. In other words, rules related to aesthetics and functions, percentage of ground use, the pre-definition of what a house is or the space which implies such use and so on, should not be used to stop the building activity per se.

Chapter summary and discussion

In this chapter we used complexity and evolutionary theory to suggest a kind of urban planning focused on guiding the process of emergent change. Such management should offer the grounds for cooperation and self-organisation to emerge within and across the different hierarchical levels of society. The research suggests that top-down interventions might be needed to guide urban development; nevertheless, they should be discreet and disturb as little as possible well-functioning emergent social organisations. The kind of management suggested in this chapter nurtures emergent forms of organisation and emergent innovations. In addition, is frames design and artificial selection as tools to relate short-term actions with long-term intentions for the urban system.

The approach towards planning suggested by this research is in line with Marshall's (2012) and Portugali's (2012) suggestions for a sustainable planning strategy. Portugali suggested an alternative urban management process, one which allows bottom-up interventions to have the same impact on the city as top-down ones. He called it *planning hermeneutics*. His strategy implies a true public participation in the building of the city and a true planning democracy. Portugali's suggestion in the context of urban planning has profound similarities with Loorbach's (2007) strategies to manage transition in complex systems. The similarities of the two approaches are visible even if these explorations emerged from completely different areas of research; one emerged from complexity theory in the study of cities and the other from governance. In this research we did not approach the topic of urban planning from the perspective of governance and an institutionalized management processes. Nevertheless, we argue that strategies like Portugali's planning hermeneutics and Loorbach's strategies for transitions in complex systems facilitate the self-organising character of urban systems and give a voice to relevant bottom-up interventions (Friedmann, 2011). We argue that nurturing emergent development improves governance in general, regardless of whether it assumes an adaptive, a monocentric or a multilevel approach (Termeer, Dewulf, et al., 2010). The models and strategies that emerged from such studies can be seen as interventions in institutionalized systems which improve the systems functioning and prepare them to deal with change and complexity.

From the perspective of the urban environment, adding to the basic concepts implicit in the attempts above, we suggest a kind of planning focused on the management of human actions. We argue that the design and selection of interventions in the urban environment can link short-term solutions with long-term intentions. In other words, we suggest that the design and artificial selection can be used as tools for the creation of adequate interventions; interventions able to intentionally guide the process of urban development towards sustainability. We call this planning *Strategic Intervention Management.*

In light of the arguments above, in the next chapter we will explore the meaning of *interventions* and the ways they could be used to strategically guide urban development.

Chapter 4: Categorising Interventions

The role of interventions in urban change

Introduction

In chapter 1 we introduced this research as an exploration of a new kind of urban management; a management focused on the design and selection of intentional and strategic human actions. We also used that chapter to introduce the notion of *interventions.* In chapter 2 we described our vision of the city and in chapter 3 we used complexity and evolutionary theory to justify concepts and arguments introduced in the previous chapters. In chapter 4 we will explore the meaning of interventions and how can they be used to influence urban change.

In chapter 1 we argued that a key aspect of interventions and the reason why they are so relevant for this research is related to their potential to induce change. The word intervention comes from the Latin word *intervenere* which means "*to come between*". It implies an action or a happening which modifies the natural course of things. *Interventions* modify the present and become the grounds from where new ideas and new actions will emerge; they define a future reality. In other words, interventions in the city morphology or in the city life emerge from a process of urban change and influence the direction or character of that process. In chapter 3, we used complexity and evolutionary theory to explain how interventions can be seen as part of the urban evolutionary process and explore ways how can they be used as tools to guide urban change. We named *design* and *artificial selections* as key means for such interventions to emerge.

These explorations opened the door for the conceptualisation of a dynamic and adaptable kind of planning; a kind of urban planning that acknowledges human and urban evolution as two interconnected processes of change and places interventions as the link between them. This research explores the notion that we could use interventions intentionally to address urban and social problems. In other words, we argue that in a complex system such as a city, an intervention of whatever kind has the potential to change the system as a whole and therefore could be used to address urban and social challenges.

Nevertheless, urban problems emerge from the complexity of the city. Urban problems are interconnected in extremely complex networks of relations. Addressing a problem might create other problems which one was not aware of. Rittel and Webber coined these problems as *wicked problems* (Rittel and Webber, 1973). *Wicked problems* are characteristic of complex systems. They are by nature a consequence of other problems and they are always unique. There are no right or wrong solutions to *wicked problems,* nor can we predict the adequacy of our interventions in advance.

Consequently, addressing such complex problems requires gentleness and humility and, above all it requires thinking in terms of process rather than about the finished form.

As we have seen in chapter 3 we should intervene delicately in a complex system to allow the community to adapt to change and to understand the possible unpredictable reactions of the system. *Acting small* is a way to test the system and identify unpleasant consequences before they take over the system itself (Beer, 1983).[1] Further interventions should be a consequence of the analysis of the reactions of the system. Urban design in this context should be seen as a process; a way to generate options based on a set of criteria which in itself are in constant mutation. This is the basis for a dynamic kind of urban planning; [2] a planning which emerges from a continuous dialog between human actions applied in the city and the analysis of the reactions of such system.[3]

There are many forms of urban interventions able to induce change to the development of a city. They can be related to the built environment, to the socio-cultural reality of the place, they can be political or economic. It can be a change in the in the legal system, a new subject at school, a commercial on the television... Even a letter can determine the character of a city forever (Morgan, 2008).[4] It can be something introduced overnight or something introduced over several generations.

From the perspective of the building environment it can be something small like a bench under a tree in the main square or something big like a new university campus or a new residential neighbourhood. Interventions are of endless kinds but they all have in common the fact that they influence the path of change.

In short, intentional or unintentional, small or big, natural or artificial, all interventions have the potential to influence every element (and the relationship between elements) of an urban complex system, therefore changing the system completely. Human actions and their consequences merge with the complexity of the city therefore they are to a great extent unpredictable. Due to the risk of undesired unpredictable consequences of human interventions, these should be delicate and seen as part of the process of urban change. This would allow one to test the system reactions and adjust urban change continuously in an interconnected process of human actions and emergent urban reaction.

To understand more what we mean by strategic or catalyst interventions we need to categorise them as well as to define the ways in which they could be applied in a system. The aim is to identify and compare interventions as well as the changes they trigger. The categorisation established in this chapter emerges from the specific research context and from the literature review. The categorisation is structured as follows:

First we will categorise general interventions as:

- Actions or reactions
- Natural and artificial
- Intervention of events and of space

- Acute or chronic interventions

Second we will define strategic interventions according to:

- Time frame
- Intentionality
- Where they were originated: Originated from the top-down or from the bottom-up.

Third we will focus on strategic interventions in the building environment.

- Isolated interventions or interventions in a system.
- Predictable and unpredictable.
- General and contextual.
- Hierarchies of interventions

General categorisation of interventions

Interventions as an action or a reaction

Here we look at interventions as both actions and reactions. We relate interventions with a human attitude and with urban and human evolution.

One could try to differentiate intervention as actions from intervention as reactions by saying that the first implies an active attitude and the second can be seen as more passive; as emergent consequences of an active action. But this is not necessarily true. For example, the civic centre and the heart of the Scottish city of Aberdeen city is Union Street (Morgan, 2008).[5] On the one hand, Union Street can be regarded as an active action. Among other things, it was intentionally designed to produce urban change; to improve the transport networks in the city and consequently improve trade in the harbour. In fact, Union Street influenced the character, the life and the development of Aberdeen forever. On the other hand, even if Union Street is an active and intentional action it emerged naturally as a consequence of the circumstances and its specific context; therefore it can also be seen as a natural reaction to challenges such as the traffic problems the city was facing at that time. Union Street was the most obvious solution; it was a consequence of Charles Abercrombie's work who was already working on the roads system of Aberdeen. It is a direct response to the specific needs of the city and a mirror of the ideas and concepts popular at the time. Union Street can both be seen as a consequence of the circumstances and an active and intentional intervention.

From the perspective of predictability, one can argue that in the short term Union Street was a predictable reaction to the circumstances but in the long term it was impossible to predict the development of Aberdeen city; therefore impossible to predict the need for such massive construction.

As argued in the introductory chapter interventions emerge from a given context and become part of the context from which new interventions emerge. In other words, both action and urban reactions build the grounds for new actions to emerge. Therefore *Interventions* can be seen as actions and reactions at the same time. In chapter 3, in light of complexity sciences and evolutionary theory, we have seen how this continuous relation between interventions and emergent, unpredictable reactions is in fact the basis for human and urban evolution.[6]

But how should one approach interventions in order to design them, select them or study them? We argue that the distinction between intervention as an action and as a reaction should be made according to the purpose of a particular project or study. On the one hand, an intervention can be studied to understand its relevance in a given context or to identify its emergent consequences. The intention of such study can either be to correct the emergent path of change led by that intervention or to reflect on its adequacy. In this case the focus is on the future; on the period of time after the interventions; the intervention under analysis should be regarded as an action. Consequently, all other consequent interventions, intentional or not, should be seen as emergent reactions. On the other hand, one can also study interventions with the intention to design or select them. In such cases the priority is to define the reason for the intervention as well as the intentions behind it. Therefore, the intervention should be approached as a reaction or a consequence of the system.

S*trategic urban interventions*[7] as suggested by this research's exploratory kind of planning needs to fulfil the duality of being both an action and a reaction of the emergent urban change. On the one hand they should be regarded as something that changes the future. On the other hand, they should also be seen as a direct reaction to the problems which they aim to address. In other words, a strategic intervention should emerge from an integrated and holistic understanding of the problems and the context where it will be implemented. In addition, it should be seen as the ground for future interventions and emergent urban reactions.

Natural interventions and artificial interventions

The meaning given here to the terms *Natural* and *Artificial* is different from the one described in chapter 2. Here we consider *Natural Interventions*, these being a product of natural forces and of the elements. An example can be an earthquake or a volcano. Changes in climate can contribute either to better harvests or to the complete decimation of the plantations, for example. The wind blowing, the sun shining, the sound of a river, these are all natural interventions that can make our human experiences more or less pleasant. Generally speaking, natural interventions are actions or events which are not a product of man. They are actions or events where man has no control and did not directly cause them to happen. In contrast, *Artificial Interventions* are the terminology we will use to address interventions which are manmade of which were designed and thought up by humankind.

Apparently the distinction between *natural* and *artificial* interventions is quite straight forward, but in practice they are not always easy to distinguish (Zubay, 2000: 168; Vermeij, 2004: 14). Some interventions can both be seen as natural and manmade at the same time. For example, is climate change a *natural* or an *artificial* intervention? The answer to this question relates to how we see ourselves in the world and how we look at the consequence of our existence in the shaping of the planet. There is now general consensus that the carbon dioxide we produce is responsible for climate change and that this can originate events which from a superficial point of view can be seen as "natural interventions", such as cyclones or floods (Crowley, 2000; Solomona, Plattnerb, et al., 2009).

In other words, some interventions are genuinely natural, in the way that they are not related to any human action, such as an earthquake. Others are genuinely artificial in the sense that they are a product of technology or manmade actions such as our building environment. Nevertheless, most of today's problems or happenings that challenge the human quality of life or even our existence on the planet can be seen both as *natural* and *artificial intervention*. They are what we previously defined as *wicked problems.*

When designing, selecting or studying *strategic interventions* it is important to treat them as a reaction to such complex problems. It is important to address the essence of the problems rather than the visual side effects they produce (Ehrenfeld, 2008; Foster, 2008). In addition, regardless of how adequate an intervention might seem to be one should presume that it might be the grounds for other *wicked problems* to emerge.

Are *artificial interventions* a form of technology?

Technology is described in the *Encyclopaedia Britannica* as *"the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment"*.[8] In this thesis we perceive technology as one kind of human action on the planet or one kind of *artificial or manmade intervention*. In other words, the concept of *artificial interventions* presented here includes and extends the concept of technology. Human interventions or *artificial interventions* are considered here as the rational product of an individual in a specific socio-cultural context put into-practice; they are actions which emerge from the need to relate and adapt to the environment.

Artificial interventions can engage with an endless variety of subjects and respond to all kinds of human needs not only to the ones we normally relate with technology. On the one hand, *artificial interventions* can assume the shape of a tool, a gadget or a building, which are objects considered as a product of technology. But artificial interventions can be related to art, sports, and events, cultural or religious practices... *Artificial interventions* do not necessarily need to be something physical or tangible; they can be a new topic at school or a new legal system; music or a painting. *Artificial interventions* can be a new colour given to an old building, planting a tree or cleaning a lake.

Technology and all other *artificial interventions* relate to the human activity on the planet; they relate to the innate human nature to change and adapt the natural world to an artificial one which is more suitable for our needs. Not only technology but also all other *artificial interventions* shape our needs, our ways of doing things, our daily life and how we build and use our environment. In addition, they influence the speed and the path of urban development. When we build we intervene in the city; we act on it, we change it, and it is the new reality we have created what becomes the background for future interventions (Read, 2005).[9]

This thesis argues that ideas translated into interventions are the engine for innovation and technology, and determine the essence and character of the places we live in.

Interventions as *Events* and interventions as *Space*

In this section we discuss the relation between people, space and events. We argue that these elements are intertwined in a complex system; therefore, if we change one of the elements we influence the system as a whole. In addition, we will address the relevance and the role of context in relation to the character of both events and space. There are many analogies between Alexander's patterns (Alexander, 1977) and this research approach towards interventions.[10] Therefore, we decided to follow Alexander's arguments and differentiated interventions into two kinds: *interventions of events* and *interventions of space*.

Interventions of events shape the physical context where they take place as well as the life of the people related to them. *Interventions of events* are related to activities, events or situations. They can be both natural and artificial; they might be a public celebration, the selling of a hot dog in the main square, a particular weather condition, or the sound of a river.

Events can happen once in a lifetime or daily. A procession to bury a loved one happens once or twice in a lifetime but one might drink an espresso coffee every morning in the coffee-shop on the corner of the street. Perhaps a procession happens once a year and there is a market every Saturday morning. During such events, the character of the place changes and life happens in a different way. Some events might reshape the character of places and of human life forever. An example of a dramatic event can be an earthquake which has the power to destroy a city and reshape the life of those who survived. Others events are temporary and as soon as they are over the square or the street comes back to its ordinary daily sequence of events.

Not only do special events characterise the urban space, our daily lives do as well. Our life is characterised by our daily routines, such as waking up having our breakfast, taking the bus to go to work, buying the newspaper, working and having lunch with a few colleagues. In the evening one might see some friends or go to the cinema, have dinner and prepare to go to sleep. In a square or a street, those patterns might be translated in the urban form by the coffee-shop on the corner of the street or the kiosk selling the newspapers, the bus stop, the terraces, the restaurants and so on. These terraces and restaurants might come to life during office lunch breaks and after working hours, while the newspaper kiosk might be more productive early in the morning. With this we aim to say that it is our daily sequence of events that characterise our lives and the urban environment where we normally live (Alexander, 1977).

The events that characterise a routine either of a place or of a human daily life are not that many. If we do well in those events we will probably have a pleasant day otherwise probably not; In other words, if we perform well in our work, we had a nice lunch with our colleagues and we watched a nice movie in the evening we will probably say that we had a nice day. If the streets' coffee shop, restaurants and kiosks are doing well probably its street life will be a mirror of that (Alexander, 1979).

All events need a place. *Interventions of space* are the background of events. They are related to the constructed environment. They are the places where we live and experience events. They are the physical shape of the room, the building, the street the square.... In other words, *interventions of events* define the physical form of the space where they happen; one sleeps in a bed and has a coffee in the coffee shop, watches a movie in a cinema and eats in a restaurant. Yes there are many kinds of beds, of coffee shops, of cinemas and of restaurants. Still we can always identify features and inter-relations which are strictly related to their basic function (Alexander 1979). These features and the relationship between the basic elements which compose space are what make places what they are.

Like the events that fulfil a human life or an urban space, there are just a few elements from which places are made. Buildings are made of walls, floors, roofs and openings. Streets and squares are made of facades, floors, openings, eventually the green of some vegetation and the sky. It is from the way and the process that these ingredients are put together that the quality of the space emerges. In other words, the quality of the urban building environment is related to three key factors:

a) The relationships between its basic elements that compose space. This factor relates to the quality of architecture and urban design.
b) The process by which the building environment emerges. This factor relates to the notion of natural and artificial city and the way they emerge.[11]
c) The nature and aesthetics of the elements used to create space. This can vary according to culture, values, functional needs, taste, etc.

The nature or the elements of our building environment are related to a context. In other words, both events and space are contextual, and together they form patterns which are unique;

"... so, when we see a side walk in Bombay is used by people sleeping or for car parking... and that in New York it is used only for walking – we cannot interpret this correctly as a single sidewalk pattern."

(Alexander, 1977: 73)

The pattern of events and space in Bombay is different from the pattern in New York. Both the spaces and the events they host are completely different. In this way, events and space are connected and cannot be separated from the place where they occur. They are the mirror of a culture and a society. The character of interventions of space as well as the events which emerge from a given space differs from context to context and from culture to culture.

As Alexander says, saying that an event happened within a space is obvious and not very insightful. The interesting thing is to understand the relation between the two. It is to find out how we can change events by changing the morphology or character of the space and vice-versa. Above all, the interesting thing is to understand in what way that relates to human life and life in the city. If we master the relationship between events, space and quality of urban life, strategic interventions in our building environment can reshape the way we use buildings, streets and squares and therefore reshape the way we use the city. The relevance of the arguments made until now is the acknowledgment that we can influence the character and the development of a social complex system by manipulating events, the building environment or the relation between the two. Interventions of space can be used to trigger new events and therefore to improve human quality of life in the urban space.

The understanding of the complex relations between space and events, between people and events and between people and space is of key importance for the design of *Strategic Intervention*; interventions which are applied strategically in an part of an urban system and have the capacity to improve the system as a whole.[12]

How can Alexander's patterns inform Intervention management? Patterns as the basic elements of the system

Alexander (1977) defines the quality of a building, a square or a town, by analysing what he calls patterns of space and its patterns of events. Alexander's patterns of space and patterns of events are the raw material with which we make a place. In other words, they are the basic elements which compose a complex social and urban system. According to Alexander) patterns of space and patterns of events are intertwined. Together they are what gives unique character to places and defines how we live in the city. In other words, patterns of space and of events are interrelated with human life itself and the way we perceive the world around us, therefore, any alteration in one of these patterns alters the character and human life as a whole (Wilson, 2011).

"These patterns of events are always interlocked with certain geometric patterns in the space. Indeed, as we shall see, each building and each town is ultimately made about of these patterns in the space, and out of nothing else: they are the atoms and the molecules from which a building and a town is made."

(Alexander, 1979)

Alexander describes these features as the design form which emerges as a natural reaction to a problem in the urban environment or a natural human behaviour or need. One of the multiple examples given in the book is *arcades*. Arcades are seen as such key features because they connect buildings, protect people from the environment and can make a place more beautiful.

"*The elements of this language are entities called patterns. Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever ding it the same way twice*." (Alexander, 1977)

A relevant point of Alexander's description of these features is the fact that they are sufficiently specific to induce a certain quality of performance to space and open enough to be materialised in a different way every time they are used. These patterns are described in a way that they can promote interaction and diversity and therefore they can improve quality of life.

Alexander's patterns can be useful to both empower individuals to intervene in the urban form more appropriately and give designers an emergent perspective of design.

Alexander's patterns can be used as a base to dissolve decision making by giving people the tools to build their environment with a certain functional quality. From the perspective of evolutionary theory, empowering people to actively adapt the environment according to their needs would mean trusting the quality of the natural city to serve the quality of life of its inhabitants. It would mean the nurturing of continuous change and the creation of variation. The city would emerge as a process and a direct consequence of people's aims and needs and would therefore give people a sense of belonging. As Marshall (2009) argues, Alexander's patterns, or architectural elements, could be used as bottom-up building blocks and be implemented as part of a more general system. In other words, Alexander's work can provide guidance for a standard quality of every-day bottom-up interventions still nurturing their diversity.

On the other hand, the work of Alexander can also be used as a tool to support top-down interventions. He gives policy makers and designers the tools to influence events and urban life by intervening or manipulating the building environment and vice-versa. In other words, when we know the relationship between the elements of space and the way they are related to the event that occurs in that space, we know which physical elements to change in order to influence change in human behaviour.

> *"For the pattern in the space is, precisely, the precondition, the requirement, which allows the pattern of events to happen. In this sense, it plays a fundamental role in mankind sure that just this pattern of events keeps on repeating over and over again, throughout the space, and that it is therefore one of the things which gives a certain building, or a certain town, its character."*
>
> (Alexander, 1979); 92)

Following the arguments in chapters 2 and 3 this thesis argues that top-down interventions should be used to nurture what Marshall calls the evolutionary tree (Marshall, 2009: 276, 281). In other words, top-down interventions should be used to assist and direct the natural evolutionary path of change. Alexander's work gives us an important insight into the relationship between events, people and space which could help us design and select adequate strategic top-down interventions able to adjust urban development. In addition, Alexander's work could add quality to bottom-up interventions and therefore support a more qualitative emergent urban development.

Acute interventions and chronic interventions

Interventions both natural and artificial can happen in the blink of an eye or take long periods of time for its consequences to be seen.

Natural interventions can be devastating and happen in a very short period of time; a tsunami can destroy a village within minutes. It can also take centuries for the consequences of interventions to be visible to the human eye. The long Scottish winters shape the character of cities such as Aberdeen as well as the character of the people who live in it and the way they live their everyday life. On the one hand, its impact on the granite stones of the city cannot be seen for centuries to come. On the other hand, it defines the place where people meet, what they eat, how they move in the city. Indeed, Scottish winters arguably play a significant part in shaping the urban form and peoples' everyday lives; probably as much of as any other more *acute* intervention.

Artificial interventions can also happen in the blink of an eye or they can happen over longer periods of time. On the one hand the change of a policy, just like the earthquake, can happen within minutes and have immeasurable consequences. On the other hand, changing human preconceptions can prove to be an exhausting and long process. One example of a chronic, long-term, artificial intervention could be teaching people to recycle materials, or to use public transport more. The efforts made to make people aware of their everyday decisions can prove to be a long and exhausting process. Nevertheless, in the long term, might bring tremendous benefits to life on earth.

The time to implement interventions in the building environment is very much related to their size and complexity. Human interventions in the building environment might take minutes, hours, days, months or years to implement. It goes without saying that it takes longer to build a housing block then it takes to build a street bench. An entire neighbourhood might take decades to build. During the time of its construction it will influence urban life in ways that might not be desirable. The time Union Street took to be built is an example of how devastating chronic or long-term human interventions might be for the city.

A fast artificial intervention can almost be seen as *Urban Acupuncture*, a term coined by Lerner (2012), which he described as fast and accurate interventions that can be used as a strategy to nudge change in the city as a whole. Jaime Lerner, besides being an architect and urban planner by profession was the leader of Curitiba for many years. He was the brains behind some very interesting interventions which made Curitiba an example for many cities. In his book *Acumpultura Urbana*, he explains why some interventions in Curitiba had to be made very quickly. According to him, sometimes people have to see the intervention already completed to understand the way it improves the area. To illustrate how efficient *urban acupuncture* can be, Lerner gave the example of the implantation of a pedestrian area in Curitiba as well as the Opera House which took 60 days to build. Such kind of interventions would normally take longer to implement. It is normal to take up to a year to build a building, but the issue of time was a key ingredient for the success of these interventions; therefore extra efforts were incurred to speed up the process of construction. In other words, Lerner gave the example of relatively complex and normally long interventions to implement, whose success depended on how fast they could be materialised. Still, not all *urban acupuncture* interventions have to be complex and elaborate; one does not need 60 days to put a traffic light in a problematic crossing or a lamp in a shabby street.

As evolution and complexity sciences tell us, we never know if positive or negative consequences emerge from an intervention, but fast, small or even temporary interventions can help us to test urban tendencies before committing to more permanent decisions. According to Lerner, if the intervention addresses an emergent urban need it has a good chance of working. He suggests fast interventions to test possible dynamics of the city before introducing more permanent buildings. He suggests raising temporary structures in the empty spaces of the street, able to shelter informal encounters or any function one might think is needed. If people actually start inhabiting these temporary structures, they can be replaced by buildings or more permanent constructions. The time of implementation is always an issue. We have to keep in mind, that if a certain dynamic is disturbed it can die. If we take too long to replace a meeting corner, people might just start to meet somewhere else. With this we aim to say that the success of an intentional artificial intervention is very much related to the relationship between the kind of intervention and the time it takes to be implemented.

Strategic Interventions

Short-term actions with long-term intentions

All interventions influence the future development of a system, but not all interventions do that intentionally. Strategic interventions are actions which aim to induce change in an urban, social system. They are actions implemented in the present which aim to influence the path of urban development.

As we have seen in chapter 3 in the context of design and artificial sellection[13], we can perceive evolution from the perspective of continuous process of accumulation of *short-term changes* and form a *long-term change* perspective. This distinction enables us to:

a) Relate *short-term change* with theories of emergence and with design and artificial selection. This perspective allows integrating design in the evolutionary process as a short-term cultural reproduction process. In addition, *short-term change* is very much determined by interventions some of which are human actions. As we have seen the reaction of complex systems to short-term changes is to a great extent unpredictable.

b) Relate the *long term change* with the idea of evolution that we normally have; the slow, gradual and continuous process of change which tends to be quite predictable.

The long term change emerges from the process of the relationship between short-term actions and emergent social and urban reactions over long periods of time. Long-term change is related to a vision for the future. It is related to what we want for us as a species and for our cities. Such a vision can become the intention behind strategic human actions which aim to intentionally nudge development in a specific direction. As we have seen in chapter 3 a vision for the future is relevant because it gives a sense to human actions and to the decisions we make for our communities. It justifies our interventions and gives a sense of directions for urban and social development. In addition, a clear intention gives people an idea that they are working together for a common good. These are key features to ensure human cooperation and an efficient way to guide change in a sustainable direction. The visions we have for our cities is similar to what Bortoft (2010) calls the *active absence* to define the idea of *authentic whole*. A vision is what gives meaning to human actions; it is like the subject of a book which justifies the sense and position of every word in it. With the particularity that the evolutionary book has no end and the story goes on and changes continuously in time. A vision is "*no thing*" among "*things*" but it is active; it is the engine that gives directions and sense to change and to our interventions in the environment. It is what connects the whole and the parts and the before the now and the after.

In light of this, strategic interventions can be seen as short-term, materialised parts of the whole and the vision of the whole itself. The whole shapes and justifies the parts; it gives them a meaning, a sense and a position in the context of the city as a whole, both in time and space. The vision can be translated into words and these words can be translated into guidelines to support strategic interventions. They can be translated in the kind of norms authors like Wilson (2011), Ostrom (1990) and Loorbach (2007)[14] suggests as guidance for change; a guidance for the design and selection of human actions and as the grounds from which cooperation can emerge.

Most probably, long-term visions will change in time and will consequently influence the intermediate steps we make. The process of urban change is dynamic and we as humans form part of it. Our ideas; the meaning we give to ourselves and the world around us changes and adapts to new circumstances. Humans evolve with their ideas and their environment and hopefully become more aware of the human condition on the planet (Beck and Cowen, 2006).

Intentionality and the common good

As we have seen, a vision is related to the intentions from which human actions emerge. In this thesis, *Intentionality* is not only related to a time frame or a vision for the future but it also has to do with the complexity of the urban system as a whole. In other words, all actions imply an intention. We walk with the intention to move from one place to another, we eat to satisfy our hunger, we talk to convey an idea. In the context of this thesis we define *intentional intervention* as those which have a greater perspective in mind rather than the immediate satisfaction of a personal aim or need. Strategic and intentional interventions normally aim not only for long-term changes, but they also take into consideration the bigger picture; the urban system as a whole (Loorbach, 2007). Intentional interventions might aim to change the dynamics of a system or the higher levels of social organisation.

Complexity theory tells us that everyone intervenes in the city and everyone influences the city's development. Still, some interventions are more intentional to produce change than others. As we have seen in the previous chapters, bottom-up interventions which are the basis for city development are normally focused on the self. They have no intention to trigger a greater change. Bottom-up interventions can be intentional when the civil society (individuals or groups of individuals) self-organize to achieve a certain goal or to defend a certain cause. These emergent, organizations might have an immense impact in defining a strategy for the urban development. Friedmann (2011) calls these bottom-up interventions *Insurgencies* which emerge from an awareness of the common good.[15]

The protagonists of top-down interventions may or may not have a long-term vision when acting on the city. Decision makers or private and public organisations can intervene in the city either having the wellbeing of a community in mind or be focused on their immediate and private profit.[16] Nevertheless, bottom-down interventions are normally focused on the self (which is fine due to their small scale) but top-down interventions should be focused on the common good. After all, that is the essence of politics and governance.

The attention to the common good and awareness of the system as a whole is of particular relevance when applying large scale interventions in the city. It is the responsibility of public organisations such as governmental organisations to have an overview of the whole and act intentionally on the city to improve it. Unfortunately, this is not always the case, top-down interventions are too often short-sighted and focused on temporary solutions; they normally are focused on the effects of the problems rather than on the problems themselves. They focus on short-term solutions and more concise actions (Ehrenfeld, 2008).

Table 1defines intentional and unintentional interventions originated both from the top-down and the bottom-up.

Top-down Interventions	Unintentional: - Short-term, quick fix solutions: actions like injecting money in bankrupt banks or building cars which pollute the environment less (Ehrenfeld, 2008). - Interventions aimed towards the good of a few rather that the good of a community. These kinds of interventions are normally a product of corruption or a consequence of the forces of power.
	Intentional: - Interventions focused on long-term changes and on the source or essence of the problems: actions such as implementing an ecological network of public transportation and restricting the use of the car. - Interventions focus on the good of the community. Such interventions emerge from the needs of individuals, or groups of individuals, in relation to each other and to the environment. Their focus is on the good of the community.[17 and 18] **Strategic Interventions: The focus of this research case studies**
Bottom-up Interventions	Unintentional: Everyday life actions and decisions. Such kinds of interventions refer to decisions regarding the place one works, or lives, the place where one goes shopping or has fun.
	Intentional: Such kind of interventions can be called *Insurgencies*. They refer to actions which emerge from one individual or a small group of individuals which aim for long-term changes in higher scales of social organisation. Insurgent interventions can be things like a protest, the occupation of a building, a statement written on a wall, a flyer placed in an urban public place... [19]

Table 1: Relation between the intentionality of an intervention and its origin.

Top-down, bottom-up and strategic interventions

The characterization of bottom-up and top-down interventions emerge from a definition of the natural/emergent city and the artificial/planned one explored in chapter 2. Contrary to the text in chapter 2 we now focus on *interventions* rather than on the *city*.

Bottom-up interventions

Bottom-up interventions emerge generally from human daily activity and everyday-life. They are a product of a bottom-up planning process (Portugali, 2012). As argued in the previous chapters, even if there are exceptions, bottom-up interventions are characterised by being of a smaller scale and focused on the needs of the self. It is due to these characteristics that one can argue that the natural or emergent kind of city evolves slower and is normally more predictable. Bottom-up interventions emerge by adding something slightly different than previous models to the urban fabric. These, normally small scale interventions will merge with the city form and will be the basis for future urban interventions. Due to the normally small scale of bottom-up interventions it is not extremely relevant that bottom -up agents have a greater vision in mind when intervening in the city. A small house will soon be seen in combination with other houses and perceived as a whole (Marshall, 2009). In the long term, we can perceive this accumulation of small changes as *urban evolution* but in the short term, like all other human actions, they can be perceived as small changes to make something fit to a specific context or need.

We have argued previously that emergent bottom-up interventions generates a normally more resilient and more human friendly city (Alexander, 1966; Jacobs, 1970). But, it can also generate spaces of segregation and crime (Batty, 2005). It can also generate problems like urban sprawl (Marshall, 2009).

Top-Down interventions

Top-Down interventions, on the other hand, are related to organised groups of people with more or less social, political or/and economical power. They can be governments, private companies, NGOs. Top-down interventions are a product of a top-down planning process (Portugali, 2012).

According to organisational theory, organisations are of key importance to establish the direction and speed of development of the city (Lane, Maxfield, et al., 2009). Organizations, regardless of whether they are private or public, normally engage with larger interventions in the city. Therefore top-down interventions are normally a consequence of larger scale management strategies which intentionally aim to change themselves – as an institution or organisation - or their surroundings. Furthermore, urban interventions made by organisations are normally engaged with global forces; they can reflect consideration about the macro social, political and economical aspects of society; they can take into consideration the relationship between cities, as well as between the city and the country or even the world. Top-down management has the power to make things happen quicker and can intentionally establish desirable paths of growth.

Due to the scale of top-down interventions, they are normally more invasive; as we have seen previously they tend to break the continuity of the urban evolutionary path and therefore are normally more risky. Due to the scale and possible impact of top-down interventions, it is very relevant that top-down agents, such as organisations and as decision makers, have the bigger picture of the system in mind.

It is not only decision-makers and organisations which intervene in the city on a bigger scale who should have a holistic perspective of the city in mind, architects, engineers and designers as the creators of such interventions should also have such view of the context in order to be able to design appropriate interventions of all scales.

Architecture and urban design is very much related to public governance; therefore they are of key relevance for this research. Architects, engineers and designers even have an added responsibility in the making of the city. They can intentionally shape their interventions to induce overall change in the system regardless of the scale of the design and regardless of whether the design is to serve one individual or a group. Whether if it is a private house, a garden bench, a public building or a neighbourhood, all designs can be materialised with the intention to influence a *bigger picture* of the city. Designers and designs cross all hierarchical levels of social and political organisation and they have the power to influence the system as a whole regardless of their position. This leads us to one of the questions study 3 (chapter 6) aimed to address. *To what extent do architects have or should have a holistic perspective of the social and urban environment where they intervene?*[20]

Strategic intervention

We suggest that *Strategic intervention* can be either originated from the bottom-up or the top-down. Nevertheless, it is the responsibility of the top-down to have an overview of society and to manage urban change adequately. Strategic interventions embrace characteristics of both top-down and bottom-up kinds of action:

- They should be contextual, even if the conceptualisation of the problem in relation to the tools available to act on it can be considered from an abstract perspective.
- They should emerge from an awareness of the complexity of the place; therefore they should aim to disturb it as little as possible. In light of this we argue that strategic interventions should be preferably of a small scale.

- They should be an expression of the common good. The intention behind them should be nudging urban change towards a sustainable path.
- They should be applied to speed up or to change the path of development. Their intention is to break continuity when things are not going in the right direction.

General characteristics of bottom-up, top-down and strategic interventions		
Bottom-up	Top-down	**Strategic**
- Contextual and unique - Small scale - Focus on the good of the self. - Establish a continuous process of change. Normally such a process is slow.	- Standard or general - Bigger scale - Focus of the good of the whole. - Accelerates the process of development or changes its path. It can bring discontinuity.	- Act on the general basic elements from which a society emerges. Nevertheless, adjusts them and applies them according to the uniqueness of each context. - Give preference to small scale actions. - Focus of the good of the whole. - Accelerates the process of development or changes its path. It can bring discontinuity.

Table 2: Summary of the general characteristics of bottom-up, top-down and strategic interventions

Interventions as a product of the tension of top-down and bottom-up forces

The evolution of the city as a whole emerges from both bottom-up interventions - what we call natural evolution - and the top-down, planned ones. The evolution of the city is a consequence of the interaction of individual and collective actors and of those with the environment. In other words, urban interventions emerge from the interaction between the city's everyday life and the visions and aims of public and private organisations. On the one hand, to build a single house or to plant a tree, a single individual normally needs the approval of an institution. On the other hand, top-down actions can be blocked or reshaped by bottom-up arguments and pressures.[19]

Depending on the context the influence of one and the other change and that will influence the shape, organisation and character of urban settlements. In addition, it will influence the kind of urban life people experience (Lefebvre, 1991; Marcuse, 2009). In places such as Singapore, for example, top-down public forces have much more power over urban management than in a European democratic city, where civil society has a greater role to play.

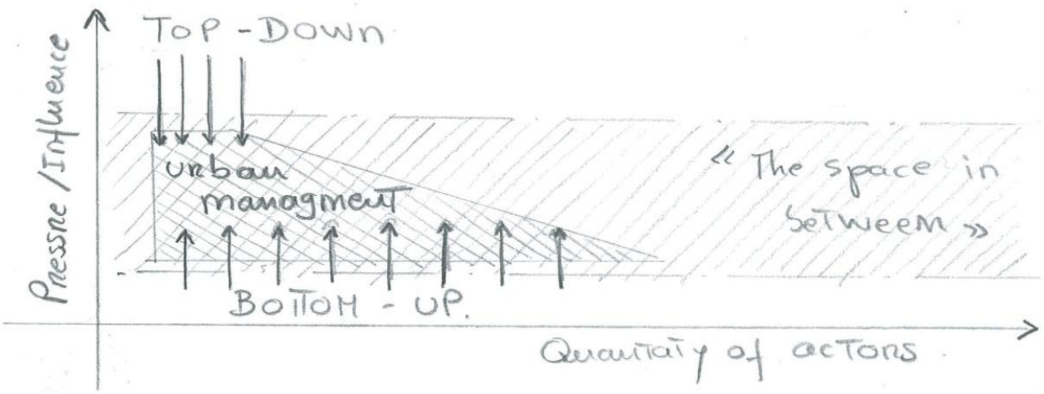

Figure 9: Interventions as a result of the tension between top-down and bottom-up forces. Adaptation of a diagram used by Terry G. McGee in ARI Singapore (2013) to illustrate the place from where human actions emerge.

Figure 9 illustrates the place of tension from which human interventions emerge; the space between the emergent bottom-up forces of the city and the top-down ones.[21] McGee (1971) calls this space in between forces *The grey zone*.

Arguably, this diagram can be used to illustrate the influence each participant has in the creation and implementation of a given intervention. It can be used to analyse the number of protagonists involved in the selection and design process of an intervention and to estimate their role and degree of influence in that process. Depending on the context participants change in numbers and in degrees of influence; therefore, this diagram is to be used contextually. We suggest that such a diagram can be extremely relevant to contextualise management systems in relation to a specific cultural and political environment.[22] Such contextualisation can have implications in the selection and design of both strategies and interventions to apply in an urban system. In other words, a diagram such as McGee's could help to shed light on the origin and dynamic of forces one intervention would have to endure in order to be implemented. Such knowledge could help to design and select more appropriate interventions able to guide urban development to a sustainable path.

McGee's diagram is just an indication of a possible framework to place interventions in terms of their position across the different organisational levels of an urban and social system. Nevertheless, the relevance of this text is to emphasise the idea that most urban interventions are a product of the tensions between top-down and bottom-up forces. They are not just a product of one or the other. Still, they emerge either from the top-down or the bottom-up and they are shaped by the negotiations between the two. The spatial order of the city is a result of the ongoing relationships between private and public agendas and between various plans with each other, and the built environment. In addition, each of these plans (such as master-plans or zoning plans) emerges as the result of negotiations between a variety of actors. In other words, not only is the city a complex system impossible to control and predict, the process of building the urban form is extremely complex as well. According to

Portugali (2004; 2008; 2012) this is the reason why, the aim of urban planning to regulate or make order out of what occurs in the city is doomed to fail.

In this part of the text we explored key characteristics of strategic interventions, namely their intentionality, their relationship with the common good and their protagonists. We have also contextualized the role of *design* and the designer in the setting of strategic interventions. In the next section of this chapter we will focus on strategic interventions on the building environment.

In other words, this research will concentrate on interventions in the building environment which emerge from the intention to improve the overall good of the urban system and are focused on long-term changes. Making such interventions is normally the responsibility of decision makers or public organisations and they are normally a product of the work planners and architects.

Categorisation of *Strategic Interventions* in the built environment

We consider the building environment only one of four areas of society where one can intervene intentionally to nudge urban and social change. The other areas are: culture and religion, politics and economy and communication and transport networks.[23] As with the urban environment, we consider these aspects of society as the grounds where interventions can be strategically placed to serve as catalysts for change. They are relevant because:

a) They play a key role in shaping social behaviour and organization; they define the city and its development.
b) They are deeply interrelated; therefore an intervention in one of these areas has the potential to influence the others as well as the city as a whole.
c) They can be considered as areas where people act on the city.

Isolated interventions or in a system

Complex systems are composed of subsystems which relate to each other in complex ways (Batty, 1994; Portugali, 1997). In other words, the structure of a complex system is the arrangement of its subsystems and components at a given moment in time. It is a common characteristic of both the subsystems of a complex system and their inner-relation to change over time. The system may remain relatively fixed for a long period of time or it may change from one moment to another. This depends upon the characteristics of the process in the system and on the reactions from the environment (Portugali, 2003).

In other words, human life self-organises around basic elements of the urban environment which are normally interconnected. The system of elements of the building environment around which urban life emerges mirrors the needs of people's everyday lives. These elements are what we previously addressed as interventions of space or the basic elements of the urban syntax[24]; they are the street, the square, the bus stop, the restaurants, the coffee shop, the newspaper stand.... When these interventions are taken into consideration independently they are normally so small that they are imperceptible in relation to the whole of the city, but when they are addressed as a system they tend to gain significance. One single person catching a bus to go to work probably doesn't make so much difference to the city, but when many people take the bus approximately at the same time to go approximately to the same place this event starts to gain significance for the city and consequently for its management.

One can alter urban life by intervening in one of the parts of the system independently, such as the bus-stop, the bus-route or the square or we can intervene in the system as a whole and on the connections between its parts. When we alter the shape or the position of the bus stop, when we change the route of the bus or when we add some green space and benches to the coffee shop's square, we are altering peoples everyday life experience as a whole. This way of understanding the city and intervening in it is characteristic of an emergent approach (Portugali and Alfasi, 2007; Marshall, 2012; Portugali, 2012).

In opposition to the emergent approach, the creationist way of intervening in the city is more proactive and as we have seen before it does not always take into consideration the established emergent systems (Jacobs, 1961; Alexander, 1966; Portugali, 2004).

Strategic interventions can either be an isolated action or various actions organised in a system, but they are always emergent; they always take into consideration an overview of the urban system as well as of the emergent complex subsystems of events and space with which they will interfere.

A system of strategic interventions is composed of several interventions which are combined to serve a common purpose. These interventions can either be of the same kind, such as several buildings placed in strategic places in the city, or of different kinds and applied in different areas of the urban system.

One single strategic intervention can have a more dramatic impact than small emergent actions. We don't build a school or a neighbourhood every day as we don't redesign our squares and streets on a daily basis. We don't change our legislation system or our transport network every day. These are interventions that change things forever and they happen occasionally. Therefore one should see them as opportunities to improve the urban system as a whole. As strategic interventions the place, function and form of such kinds of intervention would still emerge from an analysis of an interconnected systems of place and of events.

As with any other intervention strategy, top-down interventions, such as one building or a new legal policy can be isolated or form part of a system of interventions which work together to achieve a certain target. Nevertheless, it is important to keep in mind that top-down interventions have a strategic role to reset the path of urban change and speed it up. This is because they are focused on the common good and the overall system and because they are normally a product of human cooperation and design.

Isolated intervention	**Interventions in a system**
	
Figure 10: The city garden project: An example of one rather large top-down intervention in the building environment. The project suggests a three-dimensional network of pathways linking several interconnected areas for leisure activity. This project aimed to explore new ideas on how to improve Aberdeen's city centre and more specifically the Union Terrace Gardens.	Figure 11: The Micro Project System (MIS). An example of a system of top-down micro-intervention in the building environment. These interventions were designed to be applied in and around the Union Terrace Gardens in Aberdeen. All interventions were designed to improve the city centre independently but they would reach their full potential when applied as a system. When implemented together they would be optimized and therefore estimated to influence the dynamics of Aberdeen city as whole.

Table 3 relates two kinds of strategic top-down interventions in the building environment: one isolated, large-scale intervention in and a system of small-scale interventions. The first was proposed by the winning project of a public competition. The second was proposed by this research. The potentials and weaknesses of both strategies were tested in studies 1 and 2.

In short, interventions, both emergent and top-down, can happen in isolation or in a system. In both cases, if they are considered strategic interventions, they emerge as direct responses to the needs of the urban system. Strategic interventions emerge from an analysis of the systems of space and of events which they aim to influence. They will be organised and defined in relation to the parts of that system or the connections between them.

In other words, we argue that to intervene efficiently in an urban complex system a certain degree of awareness of the systems as a whole is required as well as the subsystems of events and places related to the intervention. This awareness will define whether it is appropriate to intervene in the system with a single action of with a system of interconnected actions.

Interventions according to the predictability of the system's reaction

We suggest that interventions in the generative elements of social and urban organisations tend to have predictable short-term consequences (Portugali, 2000; Batty, 2005). As we have argued in chapter 3, the generative elements of an urban or social complex system are related to human aims and needs (which are translated in the building environment in the form of interventions of space) and to the urban syntax.[24]

On the one hand, everyday life and everyday needs influence certain human decisions and actions which are quite predictable. We can expect people to try to find a place to live near the place they work. People will probably prefer to send their children to a nursery in the same neighbourhood and they will visit the local supermarket more often than any other one. On the other hand, from the perspective of the urban syntax the relation between its basic elements (streets, plots and building), their position, their size and their shape will determine a predictable urban morphology (Stedman, 2006; Marshall, 2009). These assumptions are the basis for all cellular automata predictions which are definitely something to take into consideration as a tool to guide urban design and urban management.[26]

The kinds of houses which will emerge near a highway are different from the houses that will emerge near a pedestrian street in the city centre. Not only will the plots be different in size but also in character. People will choose in which environment they will live according to how much they can afford to pay for a house, if they have a car or use the public transport if they have children or not and so on. With this we aim to say that some short-term reactions of the system to interventions made on the generative elements of the city are predictable even before the intervention is implemented. This predictability is connected to a deep understanding of the codes from which a city emerges. Consequently, we argue that, the generative elements of the system can be used as strategic interventions focused on short-term changes because they offer a certain degree of predictability.

Nevertheless, complexity sciences also tell us that any complex system is considered to be non-linear and therefore in the long term they are highly unpredictable. Interventions have the capacity to change the system as well as the generative elements which originated them in the first place. For example, the use of the “car”: The human need for fast mobility resulted in the increased use of the car. That change in human behaviour influenced the way we designed our cities: We built great highways, we cut our medieval neighbourhoods to make way for new roads[27] and we divided our cities into functional areas (Abercrombie, 1933; Gibberd, 1967) and we built vast car parks around suburban shopping malls and leisure centres. In summary, we shaped our cities around the use of the car to such an extent that they were more “car friendly” than “human friendly”, not to mention the ecological concerns related to that. These consequences or reactions to the increased use of the car shaped the way we look at the quality of life in the city and at urban planning today. Today planners promote mixed-function places; they promote walkable distances and pedestrian streets. Urban policies discourage the use of private transport and promote its public counterpart (Katz, 1994).

In short, complexity sciences show us on the one hand how the acknowledgement of self-similar aspects of a complex system tends to trigger predictable short-term reactions from the system. This characteristic of non-linearity of complex systems relates to the consequences of all kinds of interventions regardless of their scale: a garden, a new school or even a bench and a tree, can deeply change the dynamics of an urban area and redefine it completely. It can even change the character of the city habitants (Wilson, 2011). On the other hand, complexity sciences also show us how and why in the long term the system is highly unpredictable.

General or Contextual

General interventions as conceptualisations of action/ strategic interventions as unique and contextual

We consider two kinds of basic elements of a building environment which can be used to manipulate urban change. The first relates to human daily life and needs.[28] The representation of those in the urban morphology was translated in patterns of space by Alexander. These patterns were the ones defining this research’s interventions of space. The second are the basic elements of the city syntax suggested by Marshall.[29]

Both the elements of the space syntax and Alexander’s patterns are standardised elements, shapes and measures. They are algorithmic and are almost abstract formulas which are repeated over and over again in most of the urban settlements in the world. They are based on numbers, geometry and conventions. Elements such as these that we can generalise are of key importance to understand the city from a self-organising perspective and help us to draw predictions about possible urban development but they do not help us to explain the reason why every city is unique even if all cities are made of the same things.

On the one hand, human basic needs and the basic bricks of urban morphology are present in all urban forms and cross all urban scales; All humans need a shelter, all of us need to earn a living and all of us need clean air and water. Besides that all cities are made of roads, plots and buildings. Consequently, one could say that what is predictable is also generalizable to all urban forms.

On the other hand, human actions and human perceptions are not only based on general abstract elements as the ones which compose the city syntax. [30] Nor do basic human needs such as the need for work or the need for a shelter determine all our actions and the way we do things.As we have seen before, human actions and human perception of the world is an expression of human subjectivity; they are a mirror of human culture and of different world views. As we have seen in chapter 3, human actions emerge from a specific adaptation to a specific environment; therefore they are contextual and unique.[31]

In light of this fact there is a limitation to how much we can generalise interventions. Human actions are deeply connected with the individual or group of individuals who imagine and materialise them and to a specific socio-cultural and economical context. Strategic interventions can even be related to the standard components of the city but they should both emerge and be shaped by the context of where they are to be implemented. In other words, if a given intervention is a reaction to a specific need , shaped and implemented according to contextual world views, it will most probably be materialised in an unique way, regardless of how general the considerations behind it might be (Ramírez, 2000; Hansell, 2007).

In short, even if every city emerges from the same basic elements, each city is unique. Each city has its own internal rules and has a unique character. Human strategic interventions might on the one hand be a consequence of the basic standard elements that compose a city, such as the urban syntax and human everyday needs. Nevertheless, on the other hand they should be shaped by their specific context; they should be shaped by the human condition in a place and our unique ways to perceive the world around us. In other words, general aspects of the city such as the elements of the urban syntax are to a certain extent abstract conceptualisations and therefore they are generalizable. Nevertheless, when the time comes to act on the city these elements should be shaped by the context's needs and character. Strategic interventions are therefore contextual; they related to a time, a specific place. They are unique expressions of the people who composed them. The way we as humans choose to build a tower, the way we decorate a street or our front door, the way we design and use our buildings, our squares and our markets, the place where we choose to place a tree or a fountain… these choices and actions are related to who we are as humans and are a consequence of specific cultures and world views. Those choices are contextual; they are a consequence of a specific way to perceive the things around us. They are a consequence of a direct relationship between man and environment.

Hierarchies of interventions

In the previous section we have described systems of events and systems of places as two kinds of urban subsystems. But urban subsystems can also be described in terms of scale rather than in terms of their kind. In these sections we will relate the scale of the subsystems which compose a city with the scale of urban interventions. To do this we will use the notion of nested hierarchies introduced in chapter 3 - the idea that each part of the system is composed by lower level identical systems and at the same time is part of the higher level system.

In chapter 3 we used the work of Miller and Portugali, among other authors, to understand the urban structure and organisation. Based on the conclusions taken from the literature review we consider a city as a subsystem which is made up of other smaller subsystems and at the same time is part of a bigger system. In addition, we used these conclusions to suggest an alternative form of urban planning. The work of Portugali is important because it relates urban organisation with complexity theory. The work of Miller is relevant because it relates biology and consequently evolutionary theory with human organizations such as cities. Nevertheless, we decided to use the work of Alexander to define and categorise human actions. Alexander's work is relevant because it relates human organisations with design and human actions. In addition, Alexander's work enables to use nested hierarchies to categorise by scale interventions of space and events. This will enable us to have a direct relationship between the different hierarchies of urban organisation with different scales of interventions (Salingaros, 2000; 2005).

As we have seen previously in this chapter, Alexander defines the basic elements of all complex systems as patterns. On the one hand, he uses the relationship between patterns of space and of events to establish the link between the urban environment and human activity. On the other hand, he uses patterns to describe problems which continue to happen in the urban environment. In addition, he describes how these patterns can become solutions or urban interventions in the building environment. These patterns are described in a way that they are specific enough to address the problem and general enough to be adaptable to each circumstance and shaped accordingly. We do not aim to say that Alexander's patterns are the solution to all problems in the building environment nor that the needs required in specific contexts should prevail and define the final form of the intervention. What we aim to say is that Alexander's patterns can be used as a framework to help us to:

- Identify what could be used as strategic interventions in the building environment.
- Give a hierarchy and a structure to these interventions.
- Establish the relationship between a problem and a possible intervention to address it.

Alexander organised these patterns hierarchically so that they can be used as a language. In other words, he used the concept of nested hierarchies to give these patterns a structure as well as a position and a role in relation to one another as well as in relation to the whole.

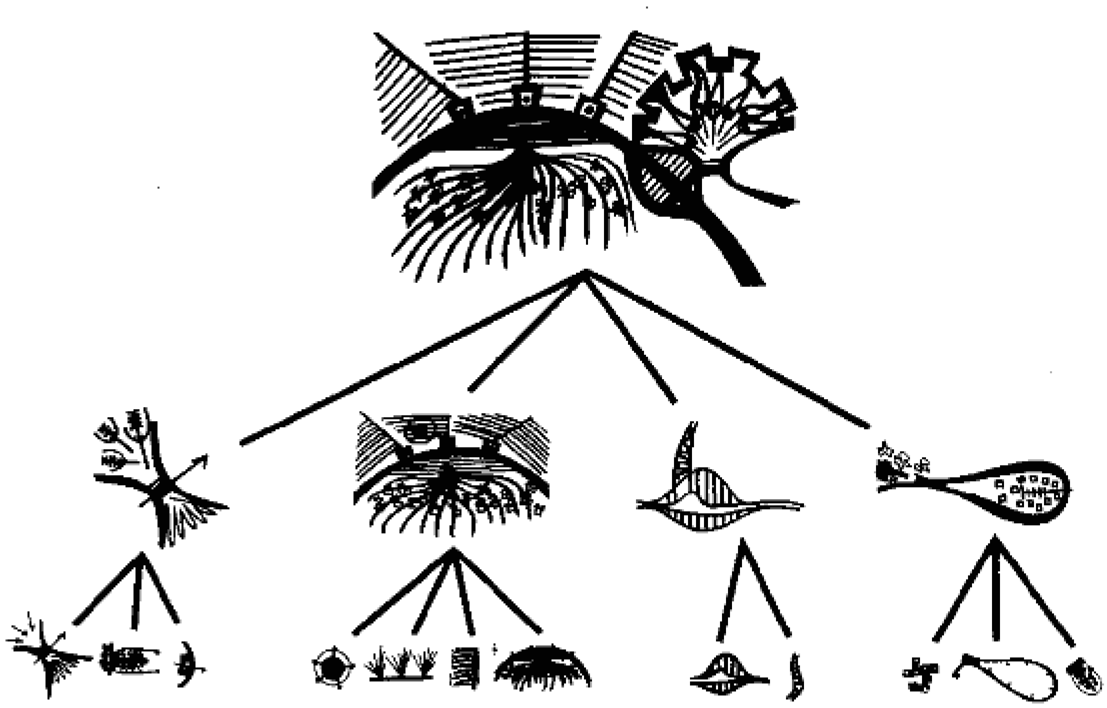

Figure 12: Alexander’s conceptualisation of the components of form (Alexander, 1964: 153).

This structure enables them to be combined in multiple ways and be adapted to all contexts and needs. Alexander’s patterns are just like words; they can be combined in endless ways and express the complexity of human and urban nature. When we consider these patterns as possible interventions and we understand their complex relations within and across hierarchies we can use them to manipulate urban and social change. In a written text this would be like changing a verb to change the meaning of a sentence.

In short, we decided to use Alexander’s work to categorise interventions according to their scale because:

- Alexander relates complex systems according to the idea of nested hierarchies. Just like Miller did when describing the city from a biologic perspective.
  “*In short, no pattern is an isolated entity. Each pattern can exist in the world, only to the extent that is supported by other patterns: the larger patterns in which it is*

embedded, the patterns of the same size that surround it, and the smaller patterns which are imbedded in it. This is a fundamental view of the world."

(Alexander, 1977: xiii)

- Alexander calls the basic elements which compose complex systems patterns. According to him these patterns can be seen as possible tools to intervene in the building environment. In light of this analogy it seems logical to use Alexander's categorisation of patterns to categorise interventions according to their scale.
- Alexander is a key author for this research and his work was previously used to support arguments and define relevant concepts in this research.[32]
- As an architect, Alexander defines hierarchies of patterns from the perspective of the building environment, which is the focus of our studies.
- The set of systems on which Alexander focused his work is more related to the focus of this research than Miller's set. Alexander focused on the study of urban and social systems; therefore the basic element of the system is the individual rather than atoms or cells.

Like Alexander, this research's focus is on social organizations and their building environment. We see the world as being composed of continents, continents are made up of countries, countries have regions, regions have cities, cities have neighbourhoods, neighbourhoods have places and places have objects and urban furniture. From the human perspective such hierarchical organisation can organise the world population in groups and subgroups to the scale of the individual.

If we follow this hierarchical organisation we can categorise interventions according to their scale just like Alexander did with patterns (Alexander, 1977). Interventions of space range from the very large such as regions and towns, down to neighbourhoods, clusters of buildings, buildings, rooms and finally construction solutions. Alexander organises patterns in this linear way to enable the reader to relate the smaller patterns with the bigger ones and to be able to see how one includes and extends the other.

"*A pattern language has the structure of a network. This is explained fully in the Timeless Way of Building. However, when we use the network of a language, we always use it in a sequence, going through the patterns, moving always from the larger pattern to the smaller, always from the ones which create structures, to the ones which then embellish those structures, and then to those which embellish the embellishments...*"

(Alexander, 1977: xviii)

For example, when Alexander describes a global pattern of space such as a forest (pattern 60) he relates it to the scale of the city as a park (pattern 13), to the scale of the neighbourhood as a public garden (pattern 14) and the scale of a house as a private garden – (pattern 59). He zooms in further to define private gardens according to the elements that compose them (pattern 107) such as the garden's walls (pattern 173). Interventions can be organised in the same hierarchical order as patterns. Interventions of space can have the scale of a public bench, a building, a group of buildings, a neighbourhood or a town. Other kinds of interventions can extend to the scale of a region and even the world, such as a change in the constitution or even a television program.

By following such hierarchical organisation of interventions, we are able to relate the scale of an intervention to a hierarchical level of social and urban organisation. In addition, we can explore ways to relate the scale of the interventions with the extent of their influence across all urban hierarchical levels.

Table 4 (appendix 1) is the characterisation of interventions in the building environment according to their size. It assumes the character and structure of Alexander's patterns organised as *Intervention Areas of Focus* (IAF). These *Interventions Areas of Focus* cross all hierarchical levels of society but are materialised differently according to their specific purpose and the intervention scale. They represent the basic elements and relationship between elements which are the source of most human problems as well as the source of their solutions.[33] From the perspective of interventions in the building environment the categorisation made here shows examples of elements or the relationship between elements in which one can intervene to induce a greater change.

The problem with giving examples of interventions is the fact that it makes them less flexible and much more restricted. On the one hand, each of the examples given can be placed under different IAF: a harbour can be either seen as a place to work or as a place of trade. Appropriate interventions are contextual. The way we look at them has to reflect the unique needs and character of the place.

On the other hand, the scale of the interventions is not absolute. In other words, when one thinks at the scale of the world it is easy to consider a building as the unit or the micro-intervention. In light of this even if we can generally give a sense of scale to interventions, the important thing to remember is the hierarchical organisation and the idea that each intervention is part of a higher level system and includes and extends to a lower one.

In addition, the scale of the intervention cannot be addressed exclusively from the perspective of its physical scale. The scale or the impact of an intervention in the building environment relates not only to its size but also to its function and to the spectrum of its potential users. Certain kinds of interventions cross hierarchical levels. The stock exchange building has a global relevance. One hospital might be enough to support the needs of a region. In this case, the building (level 8), will have an influence across other higher levels. In the example of the hospital, one building will satisfy the need for health across the scale of the province, the city, the neighbourhood, a group of people and the individual. In the example of the stock exchange building its influence will extend to the scale of the region, country, continent and world. Buildings have the ability to act as catalyst of urban scale across all levels of social organisation. Furthermore, buildings as well as other scales of urban interventions can also serve as a catalyst for change across scales because of their aesthetics or their experimental or unique character. The pyramids in Egypt, the Eiffel Tower in Paris, the Guggenheim Museum in New York or in Bilbao are just some of the many examples across the world.

We can simplify the hierarchies of interventions in the urban environment as the following:

Categorisation of interventions in the building environment according to their size		
Macro-interventions Interventions from the scale of level 6, 7 and 8. They are related to the fields of <u>urban planning</u> and eventually <u>urban design</u>	Interventions from the scale of level 9 They are related to <u>urban design</u> and <u>architecture</u>	**Micro-interventions** Interventions from the scale of level 10. They are related to <u>architecture</u> and <u>design</u> of furniture and objects.
These scales relate to the design of urban areas from different scales. Macro-interventions imply a creationist approach. Designers plan an area as a whole. In other words the macro-scale of interventions in the urban environment refers to the design of new cities, new neighbourhoods and new urban areas	Level 9 relates to the scale of architecture; to the scale of a building or a bridge. Buildings can still be of different scales and host different functions.	Micro-interventions refer to the basic elements from which a building or a place is made. It can relate to the components or shape of a building, such as a door, a window or an arcade, or elements in the urban environment such as urban furniture, a tree, signs...

Table 5: Categorisation of interventions in the building environment according to their size
<u>Note:</u> All hierarchies of interventions have the potential to influence high levels of social organisation.

The patterns of space suggested by Alexander, can be considered the basic elements around which the urban form normally self-organises (Salingaros, 2000). As we have seen, these patterns cross all levels of urban organisation. The basic elements of the space syntax can be seen as the set of rules which makes the city organise itself spontaneously in a specific and rather predictable way. Elements of space syntax such as buildings, plots and routes are more evident in levels 6, 7 and 8 of urban organisation. The basic elements of the space syntax and the interventions of space are the basic bricks we see as possible tools to be used as strategic interventions in the building environment. They are the raw material to act at the urban level and induce change across all levels of the system.

These ingredients of space are abstract and of general consideration. They should be kept in mind when planning a strategy to intervene in a city or when designing an intervention.[34] Nevertheless, the uniqueness of the context and the purpose of our actions should shape the objects we build in the city.

The relevance of *Micro-Interventions*

The most basic elements or building blocks of a community are each individual who acts on it. From the perspective of the building environment a *unit* can be considered to be an *object*. Nevertheless, the scale of that object or unit is not absolute; it changes according to each intervention and context of focus. Hierarchies of intervention are merely indicative. They should be adapted to each specific urban and socio-cultural reality. In light of this, depending on the context of the intervention, the object can be considered a building (level 9) or even the smaller elements from which the building is made, such as doors, windows, steps, structures... The unit can also be the elements which dress the urban environment, such as urban furniture or a tree, a fountain, a lamp, an information board... These are the ultimate units; the most basic elements we can use as tools to intervene in the building environment. Such elements we call the *micro-interventions*.

Both one man and one object can be considered a micro-intervention. Both one man and one architectural object can change a country or even the world as well as the way we do and perceive things.[35] These units have the capacity to influence the whole not only when they intentionally plan to do so. Emergent small scale interventions that focus on the wellbeing of the self can also have a great impact on the wider community. Nevertheless, a *micro-intervention* becomes a *micro strategic intervention* as soon as the intention behind it is the short and long term good of the whole rather than the good of the self.

We argue that *micro-interventions* are in general more efficient to nudge change than macro ones for three main reasons:

First, they are the basic elements from which systems are made; they are the raw-material from which all hierarchies emerge. Therefore, they have the capacity to influence all aspects of society, not only in their hierarchical level but also across other levels of the system. Using a biological analogy this would mean the manipulation of a cell with the intention to induce change in a whole body. The same would be to transplant an organ to heal a person. In a text it would mean replacing a verb to change the meaning of a message. In the urban environment it would be like changing the furniture in a central square to influence the development and character of a city.

Complexity theory applied to the study of cities also suggests the manipulation of the urban system from the perspective of its basic unites. Batty (1994) supports the use of micro-scale interventions to manipulate the cities' change. In his book *Fractal cities* he refers Simon (1969) to say that *"Systems, when changed, are changed at the level of their cells rather than more globally, and in this sense, contain a degree of spatial resilience which is manifested in the persistence of their form"*.

Second, both evolutionary theory and complexity theory suggest that the city system's development and its health is related to the addition and subtraction of basic elements rather than to abrupt changes.

"The fitness of the system can be damaged when growth is too quick or interventions are made at an inappropriate level" (Batty, et al., 1994).

As we have seen in chapter 3 evolutionary sciences in the study of a city suggest that large-scale interventions are risky due to the immediate impact on the urban and social order of the place. Evolution is a step-by-step process of change. When the step is too great humans require greater efforts to adapt to the environment, and there is no certainty that humans will adapt (Marshall, 2009). In addition, macro interventions imply the use of more resources, which are wasted when the intervention doesn't work as expected.

Alexander (1964) argues that meaningful designs and decisions evolve through the elements which compose the system's hierarchy (Salingaros, 2000; 2005; 2006) In other words, Alexander defends the creation of complex structures which can only be made successfully by generative techniques. This is obvious in biology but still not obvious in planning.[36] Generative methodology has to do with the creation of complex organisations by step-by-step adaptation. It is deeply related to *adaptational complexity*. It would be silly to apply this concept to a design process of a finished object such as a building but many argue that it would make sense to apply such an approach to the design of the urban space.

Third, *micro-interventions* could be used as a strategy to test the ground for eventual larger ones (Lerner, 2012). The use of micro-interventions to nudge change addressed evolutionary theory's suggestions on how to manage change. It avoids disturbing continuity and is still able to define an evolutionary path. Planners, decision makers, designers, and humans in general still have the ability to imagine what the possible long-term future should look like, but are advised to be more sensitive to the fragility and complexity of social and urban systems.

In other words, strategic interventions should be preferably discreet and not restrictive. Their aim should be to unblock healthy emergent development (Marshall, 2009: 277). Strategic interventions should be used to remove barriers so incremental improvements can emerge naturally. This approach towards urban planning offers the ground to explore paths of development and consolidate the preferred ones even further.

Obviously *micro-interventions* alone cannot address all world problems. Depending on the problem and the context, organisations and greater amounts of resources might be needed to create larger scale actions or to implement small actions across larger geographical areas.[37] What is important to retain is the fact that the scale of the intervention is not directly related to the scale of its influence across the different hierarchies of society.

We can look at the scale of interventions from two perspectives:

a) The actual scale of the intervention.

b) The scale of influence of the intervention.

The scale of the intervention used is not related to the level of the hierarchy we want to address. That is to say, the plantation of a tree can influence the use of a square which in turn can influence the life of the neighbourhood or even the city. The notion of nested hierarchies can help us to explore how to use different scales of intervention, to address problems in different hierarchies of social organisation.

	Macro		**Micro**
Relation between scale of interventions and levels of social organisation	<u>Levels of social organisation:</u> Continent: Europe; Country UK <u>Scale of intervention:</u> Interventions from the scale of level 6, 7 and 8. Scale of urban planning and eventually urban design	<u>Levels of social organisation:</u> Region, province, city, neighbourhood <u>Scale of intervention:</u> Interventions from the scale of level 8 and 9 Scale of urban design and architecture	<u>Levels of social organisation:</u> A place: Broomy Hill Railway Site <u>Scale of intervention:</u> Interventions from the scale of level 10. Scale of architecture and design of furniture and objects.
Scale of the intervention			<u>Interventions:</u> The buildings, the routes, the green areas, decorations, fences, the trains, the trees...
Scale of the intervention's influence	*".. Not only has this intervention had a great impact in the tourism and economics of the neighbourhood and near city, but it also influenced the life of train lovers all over Europe."* Participant in study 2		

Table 6: The example of Broomy Hill Railway.[38] Relation between the scale of one intervention and the scale of its influence in a social environment. The example of Broomy Hill Railway was given by one participant in study 2.

In short, the use of strategic micro-interventions to manipulate urban change embraces the fact that the future of a city is unpredictable. On the one hand, they help to consolidate the present rather than to envision great actions and revolutionary ideas for the future. On the other hand, strategic micro-interventions can serve to explore alternative paths of development. The use of micro-interventions to nudge change allows us to deal with the city as a living thing, as an ecosystem in constant mutation. "*... like dealing with something living, but not in the manner of training or pruning a tree: it's more like training or pruning and evolutionary tree, allowing new mutations to evolve and flourish into new lineages*" (Marshall, 2009).

According to Alexander (2006), to survive on earth and continue to build living structures we have to pay more attention to the intrinsic relationship between the parts and the whole, and therefore acknowledge the influence a small intervention can have in the city. This would allow us to nurture the stability given by the continuity of step-by-step urban evolution, which in many aspects offers people a greater quality of life.

Chapter summary

In the first part of this chapter we have characterised interventions in general. In the second part we have defined strategic interventions and in the third part we have focused on strategic interventions in the building environment.

We started by seeing how an intervention emerges as a consequence of previous interventions and will become the cause of new future ones. We have concluded that interventions and emergent reactions are so deeply interlinked that they can be regarded either way. Intentional actions can easily be interpreted as emergent reactions of the system; therefore one might have difficulties in determining which intervention is the cause and which one is the consequence; just like in the tale of the chicken and the egg.

Because of this ambiguity we argued that the definition of interventions as a *cause* or as an *effect* is dependent on the purpose of our study and where we start to analyse urban change. If the aim is to study the future emergent consequences of one action, the intervention should be considered a cause. If the aim is to understand the social, political or economical conditions that lead to a certain event or situation, that event or situation should be considered as an emergent consequence of the system in analyses. This distinction is of key relevance for the analyses and evaluation of our actions and consequently to establish an effective ground for this research's exploratory management system.

Secondly, we have categorised interventions as *natural* and *artificial*. A *natural intervention is* the term used to address interventions which emerge from the natural environment. An *artificial intervention is* the term used to address man-made interventions. In this part of the text we have also explored the ambiguity between the two terms. We have explored how some interventions, such as climate change, can be interpreted either way. We used examples of complex problems which emerge from the complexity of the urban system to relate human actions to the concept of *wicked problems*. The fact that there are no right or wrong solutions to wicked problems and the fact that the solutions for these problems normally generate other unpredictable ones, served as grounds to suggest that any sustainable urban planning system should be a process which evolves side by side with urban emergent change.

After that we have used Alexander's books *The Timeless Way of Building* and *The Pattern Language* as a theoretical background to distinguish *interventions of events* and *interventions of space*. Interventions of events are related to happenings, actions and feelings; they are related to non-material things. Interventions of space are related to the physical space of the city; to the building environment; to the place where events happen. We have explored the ways one defines the other. We suggested that we can manipulate events by manipulating space and vice-versa. In other words, we argued that if we identify the *building blocks* from which a given event emerges, we can manipulate it by intervening in the building environment. This statement supports the research hypothesis and establishes the grounds to explore a framework to relate events with space.

We have ended the first section of this chapter by categorising interventions in relation to the time they take to be implemented or the time they take to manifest themselves. Based on this distinction, we have characterised interventions as *acute* or *chronic*. Acute interventions can be seen as the incisions of Chinese acupuncture therapy. Incisions of this kind are fast and precise and are used as a catalyst to induce change in their direct and indirect environment. Chronic interventions are implemented over longer periods of time. They might be part of a system of interventions applied during different periods of time or they might be one long-term intervention like the systematic effort to change a mentality or a world view.

In the second part of this chapter we have defined *strategic interventions* as short-term actions with long-term intentions. We argued that the intentions of strategic interventions should be focused of the common good and should emerge from a holistic perspective of the system. We argued that strategic interventions can be emergent, such as the insurgent actions described by Friedman (2011). Nevertheless, they are the responsibility of top-down management.

The need for a consistent long-term intention and a pragmatic way to reflect on an urban complex system as a whole were the basis for this thesis' explorations in chapter 5. In other words, the framework used as the research methodology in the data gathering studies emerged from:

- The relevance to relate human actions with long-term changes.
- The relevance to relate human actions with the overall good of the urban system.

The categorisations made in the third part of this chapter can eventually relate to all other kinds of interventions. However, we approached them from the perspective of the building environment.

We started the categorisation of *strategic interventions in the building environment* by making a distinction between *single interventions* and *interventions applied in a system*. On the one hand, a building, a public lamp or a fountain can be used as a catalyst for change. On the other hand, multiple interventions (of the same or of different kinds) can be organised in a way that together they work from different fronts to achieve a common goal.

Secondly, we elaborated on the findings which emerged from chapter 3 to relate interventions with notions of predictability and contextuality. We concluded that from a short-term perspective the consequences of an intervention are rather predictable. If we change the shape of a plot the morphology of the neighbourhood will change accordingly as a whole. Nevertheless, in the long-term complex systems are by nature unpredictable.

We established that the basic elements that define a space and which can be used as tools to manipulate urban development are standard. These elements combine Alexander's (1977) patterns of space and the elements Marshall (2009) identifies as the building blocks of urban syntax. Nevertheless, as strategic interventions, these elements get their meaning from a specific context. Both the design of an intervention strategy as well as the design of the intervention itself should emerge from the needs and character of the specific environment where they are going to be implemented.

Finally, we have organised interventions according to their size. For that we have built on the notion of nested hierarchies introduced in chapter 3 from the perspective of biology and evolutionary theory. In chapter 3 we used Miller's work (Miller, 1978) to relate nested hierarchies to the context of biology. In chapter 4 we used the work of Alexander to relate the idea of nested hierarchies to the building environment. Miller suggests that all living systems emerge from the relationship between and within inclusive hierarchies. Hierarchies such as: cell; organ; organism; group; organisation; society; and supranational system in that ascending order. Alexander also organised what he calls patterns of space in an inclusive hierarchical order. In other words, all Alexander's patterns which we use to define the basic elements one can use to intervene in the city include and extends the previous ones. In light of this we used his work as a link to establish a logical coherence to the scale of interventions. As a consequence of this hierarchical organisation two key concepts emerged: *macro-intervention* and *micro-intervention*.

Macro-interventions relate to large scale interventions. They relate to systems of interventions applied across the world, continents, countries or regions. In the context of the building environment, macro-interventions refer to projects of the city's scale or the scale of a neighbourhood. Micro-interventions in the urban environment refer to things such as an urban bench a traffic light or a tree; they refer to the building blocks of urban and social complex systems. We have argued that the scale of the interventions is not directly related to the scale of their influence, therefore micro-interventions can have an impact on the neighbourhood, or even the city. We argued that macro-interventions are more risky than micro-interventions. Ultimately, the consequences of any intervention are unpredictable; therefore we better intervene discretely in the urban environment and try to cause as little disturbance as possible.

We defined *strategic micro-interventions* as the manipulation of the basic elements from which a complex system emerges. We argue that strategic micro-interventions are so relevant because:

- By changing one of the basic elements of the system they can trigger change in the system as a whole.
- They are small therefore they hardly disturb pre-established dynamics of the system.
- They can be used to test potential directions of change or the appropriateness of a larger scale intervention.

In short, we used this chapter as a way to focus on *strategic interventions in the building environment*; short-term interventions of space which take into consideration long-term aspirations for the city as well as the urban system as a whole. Interventions that on the one hand are conceptualised by taking into consideration the standard aspects of human life and the standard components of the building environment, but on the other hand are selected and designed according to the uniqueness of each context. In addition, we focused on small scale interventions and on their potential to accelerate the process of urban development or change its path.

The categorisation of interventions enabled us to relate kinds of interventions with different aspects of social and urban organisation. It also helped us to situate interventions in the building environment in relation to all other possible interventions which can be used as catalysts for urban change. Furthermore, it enabled us to define exactly the research's interventions of focus; the ones explored in the research studies.

By categorising interventions we can study them and compare them. We can see which are more accepted by different kinds of people, which are easier to implement and which have more of an impact on their surroundings. Above all we can explore tools to help us design and select interventions more adequately.

The categorisation made in this chapter was translated in the framework used in the research studies. On the one hand, this framework represents an exploration of a tool to select and design strategic interventions. On the other hand, it can be used as a systematic basis to compare different interventions applied in different areas of the urban system with the impact they have in the system's development.[39]

The following tables are both a resume of the categorisations made in this chapter and a framework to categorise interventions. The kind of interventions which were studied in this research are marked with (*).

Categorisation of interventions in relation to:	**General Categories**	
1-Their active or passive role in relation to urban and social change.	Interventions as actions * E.g. Building a bridge	Interventions as consequences or reactions E.g. A new residential area
2- Their source	Natural interventions E.g. An earthquake	Artificial interventions * E.g. A building
3- The kinds of interventions in the urban environment	Interventions of events E.g. A procession	Interventions of space or interventions in the building environment * E.g. A fountain
4- The duration of the intervention	Acute interventions or short-term actions * E.g. A public lamp	Chronic interventions or long-term actions E.g. Teaching the relevance of recycling.
	Strategic Interventions	
5 – The intentionality of the intervention	Unintentional interventions: Intention focus on the self E.g. A private house	Intentional interventions: Intention focus on the common good * E.g. A school
6 - The origin of the intervention	Top-down interventions * E.g. A change in the legal system	Bottom-up interventions E.g. Choosing a place to live
	Categories of strategic interventions in the building environment	*
7- The number of interventions and the relations between them	Isolated interventions E.g. A fountain	Interventions in a system E.g. Trees+ children playground + bus stop
8 –The predictability of their consequences	Predictable: Short-term E.g. Change the shape of urban plots – Predictable urban morphology	Unpredictable: long-term E.g. Change the shape of urban plots – Unpredictable use of urban empty spaces.
9 – The environment	General interventions: Conceptualisation phase. E.g. Establish the relation between a problem and a tool to address it. Problem: segregation. Tool: sports field	Unique or contextual interventions: design, selection and implementation phase. E.g. define location, area, design, material, etc of the sports field in relation to the area of focus and the people involved in it.
10- Their size	Nested hierarchies of interventions.	See table 4 and 8

Table7: Characterisation of interventions according to the categories explores in chapter 4

<table>
<tr><td colspan="10"><u>Relation between hierarchies of social organisation to hierarchies of interventions in the building environment.</u></td></tr>
<tr><td colspan="10">Hierarchies of social organisation
L1 World / L2 Continent / L 3 Country / L 4 Region / L5 Province / L 6 City /
L 7 Neighbourhood / L 8 Place / L 9 Object / L 10 Basic elements of the system</td></tr>
<tr><td>L1</td><td>L2</td><td>L 3</td><td>L 4</td><td>L 5</td><td>L 6</td><td>L 7</td><td>L 8</td><td>L 9</td><td>L 10</td></tr>
<tr><td colspan="10">Hierarchies of interventions in the building environment according to their size</td></tr>
<tr><td colspan="5">Macro-systems of interventions

Interventions at the level 1, 2, 3, 4, 5 and 6 are normally composed of a system of interventions.

Intervention system can be designed to influence any of these levels of social organisation but the scale of the interventions themselves is normally smaller.

The system of interventions can be composed of interventions of all kinds. Not necessarily only interventions in the building environment</td><td colspan="3">Macro Interventions

<u>Urban planning and urban design.</u> Interventions of the urban scale.

E.g. A new city or a neighbourhood.

They relate to infrastructure, connectivity and spacial organisation.</td><td>

<u>Architecture</u> * Interventions of the scale of a building.

E.g. A bridge, a square or a market.
They relate to objects rather than systems or networks.</td><td>Micro Interventions

<u>Design.</u> * Interventions in the elements from which buildings and places are made of.

E.g. A fountain, a public bench or a tree.
A decoration of a facade, an out-door's step or a lamp.</td></tr>
</table>

Table8: Relation between hierarchies of social organisation and hierarchies of interventions in the building environment.

Note 1: This categorisation is not rigid. It serves as an indication. Depending on the context a square can be considered a *macro-intervention* as well as a bridge or a hospital building.

Note 2: All hierarchies of intervention have the potential to influence all levels of social organisation.

Relation between long-term intention and short-term action L1 World / L2 Continent / L 3 Country / L 4 Region / L5 Province / L 6 City / L 7 Neighbourhood / L 8 Place / L 9 Object / L 10 Basic elements of the system										
Long-term intention	L1	L 2	L3	L4	L5 Improving tourism in a city can influence the province or even the region.	L6	L7	L 8	L9	L10
Short-term action	L1	L 2	L3	L4	L5	L6	L7	L 8	L9 Build a museum	L10

Table 9: An example of a possible relation between long-term intention and short-term action [38]

Chapter 5 - Research methodology

Research explorations and research strategies

Introduction

The preceding chapters have dealt with issues regarding evolution of the city, planning theories and theories of intervention. In doing so, we have identified strands of theory which can be used to help in understanding how designers and decision makers might consider cities from a new and innovative perspective. This chapter sets out a methodology to study this within the contexts of design, design education and public decision making, which together develop a hypothesised structure for use by designers and public decision makers.

Qualitative inquiry

Why use qualitative research?

According to Packer (2010) qualitative research is good to study *historical ontology*. Historical ontology according to Foucault involvesa critic of what we are saying, thinking, and doing (Packer, 2010) On the basis of this, Packer argues that this way of knowing relates to politics and ethics. Politics and ethics relate to who we are as a person and to how we deal with each other and the world around us. Qualitative research can thus inform the ethics of decision making, which in turn can guide new ways to manage our resources and our environment.

Qualitative research has the potential to become - when it acknowledges its own inconsistencies - an investigation that could create new ways of being; an investigation *"that would be scientific without being disinterested, because we need knowledge that is relevant, not knowledge that is disengaged".*

(Packer, 2010)

There are two relevant issues to be addressed in order to realise the full potential of qualitative research. The first relates to evolutionary theory and the concept of sustainability; it relates to the understanding of ourselves and how we see human beings in relation to the world. The second relates to the inconsistencies in the methodology normally used to undertake qualitative research.

Qualitative research, sustainability and evolutionary theory

Packer suggests a re-conceptualisation of social sciences, one that would be deeply related to a new understanding of who we are and our position in the world. As argued in the literature review, the new social sciences suggested by Packer also include humans in the evolutionary process that relates all living things with their surroundings. In his book, *The Science of Qualitative Research*, Packer relates qualitative research, sustainability and evolutionary theory, key concepts of this thesis. According to him, a new kind of qualitative research can integrate both the biological aspects of human existence and human culture and social nature. It can help us to understand the unquantifiable aspects of who we are and our capacity to change.

““In Foucault’s terms, it would include both ‘genealogical’ and ‘archaeological’ components and have an ‘ethical’ aim. That is to say, it would include a historical dimension, attentive to genesis and transformation without reducing them to the linear unfolding of a unidinensional ‘progresses. It would include an ethnographic dimension that would be sensitive to power and resistance. It would carefully examine practical activities – “discourse” – to discover how human beings are made and how we make ourselves. And it would foster social change not through violent revolt but by promoting a patient labour giving form to our impatience for liberty” (Foucault, 1975/1977. p319), working to change who we are.”

(Packer, M. J. 2010: 6)

Up to now we have considered ourselves different or better than other animal species and that has given us the right to exploit the world as we know. Now it’s time to reconsider not only our position but also our responsibility towards the planet. On the one hand, we are biological creatures participating actively in the changes of the planet. On the other hand, we are cultural beings. Regardless of how much we can compare our cultural behaviour to the one of crows or bees, it is fact that we have achieved an unprecedented social and cultural complexity and that gives us a great deal of responsibility for our future as humans and the future of all those on this planet.

Consequently, qualitative research can help bring new understanding to our existence and to our relation with the world around us. In addition, in can help us to relate ourselves to the world of the things we create. Therefore qualitative research can lead us towards alternative options for a sustainable existence.

The potential of qualitative research is not being sufficiently explored: “*This potential is, I believe profound. Attention to human forms of life, to the subtle details of people’s talk and actions, to human bodies in material surroundings, can open our eyes to unnoticed aspects of human life and*

;learning, unexplored characteristics of the relationship between humans and the worlds we inhabit, and unsuspected ways in which we could improve our lives on this planet."

(Packer, M. J. 2010: 3)

Qualitative research: The objective study of subjectivity

To realise the full potential of qualitative research, we have to be critical and acknowledge its inconsistencies of and the inconsistencies of its methodologies.

"What is needed is a kind of inquiry that is motivated by neither a technical interest nor a practical one but rather what Habermas called "emancipatory" interest. How can we create this? The imperatives to change our paradigm – to assume a new ontology, to adopt a new view of understanding and knowledge – emerge within qualitative inquiry as much as they are demanded by the crisis we face. Much qualitative research is stuck in contradiction and anxiety, and it is crucial to understand why. By refusing to abandon a posture of detached neutrality, much qualitative inquiry today continuous to bolster the attitude of domination. Neutrality is equated with objectivity and viewed as genuine knowledge. This kind of research promotes a way of knowing other people that leave them a feeling of misunderstood and treated as objects, and fails to recognize either the political and ethical dimensions of understanding or its own transformative power. When we understand another person, we don't merely find answers to our questions about them. We learn, we are changed, we mature. Contemporary qualitative research, with a few welcome exceptions fails to recognize these things or even allow space for such recognition in its repertoire of techniques and its methodological logic."

(Packer, M. J. 2010: 5, 6)

In our studies the researcher was neither detached nor neutral.

The researcher actively participated in the studies and defended the findings of the research. The results include the researcher as both one of the participants in the study and as elements that influenced and inspired the research process (Heller, 2004; Waddington, 2004; Bortoft, 2010; Packer, 2010).

We used qualitative research to explore the complex world of human perceptions and experiences. In other words, we used qualitative research to learn about each individual and each unique way of experiencing a certain phenomenon. The knowledge taken from that experience influenced the research's assumptions and perceptions of the world and the research's process and methodology.

Above all, this research approach helped in designing and conceptualising the framework to study the research exploratory planning system; a key ingredient in this research's methodology. The results presented in this thesis are not a final interpretation but a personal interpretation of the data. As suggested by Packer, we intend to bring a meaning to the narrative of the users of our models. We have tried to articulate what has been said to shed light on this research methodology and theoretical framework.

The aim was not *"to replace the interviewee's words with (my) own but to explore a way of reading their words that offers an answer to a question about constitution."*

(Packer, M. J. 2010: 122)

On a personal level, using qualitative research transformed the author both as a researcher and as a person. The information gathered changed the author's world view and helped to improve the way things are done in the future.

Packer's alternative way of enquiry

Packer calls for the need for a new kind of inquiry. An inquiry that is able to embrace the social and cultural ground where data is being collected as well as the subjectivity of both the interviewer and interviewee. He defends the need not only for a new way of analysing the data, but also a new way of asking the questions.

"*The proposal is that the traditional empirical-analytic approach to inquiry in social sciences is unable to grasp this relationship, so a new form of inquiry is needed that will study" the ways subjective and objective, self and other, psyche and culture, person and context, figure and ground, practitioner and practice live together, require each other, and dynamically, dialectically, and jointly make each other up" (Shweder, 1991, p1). Each of these pairs has been a dualism that impeded social science."*

(Packer, M. J. 2010: 139)

Husserl, Schutz, Berger and Kant share the idea that the reality as we know it is something constituted; For them, reality is based on the way we know things and that knowledge establishes the order which in turn enables us to relate with the world. They have different opinions about where this knowing is formed or where it is located, but *"(none) was able to build a bridge between individual subjective experience and objective reality. Each of them was critical of traditional inquiry for taking the objective reality of the world for granted, but none of them was able to demonstrate how this world is actually constituted by subjective experience".*

(Packer, M. J. 2010: 140) [1]

According to Packer, this inability is due to the fact that they all avoided making ontological claims, to the extent that Husserl (1982) avoided claiming the existence of the object of experience.

"The root problem is that, far from avoiding all ontological assumptions, each of these analyses presumed a basic ontological distinction between subjectivity and objectivity, between the world as the individual experiences it and the world as it really is, between appearance and reality. This dualism of 'the two realities' is inscribed in the structure of Berger and Luckmann's book, divided into sections on Society as Objective Reality and Society as Subjective reality.

Once one accepts the Kantian dualism of things-in-themselves and things-as-they-appear, it seems that one can study only an individual's sense of reality, their experience of reality...this kind of construction – a construction of knowledge of the world – can never successfully draw a distinction between what is valid knowledge and what is mere opinion."

(Packer, M. J. 2010: 165,166)

For Merleau Ponty (1962) and Heidegger (2011) this dualism does not exist. For them, both "*objects and subjects, not just ways of knowing, are form in practical activity*". Still, they avoid the problems of dualism but they both lay on abstractions of time (Heidegger) and body (Merleau Ponty). Packer suggests adding the contribution of Garfinkle (1967) to the contributions of Merleau Ponty and Heidegger to establish a theoretical background that enables us to explain dualism and that helps us to see the world in new ways. Based on the ideology of *radical realism* [2], Packer (2010: 203) states that the way we experience the world is visible and if it is visible one can study it. Furthermore, "*we can envision a qualitative inquiry that asks and answers questions that the "objective study of subjectivity" cannot frame…*" (Packer, 2010: 105,106). Nevertheless, this involves a new way of expressing ourselves as researchers and of formulating questions.

"*These sciences cannot be wertfrei (valued-free); they are moral sciences in a more radical sense that the eighteenth century understood. Finally, their successful prosecution requires a high degree of self-knowledge, a freedom from illusion, in the sense of error which is rooted and expressed in one's way of life; for our incapacity to understand is rooted in our self-definitions, hence in what we are*."

(Taylo, 1971: 57 in Packer, 2010: 123)

In light of this, a significant part of the conclusions drawn from the case studies presented in this research can be seen as opinions. Still, the observations and questions raised during the studies, as well as the opinions or conclusions presented in this thesis, are based on the inside experiences of the researcher; one of the elements of the system which composed the study itself.

We consider that the research case studies' system was composed by: the researcher, the physical context of the study, the subject of research and the participants. The elements of the system and the dynamics they have created make the study so complex that only when one is part of the system can one fully understand and interpret the information that it produced. We argue that each participant, including the researcher, is a whole; each individual has in itself the characteristics of a group and of the context. The problem is that normally, for the sake of objectivity the researcher tries to detach from the subject of research and studies the individual as the sum of the parts (Packer, 2010: 71; Bortoft, 2010).

In other words, as with Packer, we argue that only when the researcher embraces himself also as a person experiencing a phenomenon in a specific context can he engage fully with the complexity of the social and cultural background in which the research takes place. Only then can he fully understand both the system of the study and the dynamics created between the parts of the system.

Questions emerge almost naturally within the system and its dynamic interactions. The fact that they emerge from the complex dynamics of the system makes them understood by all participants and the matter for new questions to emerge. In other words, only when the researcher is part of the system will he be able to understand the role of the participants' interventions in the research study's context; only then can he fully understand how the actions, the questions or difficulties of the participants originate other actions, other questions and other difficulties which in turn influence both the elements of the system and the evolutionary process of the research.

Eventually the researcher can translate that knowledge into words but those words might be interpreted as opinions. Still, no one can say that these opinions are not relevant. They are profound once they are a product of experience. They can be seen as valid knowledge which emerged from a case study or from a study of a phenomenon in a context and therefore they have the potential to be generalised and applied to other contexts (Heller, 2004; Waddington, 2004; Packer, 2010).

In short, in the three case studies of this research each part of the system in study was regarded as a whole, including the researcher: Both the researcher and the participants in the studies had their opinions, their world views and a history behind them. During the studies, the researcher was exposed to emotions which almost certainly influenced the interpretation of the data. These emotions relate to the evolvement of the researcher in the context of the study and are openly expressed and form part of the data collected. From the perspective of evolutionary sciences opinions, emotions and interpretations are human tools to survive (Lane, Maxfield, et al., 2009); they are part of the human condition (Arendt, 1973) and no researcher can escape its human character (Packer, 2010). Therefore, we argue that it's better to acknowledge our human character than try to detach from it. In the case studies of this research the ethical positions and world views of the researcher were shared with all the participants and from that basis, several deep, honest and meaningful discussions arose.

Case studies as a research methodology

Why use case studies?

The research explored the potentials of a case-study strategy to build a hypothesis and to test its acceptance and applicability. Furthermore, it explored the case study's potential to identify problems, redefine and adjust the thesis methodology and theoretical assumptions (Sampson, 2004; Creswell, 2007).

The case-study strategy was the methodology chosen because of its capacity to shed light on the understanding of a phenomenon in a specific context and for its ability to apply that specific knowledge to broader contexts (Hartley, 2004).

We intend to generalise the research findings by selecting representative cases, by using a standard framework to sustain the research methodology and by identifying the specific processes and factors that guided and influenced the actions and behaviours of the participants.

Both the methods and the methodology used for this research can be replicated and used to study different academic contexts. In addition, they can also be used to study the practice of urban management and the influence of decisions and design to direct urban change. In the future, the triangulation and comparison of broader sourness of data would help to: firstly, cross-check information between the theory and the practice of urban management and design. Secondly, to understand how different contexts influence the acceptance and the applicability of the research exploratory framework. And finally, it would help to improve the methodology and the research tools as well as informing the explorations on an *intervention management system*; a system which is general but is still flexible enough to be adapted to any given context.

The studies developed during this research were exploratory therefore different research focuses and techniques were used. The aim was to learn more about their potential and their challenges and to use that knowledge to design future research studies (Sampson, 2004). Furthermore, the aim was to study different aspects of the problem; it was to acknowledge different perspectives and different ways of using the thesis' exploratory framework for an *intervention management system.* Therefore, the exploratory character of the cases was also used as an opportunity to confirm or deny the relevance of the selected focus groups to inform the research (Creswell, 2007: 127).

Exploring ways to conduct a case study and to collect data

The research case study was developed in Aberdeen and was composed of 3 studies.

The first study concentrated on the practice of urban planning and urban design and was focused on the development of one controversial central area of the city. Study 1 was focused on the understanding of the selection and negotiation process related to the implantation of an intervention in the *Union Terrace Gardens* in Aberdeen.

The second and third studies were focused on the academic environment (Merriam, 1988; 1998). They were developed at the RGU; *The Scott Sutherland School of Architecture and Built Environment*.

Study 2 focused on master's level students of building management. It aimed to investigate further the selection of interventions and the acceptance of micro-interventions as a tool to nudge urban change. Study 3 focused on final year architecture students to investigate interventions as a design form and strategies to improve it.

The aim of all studies was to discover what was typical or average and explore the possibility of generalising them. Because of this it was relevant to explore representative focus groups, define a generalizable methodology and an appropriate and consistent way of collecting data. Consequently, we used the studies to explore appropriate focus groups, ways to collect data and research tools which could be used consistently as part of a research methodology.

Focus groups

The focus groups of study 1 emerged as a direct consequence of the negotiation process between all parties involved as well as a consequence of the selection process itself. Participants in the initial meetings introduced me to other relevant parties which in turn led me to all participants in this study. The focus group of study 1 also emerged from the understanding of who the active actors were involved with the planning and design of the *Union Terrace Gardens* in Aberdeen. Further similar studies are needed in different socio-political contexts to prove how representative this focus group is of the selection and negotiation process of interventions in the building environment.

Study 2 focused on future construction managers and study 3 on future architects. We chose these two focus groups because they represent worldwide professionals who intervene in the city on a daily basis. Along with urban designers, housing experts, engineers, traffic planners, people working at municipal institutions and so on, who also have a key role to play. They intervene in the city professionally and they often do not base their choices or designs on theoretical knowledge about the city. Their roles often overlap and are sometimes confusing in the context of urban planning and urban development (Friedmann, 2011: 133). Because of this, these professionals are often involved with a wide variety of scales of interventions in the building environment.

In short, we considered future building managers and architects relevant focus groups for this study because they represent a generalizable group of professionals who intervene in the city on a daily basis and they are involved with the design and implementation of interventions in the building environment of almost any sort and scale.

Data collection

Due to the exploratory character of the studies, a variety of methods were used to collect the data:

In study 1 we used interviews, observation, analysis of documents, public articles, articles in Web blogs and ethnography.

In study 2 and 3 we used questionnaires, semi-open interviews, direct observation and ethnography.

The idea was to on the one hand compare the potential and challenges of each method and chose the most appropriate for future studies. On the other hand, we aimed to compare the results of different data collection methods to identify incoherencies and to make the conclusions reached more robust. Furthermore, the comparison of different kinds of data were of key importance to improve the research exploratory tools introduced to the students and consequently to readjust the research methodology (Cassell and Symon, 2004; Sampson, 2004).

Explorations in the academic environment

There are some key strategies used in studies 2 and 3 that are important to acknowledge and taken into consideration because they illustrate the exploration character of this research with regards to the use of case-studies as a research methodology:

- In study 2 several different kinds of data were collected from a short workshop. Therefore the study was focused on acknowledging the first reaction and opinion of the participants. In study 3, the data was collected over a period of 3 months. The study was focused on an activity’s process and product. In this context the participants were asked to reconsider their first impressions at the end of the research process.

- In study 2 the questions asked were more focused and direct. In study 3 the questions were more open.
- In study 2 participants were asked to use the explorative research tools to select and justify a choice. They had to select the best option between two distinct interventions suggested for one specific site. In study 3 participants were asked to use the explorative model to design interventions in different sites within Aberdeen city centre.
- In study 2 participants had the exploratory diagram displayed on the screen while they responded to the questionnaire. In study 3 the diagrams were only presented before the participants responded to the questionnaireand before they started the design process. We don’t know if the participants reviewed the diagrams after that. Nevertheless, the questionnaire’s questions were worded in a way that they would nudge participants to think about the topics and the links between them suggested by the diagrams.
- In study 2 I was invited by the responsible teacher both to give a lecture and to collect the data for my studies. This invitation shows the teacher’s openness and acceptance towards the research hypothesis and methodology. In contrast, to develop study 3, I had to ask permission to introduce the students to the research and to collect data. Unlike the teacher responsible for the building management lectures, the lecturer responsible for the architecture students was not aware or interested in the research topic.
- Study 2 embraced the whole unit of students. Study 3 focused on understanding how 7 randomly chosen students could inform us about the unit as a whole.
- Study 2 was used to understand the acceptance of *micro-interventions* to nudge change. Study 3 considered the object of architecture (the building) as a *strategic intervention.* It aimed to inform the potential of architects to be active protagonists used to guide urban change.

Research's design: The *Exploratory Interventions management system* (The EIMS)

Introduction

In this part of chapter 5 we explore the last two objectives of this research:

- To explore how we can design top-down interventions more efficiently, according to this thesis' content.
- To postulate an operational framework based on the research's theoretical approach that would lead to the design and selection of more appropriate and sustainable interventions and strategies.

To address these objectives and test the research hypothesis we designed two exploratory models. The models aimed to be used as a framework to explore how this research's approach towards urban change can improve urban management and urban design. The EIMS models are both the result of the conclusions taken from the literature review and the case studies, as the research process was not linear. The *exploratory intervention management system's models (EIMS)* were used as the basis for all three studies' methodology. However, they were used differently depending on the study and sometimes they assume more presence than others.

The models were designed to:

- Help professionals who act on the city on a daily basis to reflect on the city from a holistic perspective; we tested the mode's potential to self-educate users and stimulate people to think in complex systems from a holistic perspective.
- Relate interventions with urban change and the unpredictability of complex systems. The models were conceptualised as a framework that could be used as a dynamic working tool; something to be adapted according to the change of circumstances and according to the input of the people using it.
- Serve as a basis for communication across all people intervening in the city and reflecting on it and as a model able to relate both knowledge and theory with practice. We explored the potential of the models to be used as a common language and as a framework to share information between all parties relevant to the design and implementation process of an intervention.

In study 1, the models were used to test to what extent could EIMS facilitate a decision making process. The models were translated in the questions introduced to all participants. The arguments which emerged from that were used to justify and defend different interventions suggested to the research site. In other words, the research exploratory diagrams were used to frame a common vision for the future of Aberdeen. They were used to frame the discussion about the possible consequences of each intervention in relation to urban dynamic change and the key aspects of urban life, such as politics, economy, culture, transportation and communication networks and so on.

In study 2, the diagrams were used as a tool to explore to what extent we can help people visualising more holistic future scenarios for the city. Arguably this could improve the selection process of interventions and therefore facilitate the emergence of more adequate interventions in the urban environment. The models were used in combination with another research tool (*The micro-project system* project). On the one hand, they were translated into questions which aimed to test the acceptance of the use of micro-interventions as a tool to redirect urban change. On the other hand, they were used as working tools to define interventions and analyse the emergent change of an urban system.

In study 3, the diagrams were used to test to what extent they would influence the design concept, design process and the design object. They were used to test different possibilities to support the emergence of sustainable and holistic design concepts. The diagrams were used as a background to frame the students' way of thinking; they were used both as a framework and were translated into strategic questions to inspire students to reflect on the city from a more holistic perspective. The aim of this study was to use the models to explore possibilities to guide the conceptualisation of architecture. On the one hand it aimed to explore possibilities on how to bring together design, as a short-term action, and a vision or a long-term intention translated into the concept behind the design form. On the other hand we used the models to try to bring together the material city and human experiences and perceptions of space. The nurturing of this deep relation would eventually promote social engagement and influence of the quality of urban life (Jacobs, 1961; Alexander, 1966; Alexander, 2003; Wilson, 2011).

Before describing the models there are some considerations which are relevant to take on board. One of these considerations is related to the use of models to address and explore complex systems. It relates to the apparent co-relation between models and the over simplification of the complexity of urban social systems. The second consideration is related to the abstract character of models and the contextual particularities of each context where they will be applied.

Models and the oversimplification of complexity

In social systems problems happen at all levels all the time; therefore people must have the freedom to respond to them adequately otherwise the system may collapse (Allen, 2012). To do that Peter Allen suggests three things: motivation, a target or an intention and models. In chapter 3 we referred to the nurturing of the self-organising city as a true encouragement of social participation in the construction of urban life. We have also referred to the relevance of intentions as the reason behind human action (Bortoft, 2010). In this chapter we will refer to the relevance of models.

Models can help us to think about a subject from a more holistic perspective and to crystallise linkages that are not easy to see. Models can work as conversation devises where people can share their understanding on how things work and give ideas about how to address the problems. Above all, models can serve as a tool to create knowledge coming from different perspectives and scientific backgrounds.

However, there are relevant considerations to keep in mind when using models to address complex evolutionary systems.

First is the fact that there is no such thing as an objective model of the world (Banathy, 1996). According to systems theory, models always mirror the pre-conceptions of the people who use them; therefore any model trying to represent social systems is by definition subjective. In other words, models are conceptualisations of the complexity of social dynamics. They do not exist as such; they are abstractions. Such models help us to imagine the complexity of the world we live in but they can never represent the complexity and dynamic character of reality.

So, how can we create any model of reality able to be used as a holistic framework of thinking, without over simplifying it?

Models as an abstract tool to study contextual urban environments

The second consideration to keep in mind is related to the idea of human adaptations to the environment as a key factor for human well being. It relates to the fact that the urban context shapes human actions and behaviours; therefore it shapes the selection and design of human interventions. Consequently, the kind of urban planning suggested by this research should reflect a deep understanding of the context. Not only this, Friedman (2011) argues that planning in general is not something global or a universal truth, it is rather contextual. Therefore, any model which attempts to represent an urban environment needs to reflect the specificities of each unique context.

> “*But the pay-off* (of abstract theorizing) comes *only when we can limit our assertions to the context of particular socio-cultural traditions. The call is out for many planning theories, not one*.”
>
> (Friedmann, 2011: 136)

So, how can we create a model able to replicate the contextual reality of a complex urban system? Is the task of designing a framework able to contextualise humans and their actions in relation to the greater whole even achievable?

In chapter 3 we argued that there are basic elements common to all social and urban systems. These elements self-repeat and they justify the use of complexity science to investigate social and urban organisations. The models suggested in this thesis are defined by self-similar elements representing areas of intervention in urban systems. Even if the models suggested here, like any other model, are abstractions and general representations of urban complex systems, the way they are translated in everyday life is highly contextual.

On the one hand, we consider the user of our models an element of the system in analysis. On the other hand, we trust the human capacity to deal with complex systems on a daily basis. In light of this we trust that users will be able to adapt the models to their best interest and to relate them to the specific urban issues they want to address.

Each user of the EIMS models will interpret them in a different way and will focus on different aspects of society. As suggested by Rotmans (Grosskurth and Rotmans, 2005) in relation to the use of models as a tool to study reality, we assume that what emerges from the analysis of the EIMS models is an aspect of reality, as holistic as it can be, but it is not reality itself. Nevertheless, as suggested by Thompson (1990) models can be used as a framework to compare information; therefore they can be improved and transmit always more complete perspective of reality.(Thompson, Ellis, et al., 1990)

The EIMS models

The EIMS is composed of two models. One refers to a fixed image of what a social and urban system is at a given moment in time. The second one adds dynamism to that view. It engages with notions of time and change. As suggested by Roo (Roo and Rauws, 2012) both the EIMS models and the methodology to operate them emerge from the intersection of complexity theory, transition management (Loorback, 2007) and spatial planning.

The EIMS models were designed to help people to recognise the complexity and the holistic character of the urban fabric, guiding them to act on the city on such a basis. In other words, the models aim to help urban participants to increase their awareness of the causes and the spectrum of possible consequences of interventions or changes in social and urban systems. We argue that an increase of awareness of the complexity of urban systems will on the one hand lead to the design and selection of more adequate actions in the city. And, on the other hand, will hopefully bring a sense of responsibility to people when they act in the urban system.

Despite the fact that the exploratory models were designed to improve interventions in the urban system, they can simply be used to engage people with a deeper thought of what a social system really is. Their main value is simply to help people to reflect on human actions in relation to an urban complex system and its development.

The fact that EIMS is designed from the perspective of interventions shaped the model, its elements and the relations between them. Contrary to other models, what characterise the system are its intervention areas or the aspects of society on which one can intervene in order to improve the system or nudge its development towards a sustainable path. As we will see, such areas are related to management and legislation systems, belief systems and the building environment itself.

The EIMS models were designed to assist both the top-down and the bottom-up kind of planning. On the one hand, they were design to be used as an everyday tool to assist people involved with the city planning and city design; a tool to assist professionals such as architects, engineers, planners and transportation and environmental planning experts, housing experts and so on (Timmermans, 2012). On the other hand, the models can be used by anyone who intervenes in the city regardless of the scale of the intervention.

The fact that EIMS can serve as a common ground for both top-down and bottom-up planning represents an attempt at genuine public participation in the planning process (Marshall, 2009, 2012; Portugali, 2012). One that is based on real interventions rather than endless open consultations which normally have little effect in shaping top-down planning strategies (Friedmann, 1997).

In short, The *Exploratory Intervention Management System* models were designed to help people to relate key aspects of society and urban dynamic change with human actions. The EIMS models are general frameworks which illustrate strategic intervention areas in a complex urban system. The EIMS models invite people to use their innate capacity to deal with complex systems to meditate in the ways those general elements are materialised in each context. We argue that such models can be useful to study, design, select and implement more adequate and sustainable human intervention. We are convinced that this will enable top-down protagonists to intentionally nudge urban development towards a more sustainable path (Banathy, 1996).

EIMS models are a framework conceptualised to address the research hypothesis: *If we design and manage human intentional interventions adequately we can manipulate urban emergent change towards a sustainable development*. In other words, EIMS models were designed to support the design and selection of strategic interventions; interventions which can be used as tools to nudge urban and social development and address urban problems within the modern complex urban environment.

In light of this, as other models which inspired this research,[3] they were designed to support:

- The understanding and manipulation of complex systems.
- The understanding of humans and human action in relation to their environment.
- The design and selection of more responsible and aware interventions.

Following this the research models aimed to assist the following research explorations:

- How can we design interventions in a more adequate and strategic way?
- How can we select interventions being aware of their complex relations and the unpredictable character of their consequences?
- What kind of management system gives space for innovation and bottom-down self-organisation and still nudges change in a sustainable direction?
- How can we induce actors to cooperate towards a common good?
- How can we help them to “speak the same language”?

This thesis argues that the EIMS models could improve the urban planning process in two ways:

First, they could serve as a platform for communication between the participants involved in the creation, selection and implementation phase of an intervention as well as being used to involve the civil society in the process. They could improve communication and negotiations between experts, managers, designers, decision makers and private and public institutions involved in the design and selection process of an intervention.

Second, they could be seen as the basis for a more dynamic kind of management. A kind of management focused on the design and selection of human actions in a given environment. This kind of management envisions interventions, regardless of their kind and origin, as actions that can influence the urban system and serve as a catalyst for a sustainable urban development (Banathy, 1996).

The EIMS basic model

During the research process we investigated several models to help translate into a visual form the ideas we had collected in the literature review.[3 and 4]

The first concept we aimed to express in a visual form refers to what is known about a given system and what is unknown and unpredictable. From the literature on complexity theory and from the conclusions drawn from case-studies in the context of *transition management* (Loorbach, 2007), we concluded that what defines the character of a complex system and its unpredictable behaviour are not only the dynamics within a system, but also the dynamics between the system and its broader environment. The *MPL model* used in *transition management* was of great inspiration for the EIMS representation of this argument. It introduced us to the concept of *system internal* and *system external*.[3]

The second concept we aimed to express in a visual form refers to the idea of nested hierarchies of social organisation. To translate a nested social structure into EIMS models we explored the *multilevel model* used by Geels and Kemp (2000) and Lorrbach (2007) to study transitions or *system innovations*.[3] As the *multilevel model* is normally used for the analyses and monitoring of changes in social systems (Johnson, 2012), it was particularly relevant to define the methodology needed to operate EIMS diagrams. It helped us to share information through the different hierarchies of the system and to address the system from different hierarchical perspectives.

System internal and *system external*

The EIMS are defined as *system of focus* what Loorbach (2007) defines as *system internal.* This part of the system is composed of four areas of intervention and their intersections. The *system external* is represented by the space around that. It relates, on the one hand, to what is unknown about the system or not taken in consideration and, on the other hand, it relates to the higher levels of social organisation and the macro-context.

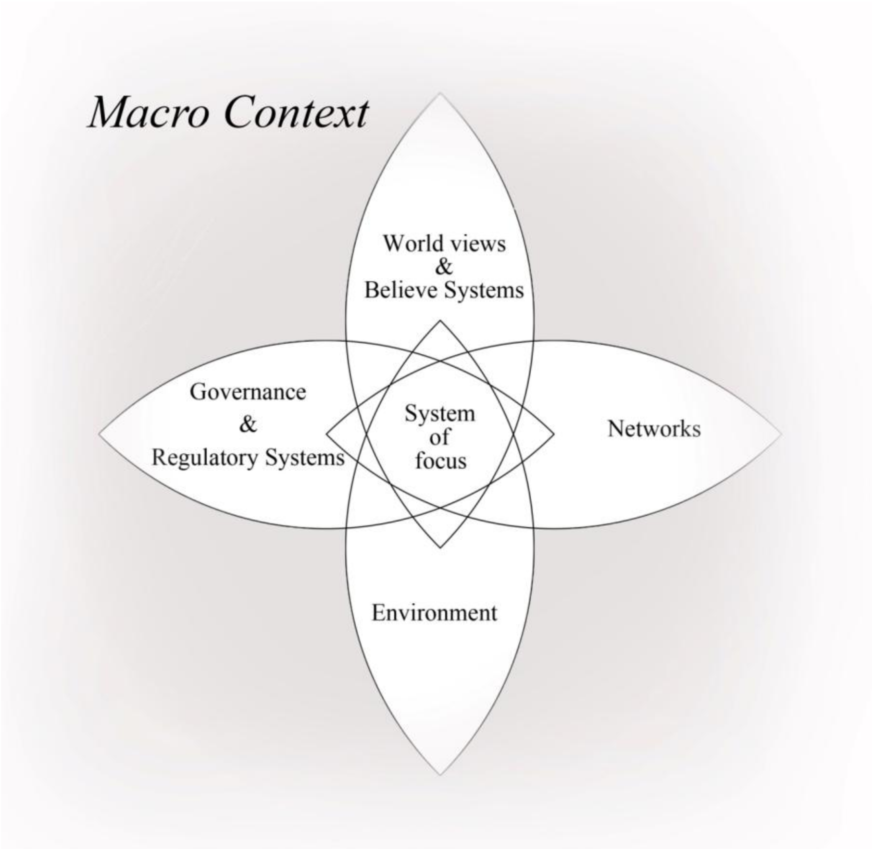

Figure 13: The EIMS basic model. It represents the four intervention areas which define the system of focus. It relates the system of focus with what is unknown about the system or its macro-context.

We chose to organise the *system internal* into four parts or areas of intervention. These four parts represent key aspects of social organisation which are relevant for the stability of any urban system. These areas represent the aspects of social organisation where problems compromising human wellbeing can emerge. At the same time, these four parts also represent the areas on which actors can strategically intervene in the system to improve it.

We have defined and characterised the intervention areas. This definition is not rigid or fixed it forms part of the research explorative process. The areas we are suggesting at the moment are related to:

- World views or believe systems: Religion and culture. This area represents the innate shared knowledge and memory. It is the lens through which one sees the world and judges what is right or wrong.
- Physical context or the environment: The natural and urban environment. The nature of the physical context is a key element to understand the subject of research. Even if this research is more focused on the urban environment, the EIMS's models can be used as a framework to address problems everywhere from a wild forest to a global mega-city. Therefore it can range from a natural context to an urban context and include everything which is in between.
- Governance or regulatory systems: Politics, economy and regulations. This area represents the system that allows us to change goods and services on a fair and ethical basis from the micro to a macro scale. It is implicit in this research's literature review that this system should be based on ethics and human nature rather than on the abstraction of numbers (Alexander, 2003; Ehrenfeld, 2008; Friedmann, 2011).
- Networks: Communication and transportation networks. This area represents the networks that allow us to move and to exchange ideas and knowledge.

The EIMS basic model is designed to allow intersections to happen between all intervention areas. Furthermore, the model's design allows the user to define areas of combination between two, three or four elements of the system. In addition, it allows the user to emphasise the area which is most relevant for the system of focus. An example might help to make this description more "visual"; if we try to represent a human activity in the system such as trading a national good, where would we place it? Would it be regarded as a trade network, as a cultural or as a political and economical phenomenon? In reality it can be considered all three and eventually even more. In addition, depending on the person analysing the system and the purpose of the analysis itself, one might give more emphasis to the phenomena as a network trade and others to the fact that it represents a part of the economic growth of the place.

The intersections represented in the model allow us to address the subjectivities of the system as well as the various interpretations of its users (Grosskurth and Rotmans, 2005).

Actually, most human actions and aspects of complex social systems happen in these spaces of intersection. Placing them in the EIMS-model is a subjective action which illustrates the world view of the one who is using the model.

The heart of the system is the intersection of all four intervention areas.

On the one hand the central area of the model represents human wellbeing. Human wellbeing is something contextual and sometimes not very objective. Because of this we addressed human wellbeing from the perspective of general human needs which are easily identifiable. We use Hodgson's (Hodgson, 2011) *World System Model* to identify these key human needs[3 and 5]: health (1), wealth (2), food (3), water (4), security and sense of belonging (5), shelter (6), education (7) and energy (8).

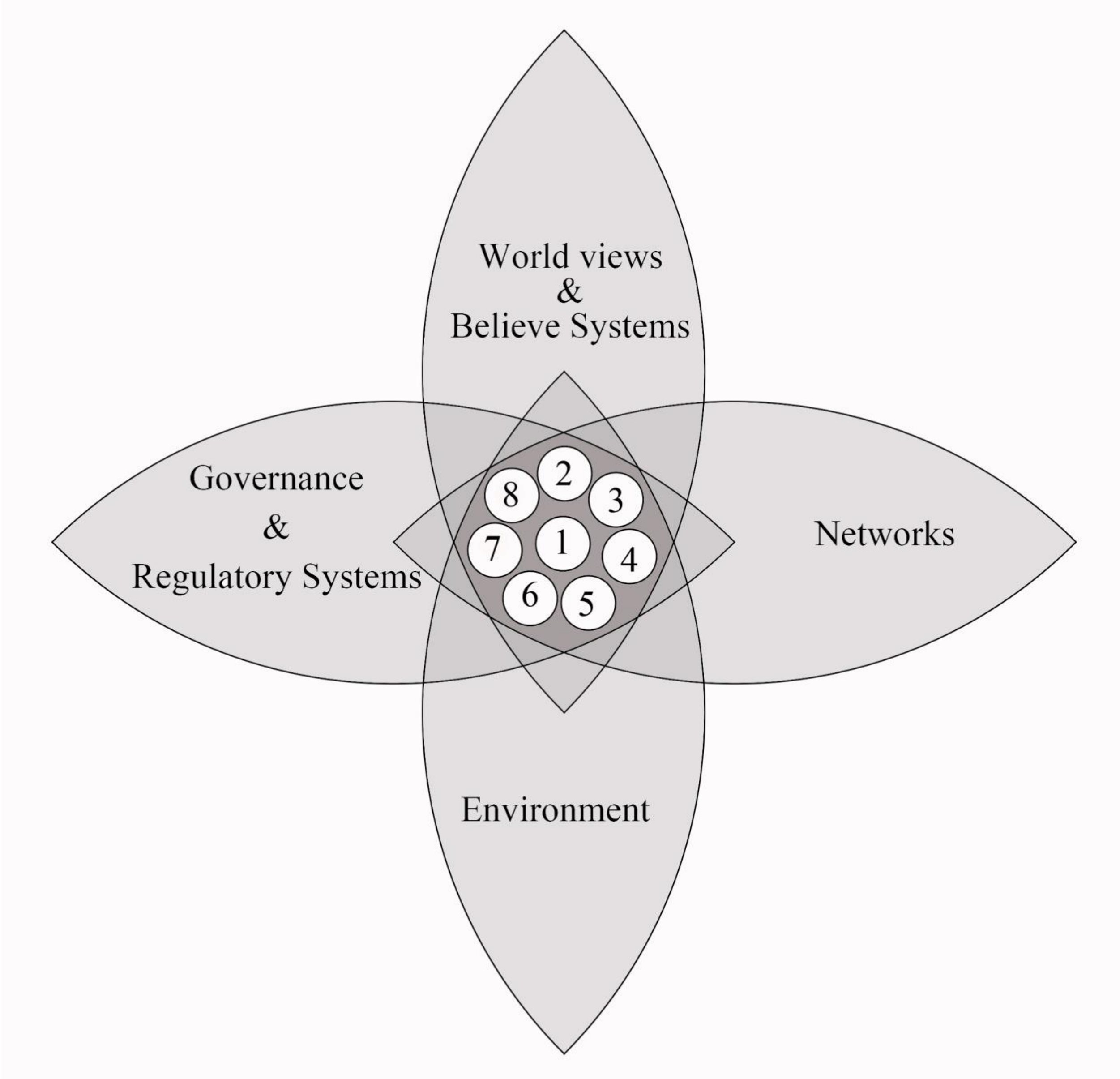

Figure14: Relationship between the heart of the system and its intervention areas
The heart of the system is based on the World System Model. (Hodgson, 2011:13)

On the other hand, the heart of the system defines the system one wants to study. It should be used to characterise the challenges one wants to address when acting on the overall system. In addition, it should be used to establish the social group of focus. Here is where we establish the scale of the system or the group of individuals on which we aim to reflect. For example, this is where we define that our investigation is focused on the criminality among teenagers living in a given neighbourhood. In other words, the centre part of the system should be used to identify the focus of the system in terms of who and what to focus on.

In short, the EIMS' *system of focus* or the *system internal* is composed by four main intervention areas and the areas which emerge from the intersection of those. The heart of the system, which represents key human needs, emerges from the intersection of the four interventions areas and it is what defines the system of study.

Everything that lies around the four intervention areas is considered the *systems external*. The outside area of the model represents the world of multiplicity and complexity. It represents what is not controllable, the unpredictable and the unknown. It also represents the broader world and all the individuals that compose it. The *system external* relates to the *system internal*, both with complexity and with a broader reality in which the focus system in nested.

In other words, as we will see subsequently, from the perspective of nested hierarchies, the *system external* can be seen as the macro-level of the system of focus.

The EIMS basic model helps one to envision the holistic nature of complex systems. It defines key elements to take into consideration to characterise an urban system and to intervene in it. In addition, the methodology needed to characterise the model, leads one to formulate a vision or an intention for the future of the system. This vision will be the reason behind the interventions in the system and can become a common target among different urban actors. In other words, the EIMS basic model opens the door for a more holistic perspective of reality and can eventually stimulate cooperation between different social and urban actors.

Nested hierarchies and EIMS-models

The EIMS models are based on the notion of nested hierarchies. Each element of the system and the system as a whole are composed of smaller social groups and are part of a bigger one at the same time.[6] In other words, the world is composed of continents, continents have countries, countries have regions, regions have cities, cities have neighbourhoods, neighbourhoods have places and places have objects (Alexander, 1977). From the human perspective such hierarchical organisation can organise the world population in groups and subgroups down to the scale of the individual (Miller, 1978).

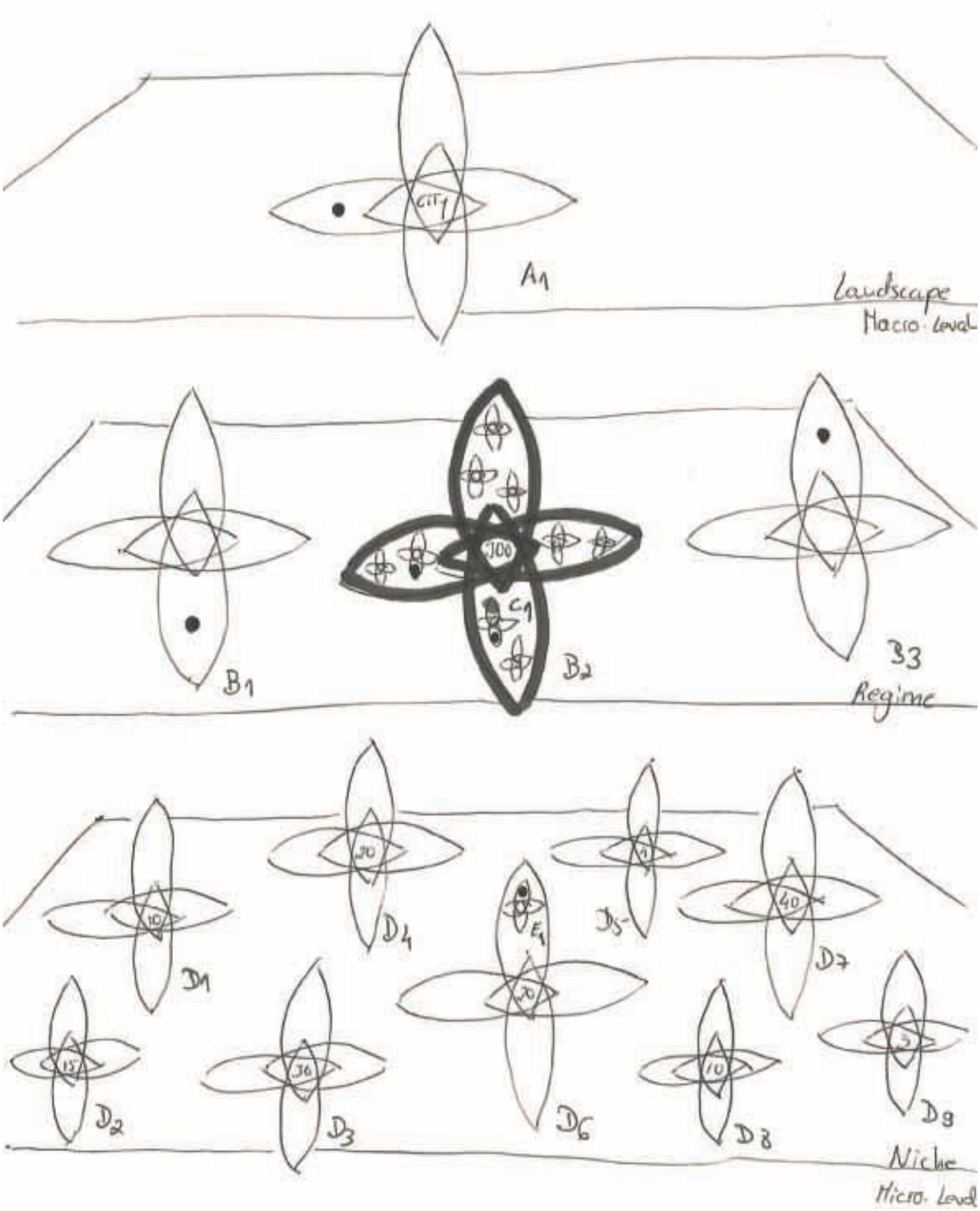

Figure15: The EIMS multilevel model is a framework of thinking. It emerges from a combination of Geels and Kemp multilevel model with concepts implicit in SCENE-model (Loorbach, 2007). 4 This image represents the conceptual approach of nested hierarchies applied in the EIMS models.

The concept of nested hierarchies applied to the EIMS model was explored in the context of scales approached in the governance theory (Termeer, Dewulf, et al., 2010)[7] and it was guided by Geels and Kemp *multilevel model* (Johnson, 2012).[3] Multilevel models were interesting for this research because they represent a nested organisation of social systems, and they can be used to conceptualise strategies to act and transform established complex systems (Loorbach, 2007).

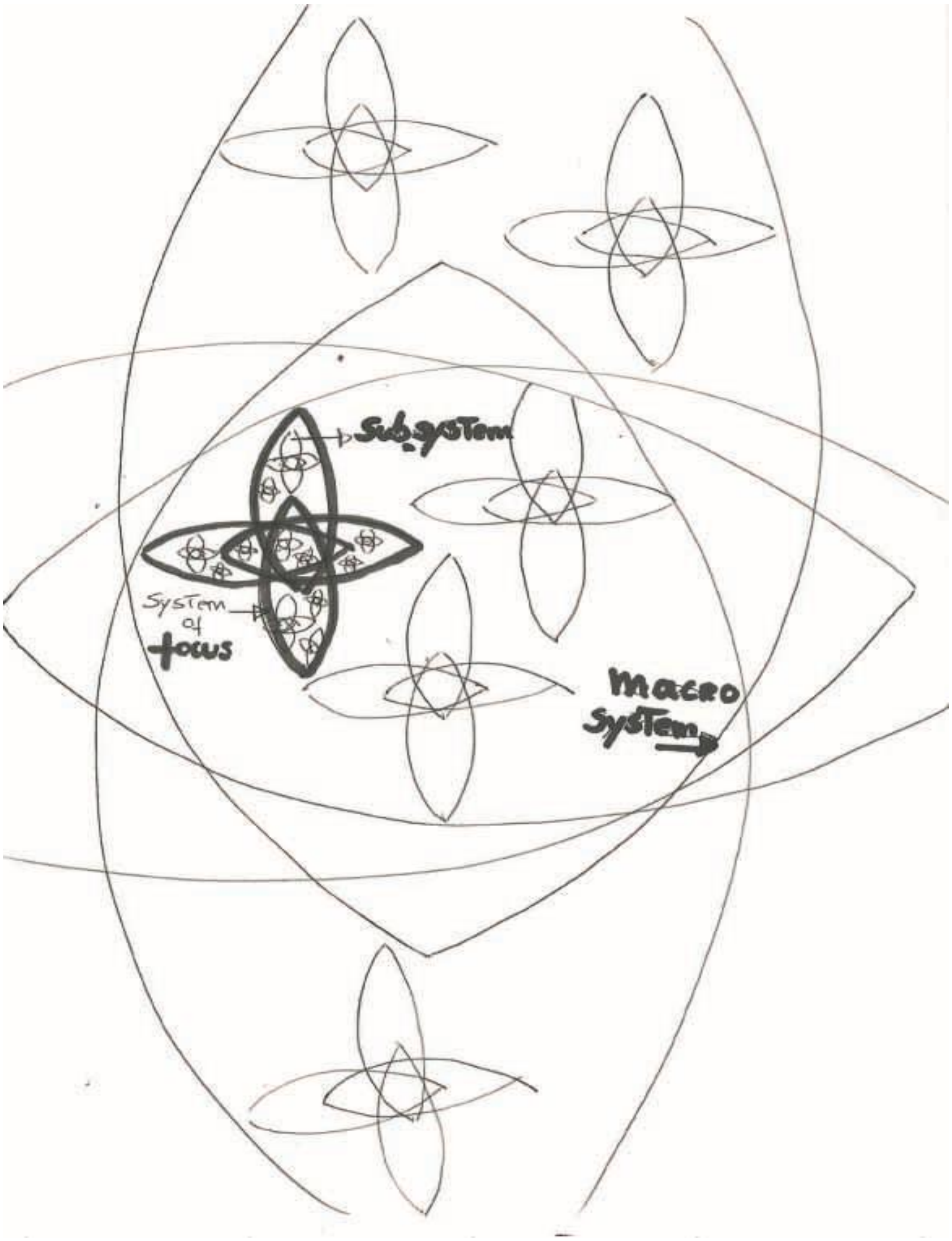

Figure 16: Nested hierarchies organisation implicit in the EIMS basic model. Visualisation of the methodology used to characterise the system of focus. To characterise the system of focus one needs to characterise not only the four relevant aspects of the system, but also its relevant macro and sub system

However, they normally require expert skills to be used in a meaningful and efficient manner. Consequently, multilevel representations of social organisations are not appropriate to be used either as an everyday tool or as a common framework to share information across different urban actors.

To be used as an everyday tool we had to simplify the multilevel models. In EIMS basic models the notion of nested hierarchies is not explicit, as in multilevel models. It is implicit in the methodology needed to characterise the system of study.

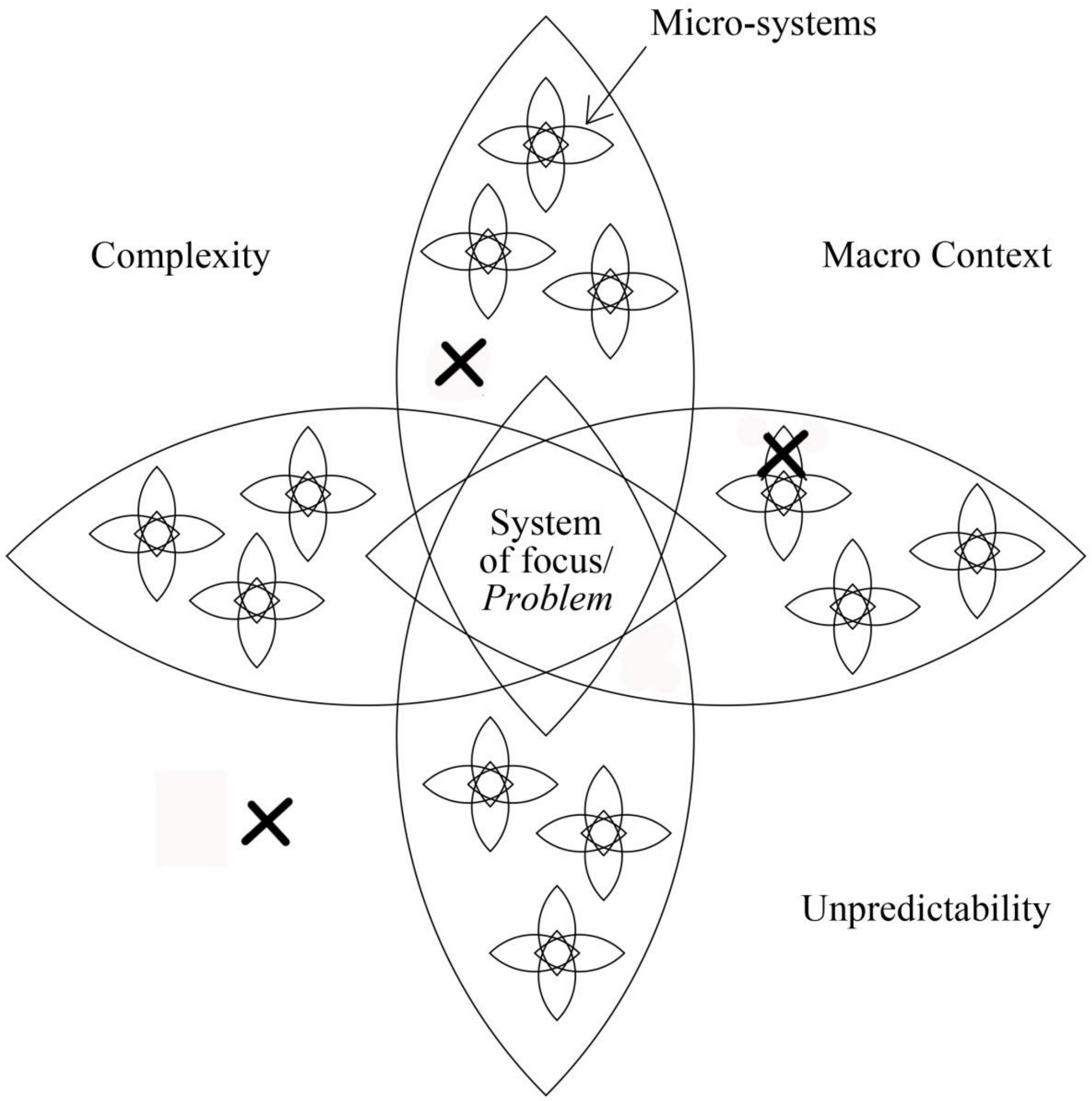

Figure17: Methodology to characterise the EIMS basic model and the system of analysis. It suggests that by defining the group of focus one defines not only the system of analysis but also the macro-systems and the subsystems relevant for that specific study. The macro-system is what we previously addressed as the system external. The subsystems are the systems that characterise what we previously addressed as the system internal. These subsystems might be subdivided and organised in infinite ways and they define not only the problems one wants to solve but they are also used to define and contextualise a solution.

In light of this, on the one hand it is of key importance to define clearly the heart of the system or the exact system one aims to study. It is important to define who and what we want to analyse because that clarity will help to define the subsystems which are relevant for that analysis as well as helping to relate the system of focus to a greater whole. Following the example above, the investigation about criminality among teenagers could lead us to say that the total group was composed of 50% Scottish, 10% Moroccans and 40% English. Of these, 50% were catholic, 10% Muslims and 40% atheists. These subgroups help define our group of focus and help relate it with problems of a higher hierarchical level, such as integration, regional imbalances and the history of the country.

On the other hand, the nested hierarchical character of the system should also be used to reflect on the solutions, or strategies to respond to that problem. All intervention areas are also characterised by smaller self-similar systems. In this way, as we will see, interventions can be applied or generated by any specific subsystems or macro-system and be represented accordingly in EIMS basic model.

The characterisation f the macro-system is also relevant for the understanding of the system of focus. The outside circle which defines the macro-system is just a simplification of very complex issues. To contextualise a system with its macro-context one needs to reflect on the things the system needs from its environment and what can it give back (Banathy, 1996).

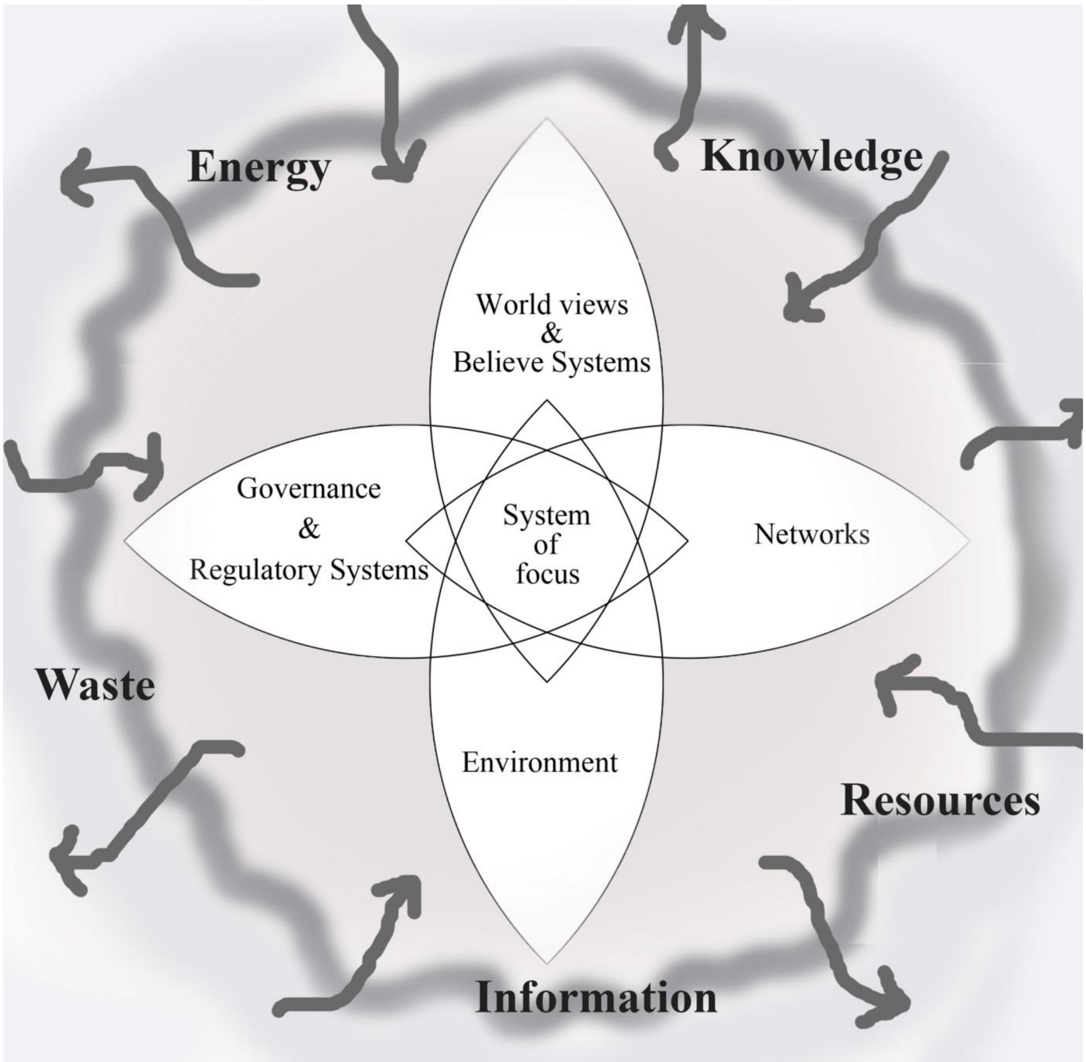

Figure 18: The EIMS models and the representation of the macro-system. It represents an exploration based on systems theory on how to relate EIMS models with a broader environment or a macro-level of the system. It represents a way to contextualise the system of focus in relation to a greater whole by identifying what the system needs to exist and what it can give back. This image also represents an exploration on how to translate these findings into actions able to improve the system. The red sparkle represents the nature of the problem which is blocking the full potential of the system from being expressed and the green dot marks the nature of a possible intervention to address that problem.

Defining the needs and possible contributions of the system can be of key relevance to find a strategy to address a given problem or to formulate a vision or a common aim to achieve (Loorbach, 2007). The characterisation of the system of focus in relation to the macro-levels of the system might help to discover the uniqueness of the system in relation to the whole. This can help defining types and areas of intervention which transform that uniqueness into a contribution that benefits the system as a whole. Following the example above, investigation might reveal that most of these teenagers depend on social security to survive. Nevertheless, some are interested in sports, others in crafts and others in helping people in need. These ingredients might be the basis to reflect on strategies to unlocking unwanted synergies in the system as a whole.

An important issue to take into consideration is that the analysis of EIMS and its models is dynamic; system and subsystems should be erased or added when needed.

In short, EIMS basic model is able to perform all the tasks of the multilevel model but it has a more simple and pragmatic form (Timmermans, 2012). They are able to relate the system of analysis not only with the macro-levels of the system, but also with the micro-levels of social organisations.

The way the models engage with the notion of nested hierarchies can be represented in the models but is directly related to the methodology needed to characterise the system one aims to study. EIMS basic models work as a framework that crosses all levels and areas of any social system. It is scales; it can be used to characterise both of an individual or a society. They can be used to reflect on the dynamics of a country or even the world.

Until now the EIMS basic model has been described as a framework to characterise social complex systems in a holistic manner; a framework of thinking. Now we will explore the potential of the model to relate social complex systems with human actions.

Interventions in the context of the EIMS

One of the main contributions of EIMS models is that it relates interventions or happenings with a specific context. In this exploratory model, the interventions on which we want to focus our analyses are marked as a sparkle in the EIMS basic model. This sparkle represents something we want to investigate in relation to the background system.

One can consider either past interventions or future interventions; One might aim to understand how past interventions shaped the reality we see today or speculate about how a possible intervention can shape the future development of an urban system.

On the one hand, depending on the study, interventions can be marked according to their hierarchical position in the system or the hierarchical level of their source; That is to say, the building of a basketball field can be marked as an intervention in a specific subsystem because it’s targeted to influence the dynamics in behaviour of a specific sub-group. However, it can also be placed in a higher representation of social organisation because it is a governmental initiative. Normally speaking, we assume that strategic interventions are originated from the top-down; therefore the interventions are normally marked on the target group one aims to manipulate. Interventions can target both groups and sub-groups of focus and macro-levels of social organisation. Therefore they can be placed both inside and outside the system of focus.

On the other hand, interventions are also marked according to intervention areas. In other words, adding to the categorisation made in chapter 4, one can use the model to define the aspects of the system in which one aims to intervene. That is to say that one can use the EIMS models to define strategic interventions both in terms of their kind and in relation to a social hierarchical level of focus. A basketball field would be most possible marked as an intervention in a sub-system of the building environment.

The general characterisation of interventions explored in chapter 4 is independent from EIMS basic model. Each of the four intervention areas of the system include the categories explored in chapter 4 and eventually many others that were not addressed in this thesis. All interventions, regardless of their position in the system, need to be categorised according to their scale, according to the time they take to be implemented, to their strategy of implementation, to the predictability of their consequences and so on. Regardless of this categorisation, interventions can be marked in all intervention areas defined by the model.

In short, a strategic intervention of analysis is defined in the context of the EIMS by the combination of the categorisation explored in chapter 4, its place in relation to the system's hierarchical levels of social organisation and its position in relation to the system's intervention areas.

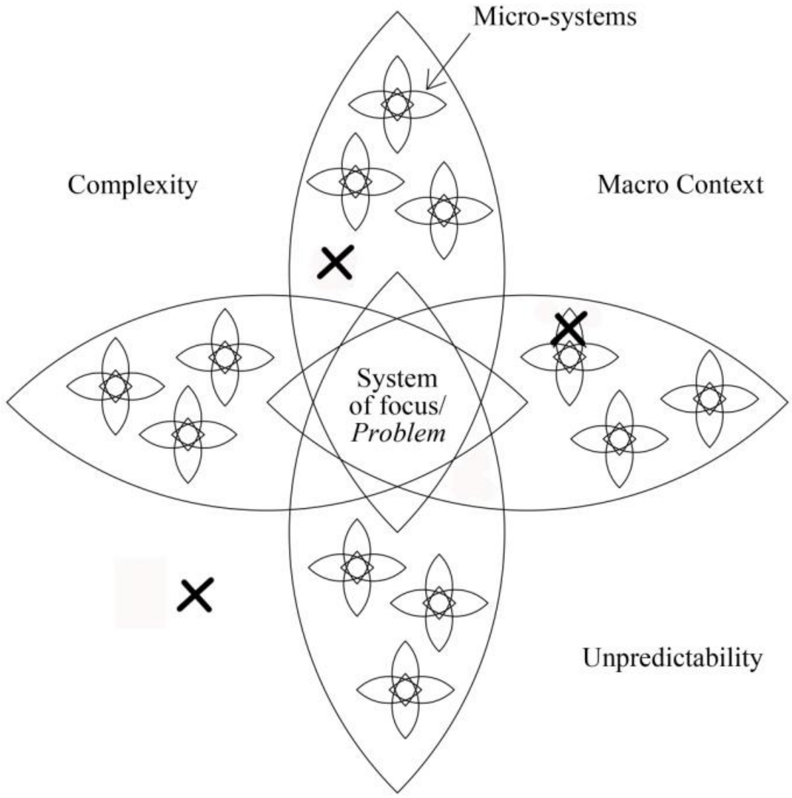

Figure19: Relation between key concepts presented in the literature review with the EIMS basic model. The image exemplifies how to characterise interventions in relation to hierarchical levels of social organisation and in relation to the systems intervention areas.

In short, figure 19 represents the relationship between the system of focus, the macro-system, relevant subsystems and different kinds of interventions. This relationship explains both the intention behind each intervention as well as the role and position of each intervention in relation to the whole system.

Interventions are defined in terms of their type by relating them to the model's four areas of intervention. They are defined in terms of the hierarchical levels by relating them with the system's sub-systems and macro-system.[7]

The EIMS basic model relates interventions to a specific time and a place. It relates interventions to one another as well as to the system as a whole. By making this relationship visual, other relations might be explored and new ideas or solutions might emerge. Consequently, we tested the ability of this model to serve as a base to support dialogue and exploration on urban systems. In addition, we have explored the potential of EIMS basic model to give a more holistic perspective of urban and social systems and inform the design and selection process of strategic interventions.

Who would use the EIMS basic model and for what?

We argue that the basic EIMS model can be used as a tool for professionals to analyse their intentions in relation to a specific context before they act on it. Professionals such as designers, architects, planners and decision makers could use this everyday tool-kit to establish views and strategies of action, select interventions and design interventions without having to have a profound knowledge of the overall complexity around the system of focus. The exploratory diagram will hopefully enable the user to have key aspects in mind when reflecting on a place, a city or a country and when designing and selecting interventions to act on it. We suggest that the EIMS basic model can help "professional urban actors" to:

- Characterise the context of intervention from a more holistic perspective.
- Establish common world views and a common vision for the future.
- Establish a strategy to achieve that ideal.
- Decide in what area/ areas to intervene.
- Decide what kind of intervention/interventions should be used to address the problem more efficiently.
- Decide in what social organisational level would be more appropriate to intervene.
- Select the most probable efficient strategies or action.
- Analyse how the micro and the macro-level of social organisations influence the system in focus.
- Design and conceptualise interventions in general and more specifically design buildings and public spaces which better serves human life and human development.

The EIMS basic model helps to relate social systems and the challenges they face with human actions. The model can be either used to find the source of a given problem or to design and select interventions or strategies to address that problem.

The EIMS basic diagram aims to represent society as a whole and illustrates the unpredictable and complex character of social systems. It is a framework of thinking which aims to express the impossibility of controlling complex systems. It is a framework where human actions are marked and urban reactions are analysed in an open-ended and continuous process.

The EIMS basic model helps define a clear common vision for the future and establishes the role of each part in relation to the whole. These are key contributions of EIMS basic model to establish the grounds for cooperation within and across different hierarchical levels of the system.

In addition, EIMS basic model can be used as a common ground to share information between different urban actors.

Testing the validity of these suggestions was the focus of the research's studies but more studies still need to be carried out. Study 1 was designed to test the applicability of the model in a real-life situation. Study 2 was designed to test the acceptance of the model and its clarity. The original model was adjusted according to the conclusions drawn from this study. Study 3 was designed to test in what way does the model influence the design process of an intervention in the building environment.

Summary

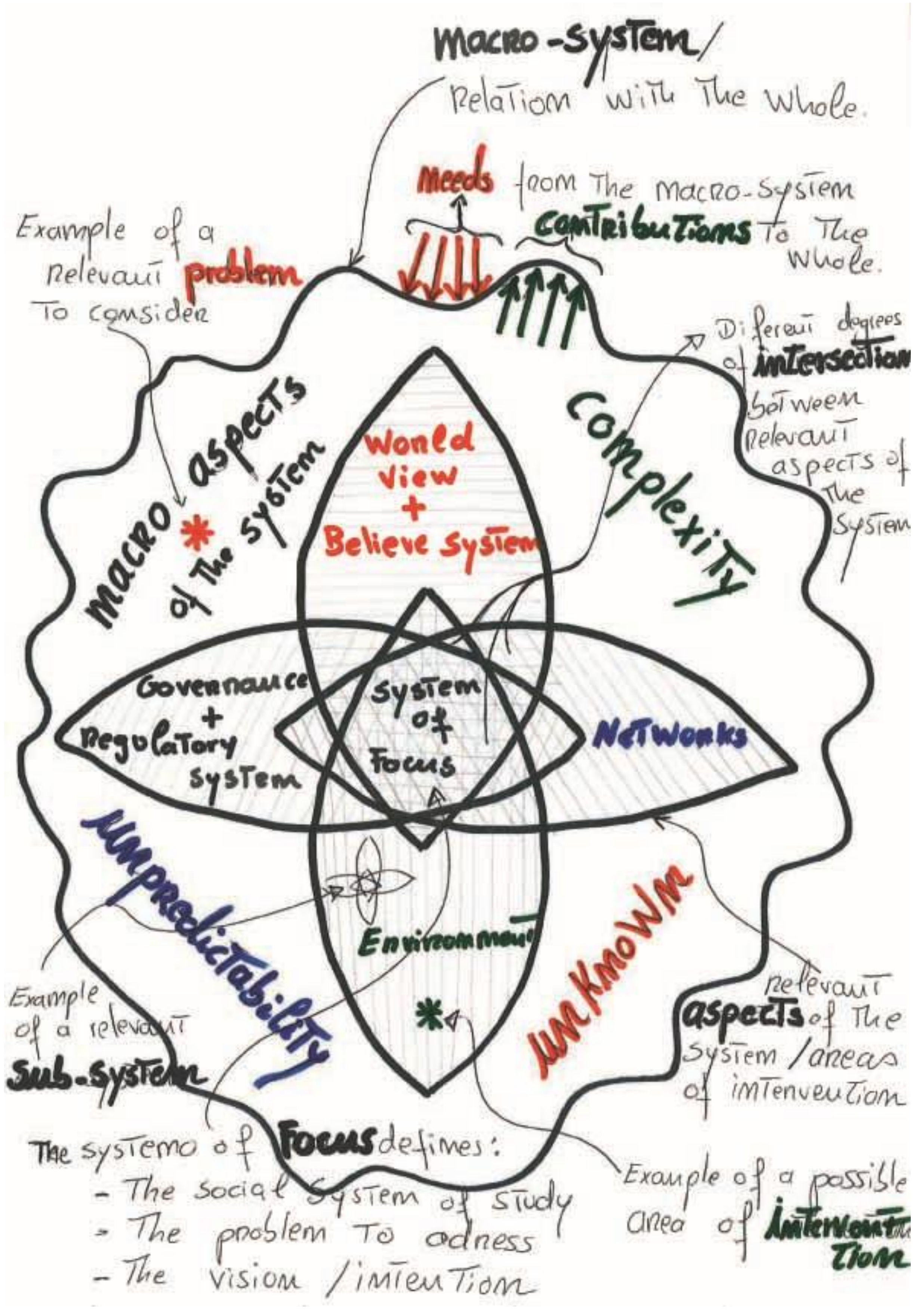

Figure 20: Summary of the research explorations to design the EIMS basic model.

The EIMS basic model tries to resume in a few schematic lines the key concepts of this research. In the literature review such concepts are addressed independently and perhaps the links between them are not even very clear. Nevertheless, they intertwine to shape the EIMS basic model presented here.

The concepts which gave shape to the EMIS basic model are:

- Cities are all made of the same things and yet they are all different. There is need for a general framework to be used as a guideline to think about specific complex systems in a holistic manner.
- Social and urban systems are complex systems. Complex systems are impossible to fully understand or predict.
- Society is organised in a nested hierarchy structure. A system is made of subsystems and is part of a bigger system.
- Each system or subsystem is a whole. Therefore conclusions taken from subsystems or aspects of a system can inform the system as a whole.
- Intervention areas are representations or perspectives of the system as a whole.
- Human actions are adapted to specific environments. If we understand the environment better our actions might be more appropriate. Therefore we need a framework able to relate people with their environment and actions.
- *Strategic Interventions* can be used as a catalyst for changes in the system as a whole.
- *Micro-interventions* disturb the system's self-organisation less.
- A common intention or vision for the future is needed to establish the ground for human cooperation.

The EIMS dynamic model: *From a picture to a film.*

The EIMS basic model represents a snap-shot of a reality of an urban system in a specific time. The EIMS dynamic model relates a social reality with time and change. In other words, the EIMS basic model helps to relate *Interventions* to a holistic picture of a specific social system. Still, it does not help visualising the dynamic and emergent character of that system. Consequently, the EIMS basic model cannot be used to study or manage urban or social change.

To study the changes in a social system we need a model that builds on EIMS basic model but adds dynamics to it. The EIMS dynamic model embraces all the concepts behind EIMS basic model, is simple and pragmatic but also engages with concepts of self-organisation and dynamic change. It makes visual the notions of time and evolution as well as of natural and emergent change.

The EIMS dynamic model can be used to represent human actions in relation to a social context but it also enables its users to envision and reflect on the consequences of their actions over time.

Therefore it can be used as a framework to guide the management of change from the perspective of human actions. It helps to contextualise human actions not only with the present reality of a social system but also with its past and future. It helps to monitor the emergent reactions of a social system to an intervention and therefore it allows the user to react to these changes in a consistent manner.

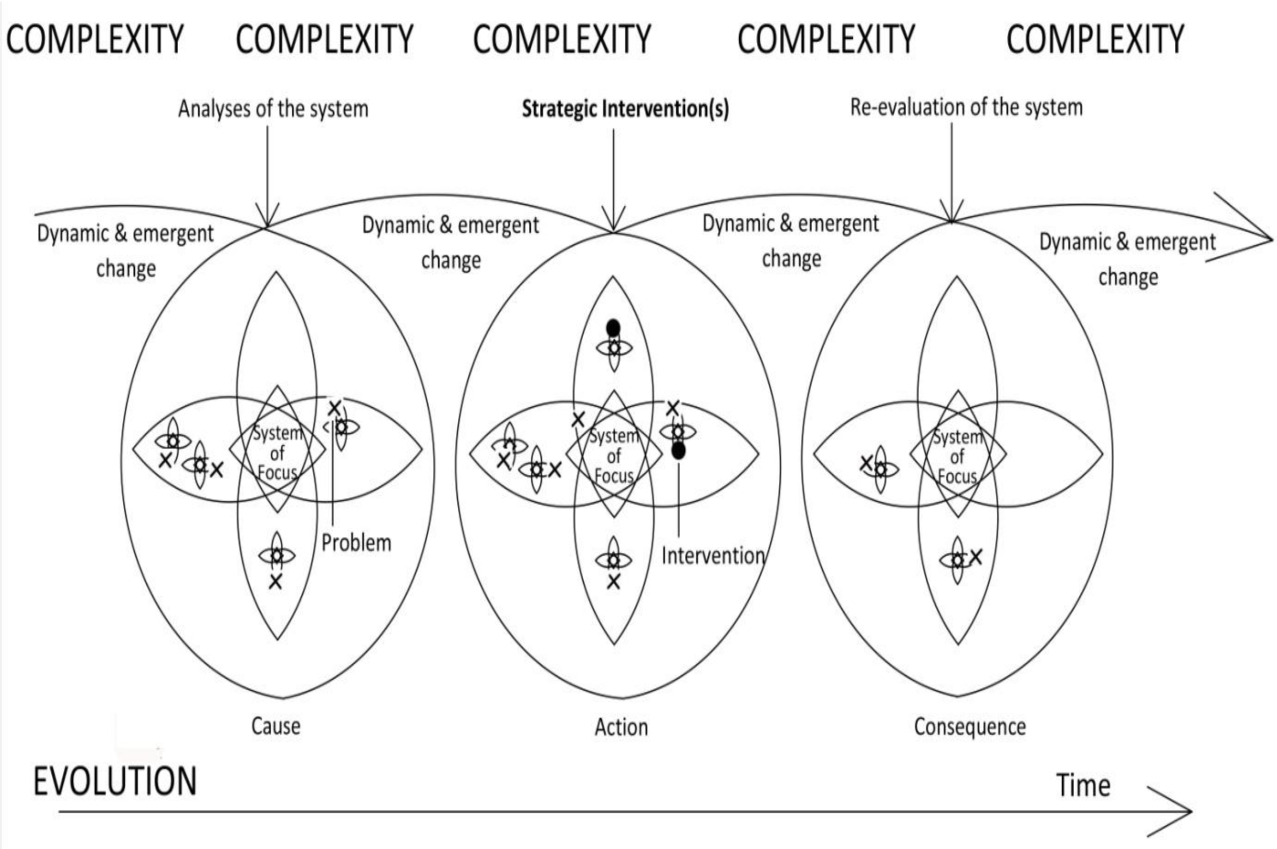

Figure 21: Relation between the EIMS' operational phases and the process of urban and social change.

Figure 21 represents the exploration on the EIMS dynamic model. The model represented here is based on EIMS basic model, but it adds the notion of:

a) Time and dynamic change

b) Self-organisation and emergent systems.

Following this, the new concepts introduced in the dynamic model are therefore: *complexity*, *evolution* and *dynamic change*.

Complexity refers to unpredictability; to what is not controllable; the unknown; the broader whole; the system external. Complexity is represented as the background. It is the ground where everything happens.

Evolution refers to time and continuity; it is also represented as a background of the systems and the interventions applied in it.

Dynamic change is related to the self-organisation of the system. It relates to the process of natural change and to the new social realities that emerge from it. This idea is represented in a form of a continuous loop which holds a sequence of snapshots – basic models – representing different chronological realities of the social system one aims to analyse.

Intervention refers to an action or a happening in relation to a specific context in a specific time.

Representing interventions in relation to time

In the EIMS dynamic model, interventions can be seen either as a cause of change or a consequence of other interventions. In other words interventions can be perceived as:

a) The cause of a future reality. Something that triggers change, regardless of whether that change is drastic or merges with the natural development of the social system. The time of an intervention is represented by an arrow placed at the intersection points of the dynamic change's loop. This representation of interventions states them as the cause of a future reality and it places them as the *intervention of analyses*. Following this, unexpected and significant happenings that cause abrupt change in the system should also be marked in the same way. They should be regarded as interventions that happen at a given time and influenced systems evolutionary process of change.

b) The consequences of change, of a happening or of an action. In other words, interventions can be considered as a sequence of happenings or actions which emerge as a reaction or a consequence of an initial intervention.[8] Interventions as consequences are analysed as part of the evolutionary process of change. They are implicit in the representation of the loop of change. In other words, consequences of previous happenings or actions merge with the notion of dynamic change. These consequences merge with the natural self-organisation of the system therefore they should be analysed in the context of evolution and the unpredictability of complex systems.

Representing interventions in relation to a context

The EIMS dynamic model enables the user to visualise interventions from several angels within a period of time. Therefore, interventions should be marked not only in relation to time but also according to their nature. They should be specified in the EIMS basic model represented within the loops of change. This enclosed area within the loops of the model represents the reality of a given system at a given time. By specifying the intervention within this model we are defining the character of the intervention and where in the social system that intervention took place.

EIMS basic model is always in the background of the dynamic one because it is the basis for comparison and observation. The basic model represents a chronological sequence of pictures of the system in analyses. Conclusions should be taken from the comparison of at least three realities of the system at three different stages of the process of evolutionary change; for example before the intervention, at the time of the intervention and after the intervention.

The EIMS dynamic model should be used to reflect on the possible future consequences of human action or to learn from the consequences of past interventions. After analysing the process of change of a system within a period of time decisions can be made to intervene in the system again or let it follow its natural evolutionary process.[9]

Operational and methodological approach

In this part of the text we will describe how to operate EIMS models individually and as complementary models. It will also describe how it can be used to support a management process as well as the design and selection of interventions. We argue that not only the models but the methodology suggested to use them will help selecting and designing more contextual and efficient human actions.

This methodology emerged from the literature review and the studies. On the one hand, the operational and methodological approach described here has similarities with the one suggested by Loorbach (2007) to guide and implement changes and innovation in institutionalised systems. On the other hand, it is the result of constantly adjusting the models as a response to the challenges the users faced to use them.

Figure 22 relates the operational phases of the model with the natural process of urban change. Therefore it should be used as a contextualisation of the description that follows.

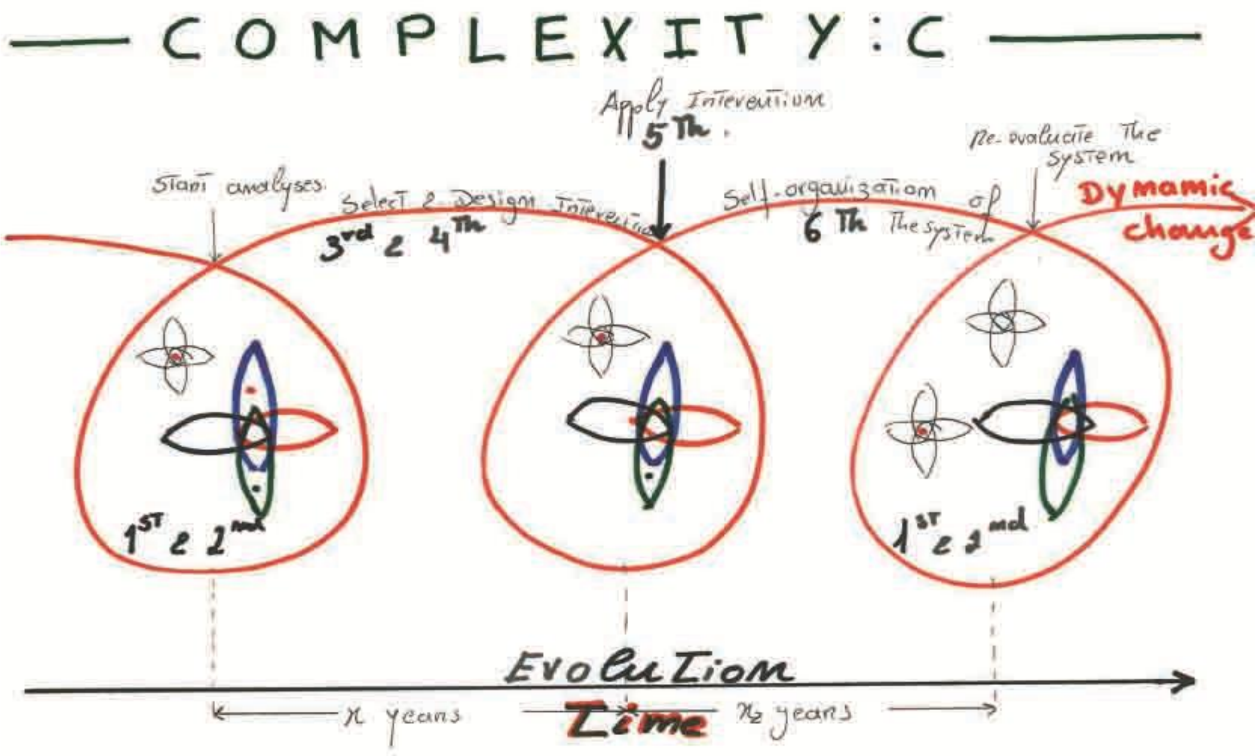

Figure 22: Relation between the EIMS' operational phases and the process of urban and social change.

First phase: Define the system of study

To define the system of focus we need to define the *EIMS basic model*.

The first step is to clearly define the model's core: The core of the model establishes the social system of analyses and the problems to be addressed. This is the phase where general meanings and world views are established. The assumptions made here will give a reason to all the steps and decisions that will come after. At this phase the social group of analyses and the definition of the problem are temporary. They will change or will be adapted according to the information gathered by following the methodological process. At this stage the definition of EIMS model's core is just the seed to start the process of analyses. It is the seed that enables one to address the system from different perspectives and start making the links between different aspects of society.

The second step is to characterise the system from the perspective of the four intervention areas: The system is characterised by defining each of the model's four main parts. To characterise the four different areas of the basic model one needs to have in mind the hierarchical character of the system. In light of this we need to consider the variety of relevant subsystems which are relevant to each of its parts and the fact that the focus system is part of a greater whole. On the one hand, this is the time to reflect on the needs or challenges faced by the different areas of the system. On the other hand, it is also the time to define what contributions the different areas of the system can offer to the subsystems and the system as a whole.

The third step is to look at the model again and try to see it as a whole. Consequently, the core of the model can, or should, be readjusted to give a more integrated perception of the system. At this point, after the research and the reflections made to characterise the model, one can redefine the system. At this stage one should define the contributions and what is unique in the system as well as the source of its problems. As a result the research question might be better defined, the social group in analyses might be adjusted and the vision for the future of the system might change.

We should also use this phase to identify the basic elements of the system which could be used to address the challenges identified in phase one and two.

Following the literature review, we suggest basing this reflection on the structural and basic elements of the system:

a) Human needs: health, wealth, food, water, security and sense of belonging, shelter, education and energy.

b) Space syntax: Streets, plots and buildings.

After identifying the structural element we want to use to manipulate the system, a possible interventions area should be temporarily marked on EIMS basic model.

In short, the first phase of the application of the EIMS models is to characterise the model in a way that it gives a clear idea of the system of focus and relevant subsystems. This is the phase when we define the systems needs and its potentials. We study the source of the system's problems and define a common vision for the future. After that we start to develop general strategies to address the system's challenges.

Second phase: Suggesting an intervention or an intervention system

This is the phase to clearly define strategic actions to address the system's problems. This is the phase where one clearly defines the aims and intentions of an intervention as well as who the people are who will benefit from these interventions and in what way. This is also when it is defined where in the system is most appropriate to intervene. The methodology to define a strategic intervention of a system of interventions goes as follows:

Step 1: First the users will focus on the basic model.

The EIMS models can be applied by independent individuals or groups. In either case, this is a phase for reflection and discussion. If the model is being used by a group, this is the time to debate the system and the actions to take to improve human life in it. From the debate, based on the EIMS basic model, strategies for adequate action will hopefully emerge. At this stage EIMS basic model becomes a common framework and a shared language which can be used as a common base for discussion. This reflection will lead to a more precise definition of the problems and of the intentions behind our actions, which in turn will shape the design and the selections of the interventions .This is the phase when interventions or system of interventions are suggested in relation to the system of focus.

The same happens if the model is being used by a single individual, with the difference that the process will be more focused on reflection rather than discussion.

At this point, interventions have to be marked as actions or happenings in the model. They can be either marked inside or outside the system of focus.

Step 2: Second the users will use the *EIMS dynamic model*.

Now is the time to engage with the notion of time and unpredictable change in relation to the interventions suggested for the system.

To characterise the EIMS dynamic model the user has to:

First, join the two models together; *EIMS basic model* should be used as a background of *EIMS dynamic model.* The EIMS basic model, which emerged from the phases above, should be placed within the loops of change represented by the dynamic model. The EIMS basic model should include the representation of the intentional interventions for the system.

Second, interventions should be marked in relation to time. An intervention of focus should be interpreted as a cause of change. It should be marked with an arrow on the line of the loop of change which encloses the basic model. In other words, interventions of focus should be seen as an action which will trigger change in the system; therefore, it should be marked in the continuous loop which represents dynamic and unpredictable change.

Third, if the purpose of the study is to select or design strategic interventions, the user should use the models to reflect on possible reactions of the system in different points in time. Users should try to define several future basic models to reflect on the system's reality soon after the intervention is implemented and in the long-term. To do this the user should reflect on the possible influence of the intervention in all four intervention areas of the system and try to imagine how one can influence the other. These explorations should be places within the evolutionary loops of the dynamic model and should be considered as part of a continuous evolutionary process.

This exercise will oblige the user to think in terms of complexity and unpredictability. The aim is not to predict the future of urban and social systems. As argued in the literature review, that is an impossible task. The aim is rather to engage the user with thoughts about the consequences of their actions and how those actions will shape the future reality of the system.

If the purpose of the study is to monitor or understand the process of change of a system in relation to a given action, then the study should also take into consideration the reality of the system prior to that action. In other words, to understand the process of change one needs to engage with the notion of urban and human evolution; therefore, one needs to consider past present and future to perceive a direction of change. Only then one can eventually make the link between a motion of change and a specific intervention.

Third phase: Try different options and share opinions

The third phase is to try several alternatives and select the best option. To select or define an action one has to take into consideration the knowledge acquired and has to reflect on different strategies and possible different future scenarios.

According to Hodgson (2011), this is the phase where we look at the connections between the elements of the system and explore future possible consequences. This is the moment when we deal with the unpredictability of complex system and define the best strategies to deal with it. In the context of Hodgson's "games", this is when the *wisdom consul* comes forwards and shares their perspective of the issues in hand in light of a more holistic vision of the problem. In the context of *intervention management* this is also a time for sharing perspectives, ideas and knowledge. This is a time where both EIMS models can serve as a base to share information and strategies across different hierarchical levels of the system as well as between actors operating in different areas of the system.

By reflecting on the future consequences of several strategies in the context of the whole complex systems one should be able to select what apparently is the best option.

Fourth phase: Defining or designing the selected option

At this point the general idea about the desirable strategic interventions is formed. By now the user should know the intentions of the interventions and their character. In addition, it should be clear where exactly in the system the intervention is going to be implemented and which areas or levels of the system it aims to reach.

These conclusions can be translated into a final model or a summary diagram which will serve to define further the interventions and bring together the professionals needed to implement them. In the context of interventions in the building environment these conclusions can be materialised in the form of a sketch or a list of design intentions. This will be the base to define the design concept which, in turn, will give shape to the design and the interventions itself.[10]

Before implementing the intervention, one should verify if there were significant changes in the system during the process of negotiation and design. If there were significant changes in the system or in the system's dynamics, the intervention should be re-evaluated or adjusted accordingly.

Fifth phase: Implementation

After designing or characterising the selected interventions, the time comes to implement them. This is the phase when one actually implements an intervention in the system of focus or in the context of analysis.

At this stage the model can serve as a base for communication between all participants in the implementation process. This is when the pragmatic character of the model and its potential as a tool to induce cooperation will be put to the test. At this stage the model has to be clear in expressing a common intention and transmit the idea that all participants have a key role to play and are themselves part of the system.

Sixth phase: Monitoring the system

The monitoring phase is related to a top-down concern with the dynamic and unpredictable changes of a system. In other words, the analysis of the system's reactions to an intervention is only relevant for top-down management of long-term urban change.

In this context the EIMS models can be used as a tool to support the monitoring of the system and suggest interventions to readjust it when is needed. This role of the EIMS models is then to guide and support the kind of management suggested by this thesis;[9] it relates to the hypothesis of managing urban and social change through the management of human intervention.

The kind of management suggested by this thesis implies all the phases of the methodology suggested here. It requires:

- The analyses of the system at several points in time
- The selection and design of the intervention
- The implementation of the interventions
- The monitoring of the system's evolution.

When the system is not emerging towards a desirable direction the intervention management cycle should be reinitiated. In other words, when the expert would expect that another intervention is needed to re-adjust the path of urban and social change, the EIMS operational process should start all over again; one would need to define the system again and the strategic interventions needed. After these interventions have been implemented in the system, the monitoring phase should start again. This process would consist of acting strategically in the social system, monitoring the system's reaction and act on the system in case it's needed.

In case the self-organisation of the system is satisfactory no strategic intervention would be required. Having an overview of the general dynamics of the social-system in analyses might be relevant to allow one to address the problems promptly and adequately as soon as they emerge or even before they emerge. Cellular automata models can support this, more pragmatic, analysis. Eventually information can be shared between the models and more informed conclusions can be drawn.

Monitoring is a role for experts and it was not the focus of our studies. We focused on professionals such as architects and decision makers and on the way they could contribute to sustainable management of the system from an emergent perspective.[9]

In other words, in the case that the EIMS models are used as an everyday tool for practitioners such as architects, the monitoring phase is not applicable. As we concluded from the literature review, we act on the city based on the reality we encounter at that specific time and space. Regardless of whether our interventions triggered the expected consequences or not, the reality of a future intervention will always be different from the previous ones. Future interventions will always have to address the consequences of the previous ones; therefore, an analysis of the system is always required before intervening in it.

According to this research the constant process of analysis of the reality of a complex system before intervening in it is, the most efficient way of addressing the problems; it is the most efficient and flexible way to deal with the unpredictability of complex systems and eventually lead urban and social development towards a sustainable direction.

The phases described here do not have to necessarily happen in this given order. The sequence of the operational steps is related to the users' intentions when using the models.

The EIMS models can be used to:

a) Explore possible interventions to address a given problem.

b) Explore possible interventions to achieve a certain intention for the future.

c) Explore the adequacy and possible emerging consequences of a given intervention.

In the first it makes sense to start by using the models to explore the problems, formulate an intention for the future and finally explore interventions which satisfy both.

In the second possibility it makes sense to start using the EIMS model to explore the adequacy of initial intentions in relation to a present context both from the perspective of micro and macro social organisations. Secondly, it makes sense to explore the challenges and potentials which could be used as interventions and, finally, reflect on the intervention itself.

In the third possibility it makes sense to start the study from the perspective of the intervention. From here the models could be used to explore how the interventions could be adapted to address contextual challenges or to merge easier with the implementation context.

Ideally we would like to translate the EIMS methodology into a computer program or an application. Such an application could be used to facilitate and direct the user's explorations through the reflection process. In the present research we used the exploratory theoretical models to test the impact of such a framework in the creation of more adequate interventions in the building environment. In the future we could use the computer model to bring more depth to the study and explore alternatives. The findings collected from the use of such a model could form the basis for a new tool to support the design and selection of both top-down and bottom-up interventions.

Summary

The EIMS models are a visual representation of the most relevant assumptions which emerged from the research's literature review. They are designed as both an exploratory working tool to support the design and selection of interventions and a framework to test the main conclusions drawn from the literature review.

In other words, the models are especially designed to support the work of professionals, who intervene in the city daily. They aim to be a working tool to help professionals to reflect on the intentions behind their action in the context of social complex systems. These models can serve either to support the selection or design of interventions or strategies of action. The EIMS models can also be used as a framework to support a new kind of management system. A management system that is based on a continuous dialogue between human actions and emergent reactions of the system.[9] The EIMS dynamic model aims to help its users to manage the process of change by facilitating the selection and design of strategic interventions. In light of this the EIMS dynamic model serves as a framework to:

- Analyse complex systems.
- Relate interventions or short-term actions with long-term visions or intentions for the future.
- Visualise the influence of one action across different aspects of the system through a period of time.
- Visualise the influence of one action across different hierarchical levels of the system through a period of time.
- Design and select more adequate interventions in complex systems.
- Monitor change and support a coherent and continuous dialogue between intentional human actions and emergent reactions of the system.
- Share information and a common vision across hierarchical levels of the system and across the people involved in the process.

Chapter summary

We started this chapter by explaining the reason why we used qualitative research and case studies as the research methodology. Following this we described the research tools we designed to test our hypothesis, and explore new findings.

The EIMS models put both the problems and the solutions of social systems in the contexts of complexity and uncertainty. In addition, they engage with notions of time and of cause and emergent effect. Hopefully, EIMS models will bring more awareness to people and give them a sense of responsibility for their actions.

The EIMS models are a tool to analyse the reality of any social system at any given time. They are a tool to define strategies to intervene in the system adequately. The EIMS models can be used to support the selection and design process of strategic interventions or strategies. They can be used as a tool for communication across different hierarchical levels and people involved with different aspects of the system. Additionally, the models can be used to form coalitions between the people involved with the interventions management process. Finally, the EIMS models can be used as a tool to support *Intervention Management*; they can support the eternal dialogue between men and their environment. And, the strategic interventions that emerge from that dialogue can be used to guide the process of urban and social change.

Tackling of the problem and the acknowledgment of the situation emerges from the methodology needed to use the models; it emerges from the elaboration and the analysis of the models themselves. The models and the process of making them will lead to an intention which in turn will lead to a definition of an intervention. A clear conceptualisation of the intervention will lead to its design, a definition of a strategy or of system of interventions.

We used three studies to test the applicability and the acceptance of both the models and the methodology to use them. We tested the models from the perspective of decision makers and future architects and construction managers. We used the studies to develop the models themselves and to adjust phase one and two of the methodology. Further tests are needed to test the methodology described further. In other words, this research's case-studies focused on EIMS as a tool to better understand a certain social reality and to develop a vision for the future of a social system. We tested the models as design and selection tools. We did not test the efficiency of the models as communication tools nor as a framework to guide top-down long-term management. The conclusions taken from more case studies would contribute to adjusting the model and the methodology suggested in this thesis.

EIMS models are not fixed or complete; they are just possible models, to help us manage urban and social change by designing and selecting more adequate human actions. The relevance and efficiency of the model is strongly related to the people using it and the context of the situation.[11]

Chapter 6: Studies

Introduction

In chapter 5 we established the used of case studies and qualitative research as the methodology to guide our research explorations. In addition, we have introduced the EIMS models[1] as a visual representation of the literature review's findings, as a tool to explore the last two research objectives and test the research hypothesis as well as a framework to insure objectivity in the research process. In this chapter we will address how this methodology was explored in three case studies.

On the one hand, this research's studies investigated the acceptance of the planning strategy explored by the research; the use of strategic interventions as a tool to nudge change. One the other hand, we used the studies to improve and question the validity of the exploratory framework developed in this thesis; we used the studies to address questions such as, are the EIMS models applicable in real-life scenarios; in what way? Are they useful? What are their strengths and weaknesses? How can we improve them?

Study 1 tested the acceptance of the philosophy behind the EIMS models and its possible applicability in a real-life situation. It also tested the openness of decision makers to use micro-interventions as a strategy to nudge urban change. In addition, this study served to develop a deeper understanding of the dynamics in a real-life process of designing and selecting interventions in Aberdeen's building environment. The data was largely collected from the researcher's personal experience as part of the intervention's selection process.

In study 2 we have tested the acceptance of the thesis exploratory management strategy in an academic context. In addition, we used the same study to test the clarity of the EIMS models and see the difficulties participants would have in operating it. We also tested how effective the models were as a tool to guide people to emerge with a deeper evaluation and understanding of complex systems and their dynamics.

To explore the acceptance of the use of micro-interventions in Study 1 and 2 we used a second research tool which we will explore in the studies' context; MIS (The micro-intervention system).[2] The *micro-intervention system* was used in combination with the EIMS models.[1]

Study 3 focused on the role or architecture as a potential tool to nudge urban development. We used future architects to test, on the one hand, their awareness of the deep relationship between the building environment and human character and how one deeply influences the other (Ponty, 1962; Wilson, 2011). On the other hand, we tested their awareness of the city as a complex open system

(Portugali, 2000). Then we tested to what extent would the EIMS models increase that awareness and in what way did that influence their design process, their design concept and their design object.

All studies were developed in Aberdeen city centre.[3] Nevertheless, study 1 and 2 focused on the Union Terrace Gardens as the research context [4] and study 3 was open to any specific site within Aberdeen city centre.

Introduction to study 1 and Study 2

In study 1 we tested the acceptance and applicability of an alternative management system in a real-life situation and in study 2 we tested it in an academic context. The studies focused on two distinct but correlated issues:

a) Little attention has been paid to the potential of using *micro-interventions* to nudge urban change. In these studies we tested the acceptance of this urban management strategy as alternative management system.
b) Explore the applicability of the EIMS as a framework to help the selection and negotiation process of intervention in the building environment.

We used the *micro-intervention system* (MIS) [2] to test the acceptance of *micro- interventions* as a tool to nudge urban change. The *micro-intervention system* was presented as an alternative to two other large-scale interventions suggested to the same site.

We used the concepts behind the *explorative intervention management system* and the EIMS models[2] to investigate and improve the process of selection of interventions to be applied in the *Union Terrace Gardens* in Aberdeen. In addition, in study 2 we tested the clarity of the models and the efficiency of their operational methodology.

Research context: *The Union Terrace Gardens*

Both study 1 and 2 focused on *The Union Terrace Gardens* [4] as the context for the interventions of study. The gardens are situated in the heart of Aberdeen city in the UK.[3]

Union Terrace Gardens (UTG) are situated in the small Denburn Valley which passes under *Union Street*; “The centre” of Aberdeen city. Along with the gardens, the valley is now the route to the railway and to the oversized Denburn Road; elements which have a very strong impact on the character of the gardens.

Figure 23: North view of the Union Terrace Gardens. Street perspective taken from Rosemount Viaduct

Figure 24: Google map's aerial view of the Union Terrace Gardens and its direct urban context.

Besides being considered by many as the heart of Aberdeen, one of the unique particularities of this garden is the fact that it links two different levels of the city as well as two different periods of time. The gardens link the "higher city"- Union Street and the urban areas which emerged after its construction - to the "lower city" - the medieval neighbourhood which relates the old city of Aberdeen with the harbour.

This difference in height is best appreciated from the top of the *Union Bridge*; the majestic arches over the Denburn Valley which expresses the topography challenges involved in building Union Street. From Union Bridge one has a magnificent view from above, over the gardens, the old carriageway which is still functioning and the old building of Belmont Street. Without being an archaeological site, this view reveals Aberdeen's history at one glance.

In addition, from here one has on the back the busy urban life of Union Street and can see on the opposite side of the gardens, *His Majesty's Theatre* and the library.[4]

"*They* (the gardens) *remain not only a surviving fragment of the original level of town, but they mark the place where the new city soared above the medieval town, a memorable part of Aberdeen's heritage*."

(Morgan, 2008)

Context of selection

Study 1 focused on the selections between three possible interventions The *micro-intervention system* (MIS), ACSEF's Intervention; *The city square* (CS) and the Peacock Visual Arts' centre (PVAC).

Study 2 focused on the selection between only two interventions, The *micro-intervention system* (MIS) and ACSEF's Intervention; *The city square*

The research suggested the *micro-intervention system* (***MIS)*** as a strategy to improve the character and dynamics of the city as a whole. The *micro-intervention system* is the translation of the literature review's findings in an urban design project for the *Union Terrace Gardens* in Aberdeen. The project was developed in the *Robert Gordon University* in a workshop conducted by the *Prince's Foundation* in August 2009.

The *micro-intervention system* was very much in line with what the *Friends of the Union Terrace Gardens* wanted for the place.[5] The research suggestion implied the preservation of the existing site and the implantations of a system of small scale key interventions to trigger urban change.

Option 1: *The micro-intervention system:* ***(MIS)***

The micro-intervention system project aimed to use strategic micro-interventions in the building environment to improve the character and the social dynamics in the gardens and consequently the dynamics of the city. The acceptance of the management approach suggested by the micro-intervention system was tested both in study 1 and 2.

The project aimed to address two main urban problems: Urban connectivity and the lack or the misuse of the gardens.

Urban connectivity:

Aberdeen city centre is characterised by the simultaneous existence of two urban levels which express two different ways of experiencing the city: The lower Aberdeen and the higher Aberdeen. The lower Aberdeen is nostalgic, represents the comfort of history, and connects the green fields of the valley with the harbour. It's a charming place for pedestrians. The higher Aberdeen represents the more modern and dynamic city; the city of consumerism and the internet. It's made for traffic and the use of a car.

The system of interventions suggested for Union Terrace Gardens can help to establish continuity within each of these two different urban levels, which at the moment are fragmented. Furthermore, it can connect the two urban levels of the city. In other words, the UTG can be the connection point between the lower and the higher Aberdeen.

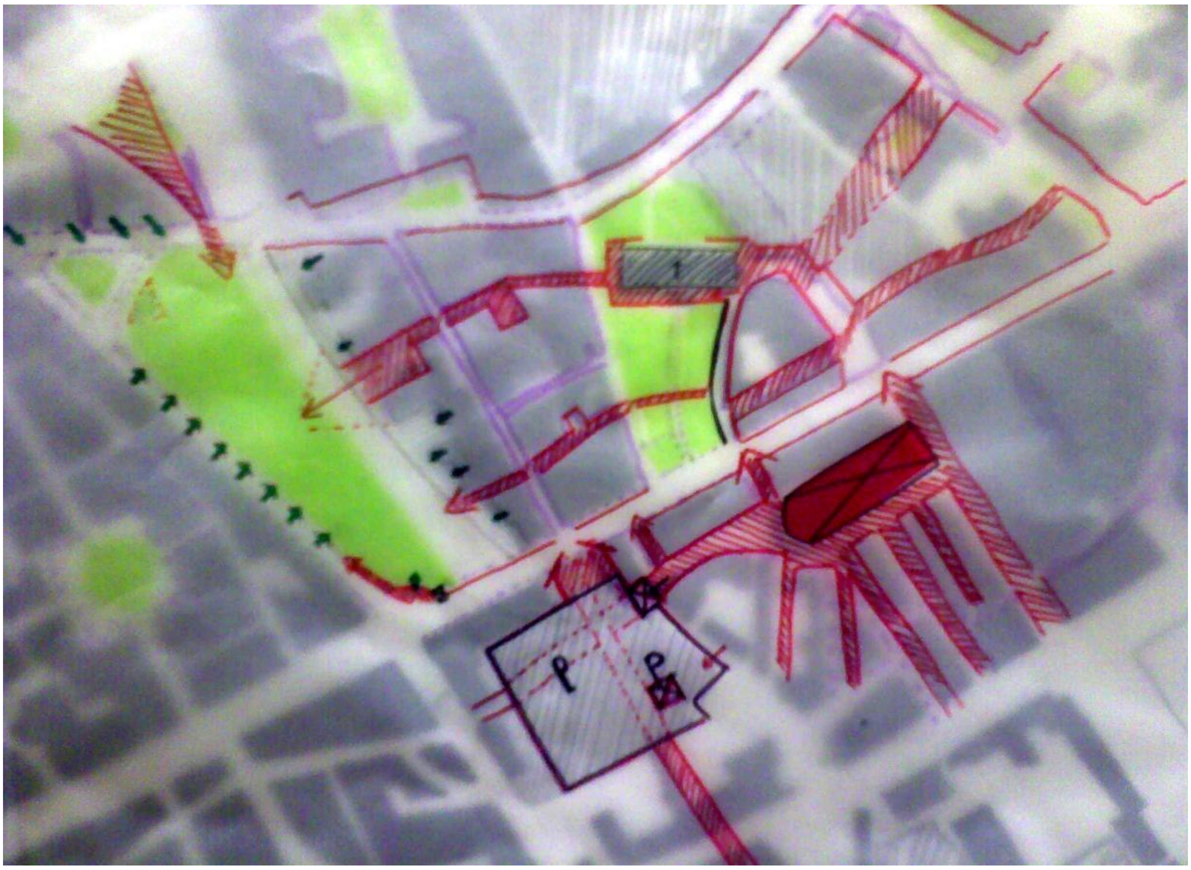

Figure 25: The MIS project's strategy

The lack or misuse of the gardens:

By addressing the problem of connectivity we will automatically bring more people to the gardens and start therefore also addressing the problems related to urban criminality. However, this is not enough and other interventions have to support the garden's social life. In light of this the micro-intervention system suggested interventions to attract both seasonal social activities and attract people to the gardens on a daily basis.

The *micro-interventions* suggested in the project are focused on the manipulation of the basic elements of the garden that have the potential to change human behaviour and human dynamics and therefore have the potential to change the urban and social system as a whole. The interventions suggested are small in scale, therefore they disturb as little as possible the emergent organisation of the system or any existing synergies related to this urban area.

Some of the interventions suggested were part of the original drawing of the gardens and many other were suggested by the people of Aberdeen.[6]

Each intervention had the target to address specific urban problems but they also relate to each other in a system (Geels and Kemp, 2005). Each of them has consequences to the broader use and character of the gardens which in turn will define the way other interventions will be perceived and used.

Our work was to make each independent intervention work as part of a bigger whole; a system which can have a positive impact in the dynamics of the city as a whole. Therefore, the interventions suggested by the project should be applied as a system. Nevertheless, there are interventions which have a more strategic relevance than others. And eventually they could also be implemented one at a time; however, the improvements in the gardens would probably be much less than when interventions would work together to support a common vision for the city.

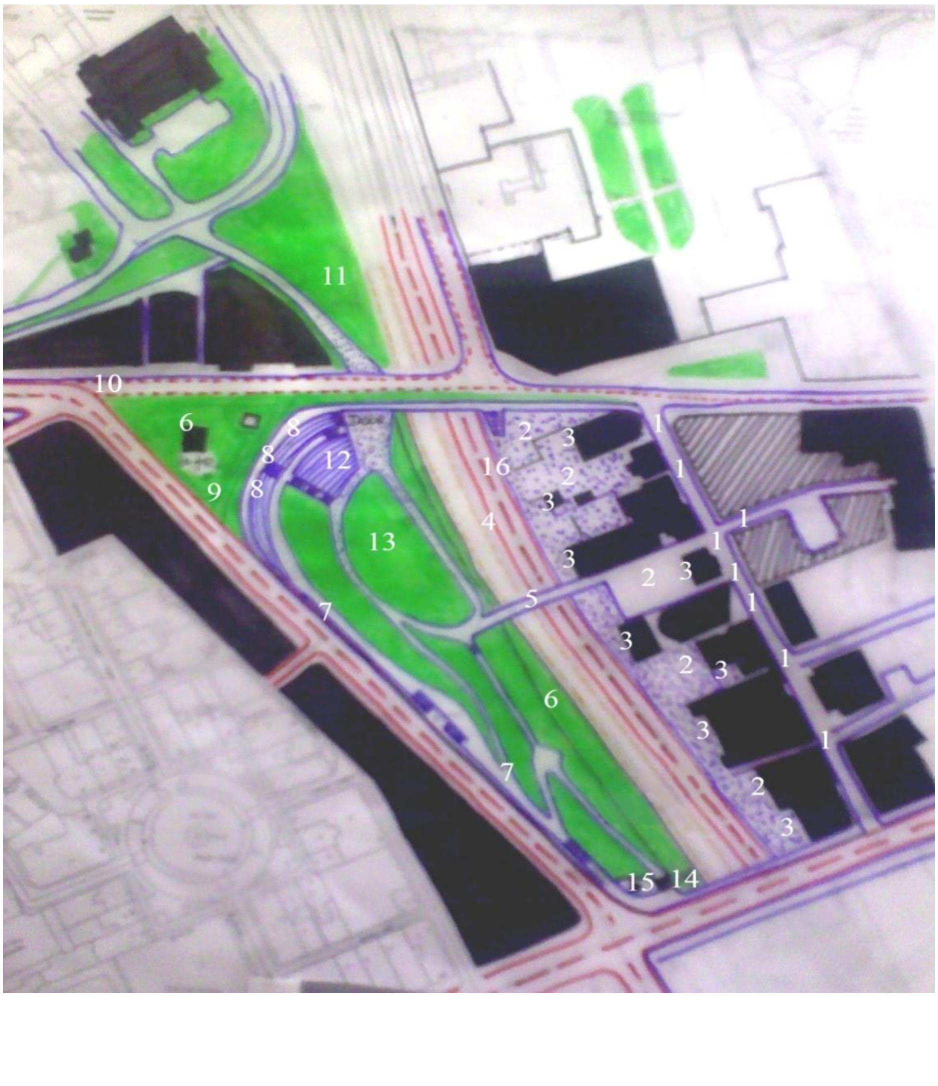

Figure 26:
The MIS project's interventions. Together with table 10 (appendix 2) this image illustrates and describes the interventions suggested by the micro-interventions system for the Union Terrace Gardens.

Option 2: ACSEF's Intervention; *The city square: (**CS**)*

The city square implied covering the Denburn Valley bringing it to the level of Union Street. According to the people involved in this plan, this would be the most efficient strategy to solve connectivity problems and to increment the gardens area. Furthermore, it would cover the railway and Denburn Road, features that according to many diminish the living qualities of the gardens. The several floors of underground space would be home to parking and the necessary functions needed to support life both at square level as well as in the underground levels. The underground area could be eventually used to host Peacock Visual Arts centre and much more.[7]

The city square was estimated to cost £140 million pound. Sir Ian Wood offered £50 million pounds of his private fortune to support this particular intervention. This proposal was supported by Aberdeen City and Shire Economic Futures (ACSEF) who created special internal group to support and promote the project, such as the *Project Management Board* and a the *Project Advisory.*

Option 3: *The Peacock Visual Arts' centre:(**PVAC**)*

In 2007 the *Peacock Visual Arts* centre suggested implementing their new home at the *Union Terrace Gardens*. They have made their intention public by promoting a project made by Brisac Gonzalez, where 3D animations suggested a very dynamic and modernistic building. With Brisac Gonzalez project, Peacock Visual Arts would guarantee £9.5 million of funding from which £4.3 million were donated by the Scottish Arts Council, SAC.

The project extended in length along the west side of the gardens. It would cover a great part of the garden's area and it would necessitate the cutting of the old elm trees; however, it would respect the topography of the place. To give back a bit of the green area taken from the city, the different level roofs of the building would be planted with vegetation. To address the problem related to the difficult access to and across the gardens, the building was shaped to form a number of ramps which would make the connection between the two levels of the city smoother.[8]

All three strategies suggested that the gardens had similar intentions for the site and for the city and therefore were presented as catalysts for a wider urban change. In addition, all three suggestions were intentional, originated from the top-down and implied the manipulation of the building environment. Nevertheless, the proposal suggested by Peacock Visual Arts emerged from the need for new installations rather than an active will of changing the urban dynamics. Both Peacock Visual Arts intervention and ACSEF's emerged from local organisations and from individuals deeply connected to Aberdeen city. The MIS emerged from an architect and researcher with no personal references in the city. It emerged from a rational contextual analysis of the problem and of the urban morphology. In addition, theoretical support emerged from the research to identify the basic elements of the UTG which could be manipulated to trigger greater change in Aberdeen city.

The main difference between the three alternatives presented here is the fact that the *micro-intervention project* was presented as a system of small scale interventions and the other projects suggested isolated, bigger scale interventions.

The next tables show the categorisation of the interventions suggested for the Union Terrace Gardens in the context of case study 1 and 2. This categorisation follows the conclusions taken in chapter 4. It was used as a basis for comparisons, the therefore as a guide for the case studies' conclusions.

Categorisation of interventions in relation to:		
1-Their active or passive role in relation to urban and social change.	Interventions as actions : **1- MIS** **2- CS**	Interventions as consequences or reactions **3- PVAC**
2- Their source	Natural interventions	Artificial interventions **1- MIS** **2- CS** **3- PVAC**
3- The kinds of interventions in the urban environment	Interventions of events	Interventions of space or interventions in the building environment **1- MIS** **2- CS** **3- PVAC**
4- The duration of the intervention	Acute interventions or short-term actions **1- MIS** **2- CS** **3- PVAC**	Chronic interventions or long-term actions
5 – The intentionality of the intervention	Unintentional interventions: Intention focus on the self	Intentional interventions: Intention focus on the common good **1- MIS** **2- CS** **3- PVAC**
6 - The origin of the intervention	Top-down interventions **1- MIS** **2- CS** **3- PVAC**	Bottom-up interventions

7- The number of interventions and the relationship between them	Isolated interventions **2- CS** **3- PVAC**	Interventions in a system **1- MIS**
8 –The predictability of their consequences	Predictable: Short-term	Unpredictable: long-term **1- MIS** **2- CS** **3- PVAC**
9 – The environment	General interventions: Conceptualisation phase.	Unique or contextual interventions: design, selection and implementation phase. **1- MIS** **2- CS** **3- PVAC**
10- Their size		See table 4 in appendix 1

Table 11: Characterisation of the three interventions investigated in studies 1 and 2 in relation to the categories explored in chapter 4

Legend:
1- **MIS** = Micro Intervention System
2- **CS** = ACSEF's city square
3- **PVAC** = - Peacock Visual Arts' centre

Hierarchies of interventions in the building environment according to their size			
Macro-systems of interventions Intervention system can be designed to influence any of these levels of social organisation but the scale of the interventions themselves is normally smaller. The system of interventions can be composed of interventions of all kinds. Not necessarily only interventions in the building environment	Macro-Interventions Urban planning and urban design. Interventions of the urban scale. **2- CS**	| Architecture Interventions of the scale of a building. **3- PVAC**	**Micro-Intervention** Design Interventions in the elements from which buildings and places are made of. **1- MIS**

Table12: Relation between hierarchies of social organisation and the hierarchical position of the interventions investigated in studies 1 and 2

Relation between long-term intention and short-term action L1 World / L2 Continent / L 3 Country / L 4 Region / L5 Province / L 6 City / L 7 Neighbourhood / L 8 Place / L 9 Object / L 10 Basic elements of the system										
Long-term intention	L1	L 2	L3	L4	L5 **Improve urban dynamics**	L6	L7	L 8	L9	L10
Short-term action	L1	L 2	L3	L4	L5	L6	L7	L 8 **2- CS**	L9 **3- PVAC**	L10 **1- MIS**

Table 13: Relation between long-term intention and the short-term action regarding the interventions investigated in studies 1 and 2

Study 1

Key features of the study

- The case study was bounded by time and place: data was collected over a period of 9 months and was related to the *Union Terrace Gardens* in Aberdeen.[4]
- The focus group consisted of key protagonists in the negotiation and selection process regarding two big scale interventions suggested for the UTG in 2008 and 2009: The city square and the Peacock Visual Arts' centre
- The system studied was: Marta as researcher and as a person (Garfinkel, 1967; Packer, 2010), Aberdeen and more specifically, the Union Terrace Gardens, protagonists of the negotiation and selection process (both representing bottom-up and top-down positions), the research's hypothesis translated in two research tools: The micro-intervention system (MIS) and the research's exploratory framework (the EIMS-models).

Aims of the data collection

- Test the acceptance of *micro-interventions* as a tool to nudge urban change. Test the acceptance of self-organisation and unpredictability as part of governance and governance as a process of nudging change.
- Test the applicability of the exploratory framework (the EIMS- models) as a selection tool.
- Explore the influence individual participants and organisations have in the decision's process and in the decision's product.

Methods to collect data

The study was conducted on two levels; on the one hand, research was carried out to investigate the city's culture, history and morphology. On the other hand, we used meetings with key urban participants to collect data.

To become more acquainted with the city, the city's social activity and with the theme of study we read about the history of Aberdeen as well as of the Union Terrace Gardens (Morgan, 2008).[3 and 4] During the historical analyses of Aberdeen's development, we have tried to relate the public discussion in analyses to a broader context of *interventions* that took place throughout Aberdeen's history; Interventions, such as Union Street, which could justify or contextualise in terms of scale the two interventions suggested for the city.

A study made in RGU in 2006 entitled *Urban Connections* (Aberdeen City Growth) gave us an overview about the feeling Aberdonians have about the gardens as well as informing us about their suggestions to intervene in the site to make it more adapted to their needs.

Sketches and notes were made during several walks through Aberdeen city centre. This data was the basis for the MIS project, suggested as an alternative to the proposals on the selection table.

Observations were made and notes were taken during two encounters at the *Union Terrace Gardens*, organised by The *Union Terrace Gardens' Friends*.[5] During these casual meetings we engaged in conversations with 11 participants about their intentions and choices for the gardens. The same questions were asked to several personal friends and acquaintances.

In addition, we have systematically analysed the information available on the internet regarding the public discussion, especially reports published on the local press website such as www.thisisnorthscotland.co.uk and http://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-19247094. Furthermore we read public opinions published in blogs and articles, such as http://www.theguardian.com/uk/scotland-blog/2012/aug/27/aberdeen-city-gardens-mistake, http://www.guardian.co.uk/uk/scotland-blog, http://dcdoolan.wordpress.com or http://www.johannabasford.com/blog-article/195 . We also looked at comments on *Face book* and postings on the sites supporting each one of the proposals: http://www.friendsofutg.co.uk/, http://www.thecitygardenproject.co.uk/, http://www.peacockvisualarts.com/, among others.

The information gathered helped to identify urban problems and the urban character of the city. This information informed the EIMS models used by the researcher and therefore helped formulising the researcher's questions and remarks during the meetings.

In addition, over a period of 9 month, the researcher participated actively in public and private discussions about the Union Terrace Gardens. The researcher participated from the perspective of an independent participant, with no particular personal interest in the gardens.

The meetings evolved around the research's main topics. On the one hand, we used the MIS to suggest the use of micro-interventions as a strategic tool to manipulate change. The researcher defended the project actively and therefore assumed her position in the discussion by defending the use of micro-interventions as a valid strategy to guide urban development.

On the other hand, questions elaborated on the basis of EIMS models were asked of the participants to inquire about their intervention of choice. The aim of these questions was to test if these choices were based on an awareness and holistic perspective of the subject and if they had taken into consideration the unpredictable character of urban development. In other words, the EIMS models were not explicitly shown in most of the meetings. This was due to the fact that the meetings were mostly organised by third parties and were focus on the discussion about existing possible interventions. Nevertheless, we used these opportunities to introduce the exploratory system's ideology as the basis for discussion. In light of this, all questions, arguments and remarks made by the researcher had the prior intention to lead participants to think according to the EIMS principals.

The meetings took place with key participants in the *Union Terrace Garden* discussion and they were the main source of data in this case study.

Besides the Provost and the official representative of the city council urban department Councillor Kate Dean, the MIS strategy and the concepts behind the EIMS models were presented to:

- Ms. Rita Stephen - Development Manager -ACSEF
- Mr. Sandy Beattie - City council - Planning and Policy
- Mr. John Michie - Key member of ACSEF's Project Management Board comprises and member of the project advisory group.
- Mr. Dave Blackwood - Member of the ACSEF's project advisory group.
- Mr. Lindsay Gordon
- Kevin McCormick
- Alasdair Craigie.
- Mr. Ken Mc Ewen
- Fraser Munro – Architect behind the *ACSEF's project*
- Brisac Gonzalez - – Architect behind the *Peacock's project*

There are audio records of the meeting with Mr. John Michie and Fraser Munro. However, the research conclusions are mostly based on the researcher's personal participation in the research context. The data was mostly collected from observations and notes taken during the meetings.

There were also e-mails exchanged with Mr. John Michie with the Lord Provost which gave an insight into how these specific individuals would relate to the institutions they represent and the theme of research.

In short, meetings were used to explore the acceptance of the use of micro-interventions to nudge urban change and to test the applicability of the EIMS model. They were particularly interesting to learn about the political and social dynamics of the city and meet people involved in urban policies and key urban decisions. In addition, they were the sources of the main conclusions taken from this case study.

The fact that the researcher was new in town and assumed a clear position encouraged discussion among the participants. Interesting and profound discussions emerged about the city, the interventions and about the participants personal and rational assumptions on the subject.

Furthermore, both the MIS project and the arguments and questions raised based on the EIMS models forced people to explain the reasons behind their intentions. This was of key importance to understand what the facts considered and what the participants' preconceptions and perceptions were.

Research findings and discussion

Research findings regarding the MIS project and use of micro-interventions as a tool to nudge urban change

The MIS strategy was very well accepted by the *Union Terrace Garden Friends*. They identified their suggestions with the project and new suggestions emerged from very in-depth discussions on the subject. They suggested additional small interventions like recovering the public toilets and implementing a ramp to improve access to the gardens.

In general, they did not want to change the morphology or character of the place, still, it seemed for them that there were only two realistic options on the table and therefore they decided to take the side of Peacock Visual Arts' centre.

In other words, during the informal conversations it became apparent that people were supporting the Peacock's project because they felt that as individuals their voice was not being heard. Because of this general feeling, they decided to join forces with Peacock to at least bring ACSEF's proposal down. Nevertheless, the *Friends of Union Terrace Gardens* actually wanted the gardens as they were and they were very enthusiastic about the MIS strategy.

All eleven persons addressed during both the gathering of the 27th February and the one of 12th of June 2010 were very emotional about preserving the gardens and uninformed about the projects.

On the one hand, they were defending the Peacock project, without realising that the project would imply remaking most of the garden's area. Most people did not realise the fact that the green presented in the 3D renderings was actually just green roofs where no trees can grow. On the other hand, when asked if they knew what functions were placed at the subterranean levels of the *Union Square,* they would quite promptly reply "Parking", even if, ACSEF did not know what to put in the underground levels at that point in time.

The MIS was introduced by the *Prince's Foundation* to the Lord Provost as an adequate strategy to intervene in the city. However, the participants representing the other interventions and representing private and public organisations did not see MIS strategy as a valid alternative.

All participants identified their preferred interventions as catalysts for urban and social change of the city as a whole. This gave us confidence to study further the research hypothesis and it was very supportive for the overall theme of this research. In opposition to the appreciation of the *Friends of the Union Terrace Gardens*, participants did not take the MIS project seriously; they did not see how small scale interventions could bring greater benefits to the city. Several participants defending the *City Square* option were happy to say that they were eager to take the risks related to such a large scale intervention. Some argued that at least something was being done and that the small scale actions suggested by MIS would have no effect on the dynamics and character of the city. The scale of the interventions suggested was often justified with the fact that Aberdeen has a history of large scale interventions such as Union Street. In addition, the discussion regarding the gardens was often associated with the discussion about the pedestrianisation of Union Street.

The fact that the MIS was so welcome by the Friends of the Union Terrace Gardens and so disregarded by representatives of private and public organisations, raises questions regarding:

- The difficulty bottom-up interventions have in being acknowledged and implemented. (Loorbach, 2007; Friedmann, 2011). It makes one question the innovative strategies which are not being heard because they cannot cross the institutionalised structures of power.
- The relations of power between the private and public organisations (Greenleaf, 1977; Morgan, 1997; Knowles, 2002; Sheard and Kakabadse, 2007).
- The influence of the *self* and *emotions* in the decision making process (Bazerman and Chugh, 2006; Morse, 2006).
- The link between big scale interventions with positions of power (Huxtable, 1984; Leeuwen, 1992; Markus, 1993).
- The influence 3D renderings have on the selection process of interventions in the building environment (Daft and Lengel, 1986; Suh and Lee, 2005; Daugherty, Li, et al., 2008; Landa, Schoutenb, et al., 2013)

Research findings regarding use of the EIMS models as a selection tool

The arguments supported by EIMS models did not influence people's choices. People had similar visions and ambitions for the future of the city. They all aimed to intervene in UTG to improve the city's overall dynamics and character. However, they did not agree with the shape, scale or design of the interventions. The concepts behind the EIMS models were used to justify all interventions equally; therefore, in this case study they did not help in the selection process.

In relation to the fact that the EIMS models did not influence human preconceptions, at least to two issues should be considered: First, the EIMS models were not introduced at the start of the selection process. When we introduced the models, ideas were formed, conclusions were taken and alliances were made between people. Further tests are needed to test if the results would have been the same if we had introduced the models at an earlier stage of the selection process. Second, perhaps the EIMS models were too general to be able to be used in a more refined selection. Consequently, additional studies should be done in other real-life contexts to test:

- A different methodology.
- A more specific framework.
- The influence of the self in the decision making process.
- The way human individual imaginary gives a new meaning and shape to an external object.

Even if the exploratory system did not help selecting the shape of the interventions, it was a great basis for discussion. It led participants to relate their interventions to bigger issues relevant for Aberdeen city. It helped participants to relate each intervention to the broader context of urban complex and dynamic change. The strategic questions raised during the meetings were useful tools to establish priorities and visualise the targets aiming to be achieved. This study suggested that probably the EIMS models can be used as a common ground for communication between top-down urban actors and eventually cross that information to the city inhabitants and the world of academia.

In short, on the one hand this study suggested that the EIMS models have the potential to help people to define intentions, strategies and visions for the future. It suggested that the models can help participants to reflect on the problems in-depth and relate them to different areas and levels of the system. On the other hand, this study suggested that the models were inappropriate to be used as a selecting tool.

Emergent findings and discussion

Study 1 reinforced the argument that every intervention is a result of the tensions between top-down and bottom-up forces (McGee, 1971; Beer, 1983). However, it also made clear that individuals have less strategic power in the decision making process than organisations and institutions (Loorbach, 2007; Lane, Maxfield, et al., 2009; Friedmann, 2011).

On the one hand, independent individuals and the private sector were more expressive about their convictions. That enthusiasm was reflected in the actions they took to make their voice heard and to manipulate the selection process. People published in blogs and websites, they made protests, wrote thousands of letters and much more. Private organisations invested a great deal of money and effort to promote their preferred intervention during the negotiation process. On the other hand, the public sector assumed a much more passive approach both in terms of financing and in terms of expressing a clear position. The public sector had the last word on the selection process and their preference changed when the party in power changed (Morse, 2006).

Study 1 proved that ideals and preconceptions are very difficult to change and that they play a key role in the decision making process (Koprowski, 1983). Beliefa influenced both the preferences and actions of the public and private sector. Personal convictions led to various interpretations of facts and numbers, and led people to take unimaginable actions to put their point across (Morse, 2006). Ideals and visions are both based on emotional and rational perspectives of the world. Together they shape decisions and therefore the interventions we make in the environment (Morse, 2006); they become the intentions that shape human interventions.

Morse shows the relevance of emotional-self awareness to justify feelings and avoid the "bounded awareness" phenomena, which causes people to ignore relevant information when making a decision (Bazerman and Chugh, 2006). EIMS models did not make people change their mind but it addressed the above problems in the following way: on the one hand it made people reflect on their emotions by having to justify what they considered to be a rational choice (Bazerman and Chugh, 2006). On the other hand EIMS models helped participants to formulate questions and look at the problems from a different perspective significantly reducing the possibility of overlooking important information (Hammond, Keeney, et al., 2006)

As argued in chapter 3, study 1 also proved that common ideals and a vision induced human cooperation. Like in living systems, people and organisations self-organised internally and between each other to form alliances to defend their common beliefs and intentions for the city (Greenleaf ,1977; Morgan, 1997; Knowles, 2002). As argued in the context of governance and decision making, groups were indeed actively formed (Sheard and Kakabadse ,2007). They were formed around the different ideals for the site (Polzer and Kwan, 2012) which expressed psychological similarities between the participants (Jaina and Tyson, 2004) and similarities of meaning (Duck, 1994). In the research context it was clear that people in the same group interpreted the information given by the EIMS modes similarly.

People cooperated on the basis of how similarly they interpret events and give a meaning to things, but that meaning does not have to be exactly the same. People and groups made compromises and therefore formed a coalition with groups who shared a similar perspective of things but were not entirely similar (Richerson, Boyd, et al., 2001). For example, coalitions were formed between the *Friends of the Union Terrace Gardens* and the "*Peacock friends*". These groups defended the relevance of preserving the historical buildings in the site and its topography. Nevertheless, the *Friends of the Union Terrace Gardens* had to compromise things such as keeping the historical oak trees which characterise the site (Gregory, 2011). These coalitions were formed to join forces against *the City Square* alternative. These compromises illustrate the challenges the bottom-up voice has to overcome to be able to cross institutionalised organisations and be materialised in the urban form (Loorbach, 2007; Lane, Maxfield, et al., 2009; Friedmann, 2011).

The process of coalition forming between groups is well documented in management sciences. For example, Jaina (Jaina and Tyson, 2004) argues that coalitions are formed not only because of similar world views and meaning systems (Duck, 1994) but also based on personal judgments of competence to complete a given task. As a matter of fact, the *Friends of the Union Terrace Gardens* saw the Peacock Visual Art group as a more capable and representative organisation able to compete more equally with the city square alternative.

Following this, the study also observed that as suggested by Greenleaf (1977), the management and advisory groups created by *Aberdeen City and Shire Economic Futures* (ACSEF) combined both a formal and an informal part. The formal part managed the operations needed to promote the proposal and to acquired extra funding (Morgan, 1997; Knowles, 2002) and the informal part was based on relationships between people (Greenleaf, 1977; Morgan, 1997; Knowles, 2002) built on similar meanings given to things and of similar interpretations of themselves and the world around them (Duck, 1994; Jaina and Tyson, 2004).

In addition, this study also raised the question of how 3D renderings and images in general influence the decision making process (Daft and Lengel, 1986; Suh and Lee, 2005; Daugherty, Li, et al., 2008; Landa, Schoutenb, et al., 2013). Despite how undeveloped the designed proposals were, their images were the basis for the discussions during the selection process. All participants, both from top-down and bottom-up were defending their ideas around 3D images of the projects which did not give any in-depth information of the projects themselves. Most of the time participants had no idea of the project's content nor of the challenges related to its materialisation. This raises the question whether the basis for the selection of interventions were the design feature or the quality of the 3D images presented. In light of this, the fact that the MIP was presented in the form of sketch plans and sections and no 3D renderings might have contributed to the fact that it was not considered seriously next to the 3D visualisations of other proposals.[9]

Study 2

Study 2 focused on the same issues as study 1 but this time from the perspective of an academic environment. The study tried to address the questions:

Did building management master's students see any potential in the use of micro-interventions to nudge change?

How did they respond to the research's exploratory system (the EIMS)? Were they able to operate the models?

Key features of study 2

- The case study was bounded by time and place: data was collected during a 30 minute workshop and was related to the UTG in Aberdeen
- The focus group was the 2009 MSc students from Robert Gordon University (RGU) – *Scott Sutherland School of Architecture and Build Environment*
- The system studied in study 2 was: Marta as the researcher, Aberdeen, discipline topic (sustainability), the research's hypothesis translated in the MIS - a drawing suggesting the use of micro-interventions as a tool to nudge change, the research's exploratory framework (the EIMS-models) and the students.

Aims of the data collection

The aims of the data collected in relation to the research's theoretical-background and to the use of micro-interventions as a tool to nudge urban change (MIS) was to:

- Test the acceptance of the use of *micro-interventions* as a tool to nudge urban change. Test the acceptance of the concept of self-organisation and unpredictability as part of governance and governance as a process of nudging change.
- Test the awareness of the students to the depth and degree of change a micro-intervention can lead.
- Develop an exploratory theory for sustainable urban management.

- Gather contributions from the participants that might lead to other theoretical approaches.

Aims of the data collected in relation to the exploratory models (the EIMS) were to:

- Test the acceptance and applicability of the exploratory model as a tool for professionals such as designers and decision makers to think and act in urban complex systems.
- Test how operational the exploratory models were. Analyse the participant's difficulties in using the models and use that information to improve them.
- Gather new ideas and contributions from the participants to design or to readjust the EIMS-models.
- Analyse to what extent the EIMS-models influenced participants to develop a more holistic view of Aberdeen city centre.
- Analyse to what extent the EIMS-models influenced the way participants would act to address a specific urban problem.

Methodology and data collection

Study 2 was divided into three main parts. The last part was subdivided in two different approaches to the study which related to two different kinds of students participating in the activity.

Part 1 consisted of a lecture to introduce the research's theoretical background and the EIMS-models. In part 2, the study was introduced and explained to the participants. We introduced the students to the *micro-intervention system* (MIS) and ACSEF's Intervention; *The city square* (CS). These interventions were introduced as two possible strategies to address Aberdeen city centre's loss of population. We asked the students to use the EIMS models to choose the best option and justify their selection. To support the discussion and frame it in the research context, a big screen displayed the *EIMS basic model* and the plans of both interventions.

Part 3 was used for discussion and to collect the data. We divided the students present in the classroom into three groups of four. We used a questionnaire[10] to collect data from the discussion within the groups. In addition, we recorded the groups' representative announcing their selection and justifying the reason for their choice. Notes and observations were collected during the lecture's break as well as during the students' discussion time. The notes describe perceptions, feelings and ways of being in the classroom. They refer to questions posed and also the way participants used the MIS and the EIMS models to reflect on themselves and their environment.

Students participating in the workshop via internet were asked to apply the EIMS models in real-life situations. [11] They were asked to use the models to investigate in what way an intervention of their choice changed their living environment. Participants submitted their conclusions both in a written format and represented on the EIMS models. This data was used to test the clarity and operability of the EIMS models and contributed largely to their improvement.

In addition, data was also collected from internet discussions on RGU Moodle's platform. These discussions emerged spontaneously among the students and between the students and the lecturer and they were of key relevance to the changes made in EIMS-models.

Research findings and discussion

To extract meaning from the research's conclusions we compared the different kinds of data collected during this case study. The comparison of the conclusions taken from the questionnaire with the conclusions taken from the written assignment and the web discussions allowed us to relate the participant's awareness of social complex systems with the methodology the EIMS models and the methodology needed to operate them.

In addition, we have also compared the findings of study 1 with the findings of study 2. This allows us to test theoretical exploration in different contexts and draw conclusions from that.

In other words, the relevance of the research findings that follow emerge from the comparison of data within study 2 and between study 1 and 2.

Research findings regarding the acceptance of the use of micro-interventions as a tool to nudge urban change

In study 2 there was a consensus identifying the strategy of using key micro-interventions to steer change as the best alternative presented. Students defined the MIS strategy as cheaper and faster to implement, posing less risks and possibly achieving similar aims for the future of Aberdeen city. They all agreed that micro-interventions are more flexible and easier to adapt and replace to address new needs and circumstances.

As seen in study 1, this contradicted the opinion of several representatives of public and private organisations, including Councillor Kate Dean, who represented the urban department of Aberdeen's city council. She saw more difficulties in the implementation of the *micro-interventions* suggested by MIS than in the implementation of the macro-intervention suggested by ACSEF. This conclusion leads us to investigate further the relationship between top-down representatives and the scale of the interventions they prefer for Aberdeen's building environment.

The fact that bottom-up representatives and academic representatives see *micro-interventions* as a relevant strategy to manipulate change and both private organisations and public institutions prefer bigger scale iconic interventions lead us to reflect on the relation of power and its symbolic manifestation in the building environment (Markus, 1993). As described by Paul-Michel Foucault, power has always been a property of social organisations and allied to power there has always been the fascination with symbols of dominance materialised in the building environment. These symbols are often related to scale and height (Huxtable, 1984; Leeuwen, 1992; Markus, 1993).

For Pierre Bourdieu (1989) symbolic power is a way to state a reality. For others, such as for the participants in study 1, it is a way to invite a new reality in. As mentioned by the participants, the priority of both *City and Shire Economic Futures* (ACSEF) and *Peacock Visual Art Group* was not to use the UTC as a tool to address any specific need of the community. The aim was to use the UTG to improve the overall quality of live in the city as well as the urban character and dynamics. The aim was to use the UTG to create an image and an identity of Aberdeen city in relation to the world (Acuto, 2010).[12] The aim was to invite tourism and foreigners to live in the city (Zukin, 1997) and contradict in this way the fact that the city is losing its population (Wiechman, 2007).[13]

On the one hand, both *Peacock Visual Art Group* and *City and Shire Economic Futures* (ACSEF) suggested interventions in the building environment as a strategy to invite more people to the city and guide them to use the city differently. In other words, both representations of symbolic power in the building environment aimed to get people to act according to the meaning they imply (Anderson, 1987). Due to the character and scale of both suggestions, eventhough they were socially accepted, they would influence human actions, the way people move in the city (Bourdieu, 1989) and human social interactions (Sassen, 1999); *Peacock Visual Art Group* suggests a more cultural environment while ACSEF suggested a more trade oriented environment. These environments will affect the urban character and urban dynamics, which in turn will influence the character of the people who use them (Sassen, 1999).[14]

On the other hand, both *Peacock Visual Art Group* and *City and Shire Economic Futures* (ACSEF) aimed to create an icon; a global landmark (Eben, 2001) something that can be related to the “Bilbao-effect” (Rybczynski, 2002). Both suggestions focused on the strategic potential of iconic architecture to attract global attention and therefore change the dynamics of the city (Debord, 1994). However, due to personal ideals and interests they could not agree on the form, character and function of such an icon.[15] *Peacock Visual Art Group* focused on the aesthetics of the architectural object to create this global icon. *City and Shire Economic Futures* (ACSEF) focused on the contextual features of the site and the great scale of the intervention to achieve the same purpose.

Research findings regarding the use of the EIMS models as a selection tool

Operating the models influenced the depth of the student’s analysis: All participants were able to refer and relate several distinct aspects of the EIMS basic model and use these relations to define their system of focus. The students who were asked to operate the model engaged in the analysis of the system in much more depth. The group of students who operated the model noticed a shortage of areas available to represent interventions in relation to urban complex systems. In addition, to complete the assignment the students felt the need for more adequate intersections in the EIMS basic model; intersections which would represent their interventions of focus more adequately.

On the one hand, this study suggested that the EIMS models were well accepted and that the EIMS basic model might have helped participants to think in more depth about social complex systems. On the other hand, it gave relevant information on how to improve both models.

Visualising the model also influenced the students' analysis: Students who dealt with the physical representation of the EIMS dynamic model engaged with the notions of unpredictability and dynamic change; they could perceive a sequence of events over longer periods of time. They could relate short-term actions with open-end future scenarios for the city as a whole. The students who were asked to imagine future scenarios for the city without the support of the EIMS dynamic model did not show evidence of awareness related to unpredictability and continuous change. They were quite certain in their statements on what the future would bring and on what it should look like.

In other words, in light of the above findings we relate the participants' different expression of awareness of the city as a complex, dynamic and unpredictable system to two differences in the methodology used.

The first difference has to do with the active use of the models: The students in the class were asked to take EIMS basic model into considerations as a framework of thinking but they were not asked to mark interventions in the EIMS models. Conversely, the students engaged with the assignment had to operate the EIMS models actively and that might have obliged them to reflect on the city in a more dynamic manner.

The second difference is related to the visualisation of the models. The students in the classroom had only the EIMS basic model displayed on the classroom's screen. The EIMS dynamic model was implicit in the questionnaire but it was not displayed. Conversely, the students engaged with the assignment had both models presented in the assignment sheet and examples explaining how to operate both of them.

In short, this study suggests that, either because of the visual presence or the need to operate the EIMS models, they helped participants to think in terms of the whole system, continuity and dynamic change. From study 2 we can conclude that the participants performed better in the presence of the models than they performed when they were absent. In addition, we have concluded that they engaged with deeper and more holistic thoughts of the system when they were asked to operate the models.

Implications for the research process and for the models' design and the methodology to operate them

In terms of the applicability of the models in a real-life situation, the assignment proved that adjustment had to be made. The participants were not using the model as expected therefore key changes had to be made in order to make the models more operational. This conclusion had significant implications for the research process and for the conceptualisation and representation of the EIMS models:

First, this study led to further research of the literature review. The aim of such research was to clarify important concepts and relate them to the models. Study 2 showed that there was the need to:

- Categorise interventions. This led to the explorations made in chapter 4.
- Express in the model the notion of nested hierarchies and the idea that the model was scales. This led to explorations on the relationship between scales of complex systems (Miller, 1978) and scales of interventions (Alexander, 1977) and the relationships between them. In addition, it led to redefining the model's core and the meaning given to the space around it. It led to the concept of *system internal* and *system external* explored in chapter 5 (Loorbach, 2007).
- Relate the concepts of interventions to the notion of problems and intention. This was explored in chapter 3 in the context of evolutionary theory. This exploration culminated in changing the focus of the models from "the intervention" to "the intention" for the system's future. Currently, it is the relationship between the intention and the problem of focus that defines the core of the EIMS basic model.
- Relate interventions and changes with the notion of time. This led to the concept of interventions as short-time actions and intentions as eventual long-time changes.
- Find a more consistent methodology to operate the models. This led us to explore the methodology and models used in *Transition Management* to introduce innovations in institutionalised systems.[16] These explorations were translated in a completely different methodology to operate the models.

Second, this study led to changes in the representation and organisation of both EIMS models. With regards to the EIMS-basic model:

- The title and the terms used to define intervention areas in the models changed.
- The physical representation of the model changed allowing more intersections between different aspects of the model to occur.
- The idea of *nested hierarchies* and of *system internal* and *system external* was introduced.

- The idea of the model as a framework was introduced. In other words, the idea of a scales model applicable to all scales of social systems and interventions was introduced.

With regards to the EIMS-dynamic model:

- The notion of intervention as an action and a reaction was introduced.
- The notion of *time* is now related with the notion of *Evolution* and the notion of *dynamic change* is now related to the notion of *self-organisation* of the system.
- The notion of nested hierarchies was introduced.

After these changes and clarifications are addressed, more studies should be undertaken to test the new EIMS models as a tool of work.

Adjustments made in the EIMS basic model

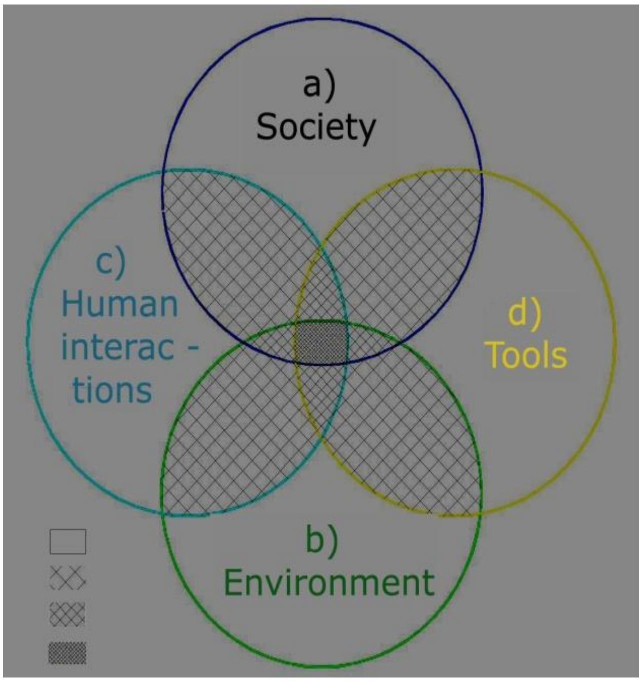

Figure 27: EIMS basic model before study 2

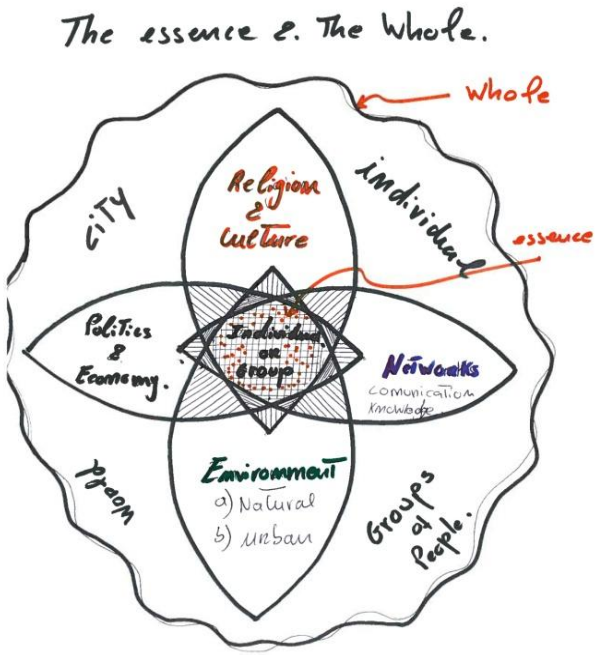

Figure 28: EIMS basic model after study 2
This model is the one introduced and explained in this thesis

Adjustments made in the EIMS dynamic model

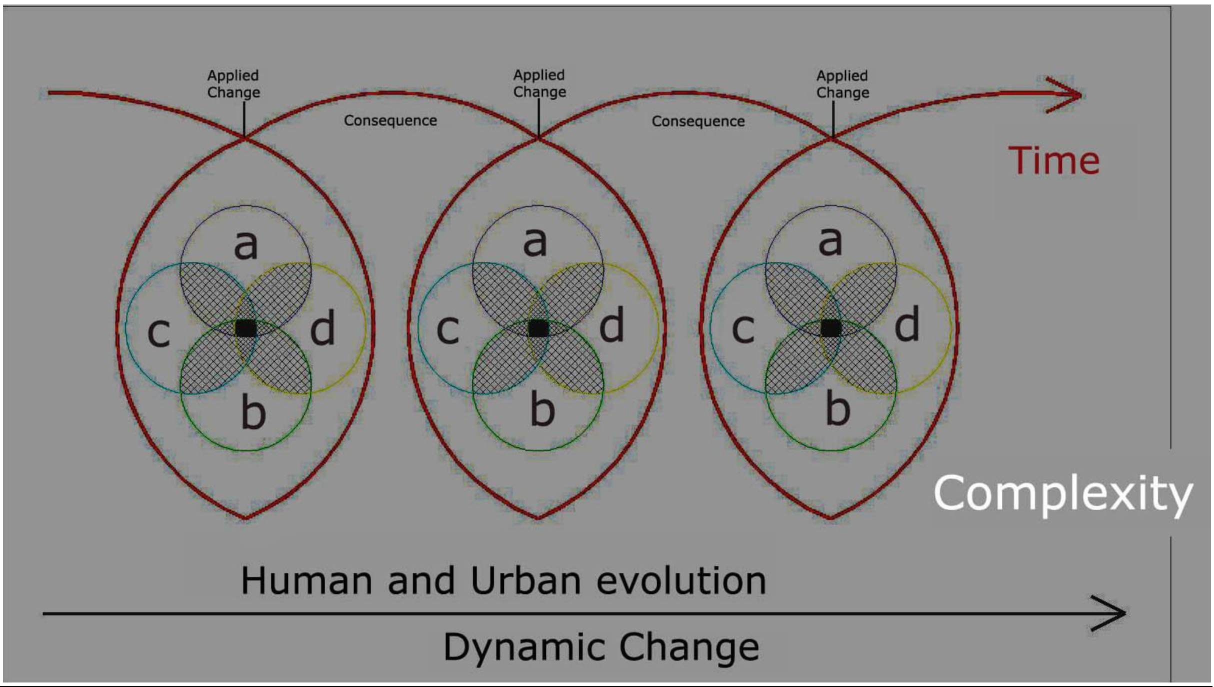

Figure 29: EIMS dynamic model before study 2.

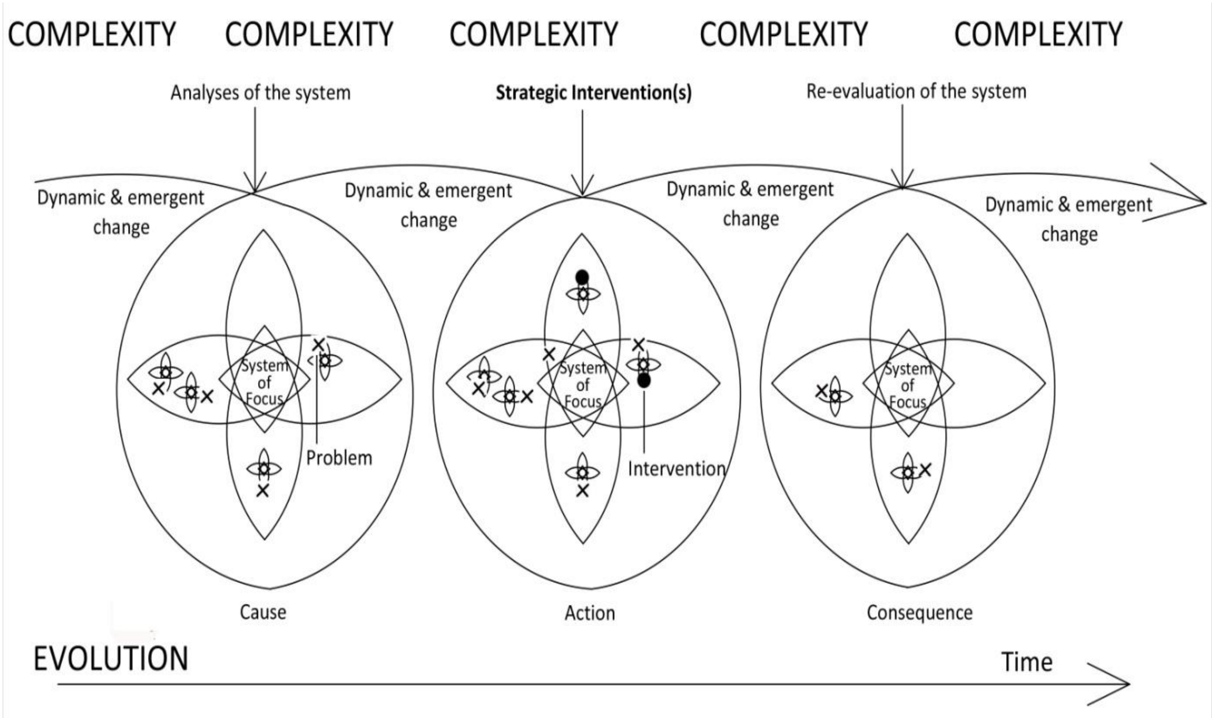

Figure 30: EIMS dynamic model after study 2

Study 3

Although architects are recurrently asked to intervene in the city, there is not much known about how aware they are of the city as a complex and dynamic system and if they use that awareness in the design process. In light of this, there could be questions about how to use architecture as intentional intervention to nudge urban change.[17]

In this study we try to discover if a deeper understanding of the urban context adds complexity to the design process and in what way it influence the design object. The study addressed the following research questions:

How did architecture students' respond to the exploratory system (EIMS)?

How did the exploratory system influence their urban awareness?

Did that change or shift in awareness influence their design process and their design object?

Context of the research

Like study 1 and 2, study 3 focused on interventions in Aberdeen city centre.[3] However, these interventions were not restricted to *The Union Terrace Gardens.* Students had to select a site, investigate the problems they wanted to address - both in relation to the site as well as in relation to the city as a whole - and explore architectural forms and functions able to address these problems. All interventions suggested by the students were characterised as the following:

Categorisation of interventions in relation to:	Interventions in Aberdeen city centre suggested by the students	
1-Their active or passive role in relation to urban and social change.	Interventions as actions *	Interventions as consequences or reactions
2- Their source	Natural interventions	Artificial interventions *
3- The kinds of interventions in the urban environment	Interventions of events	Interventions of space or interventions in the building environment *
4- The duration of the intervention	Acute interventions or short-term actions *	Chronic interventions or long-term actions

5 – The intentionality of the intervention	Unintentional interventions: Intention focus on the self	Intentional interventions: Intention focus on the common good *
6 - The origin of the intervention	Top-down interventions *	Bottom-up interventions
7- The number of interventions and the relations between them	Isolated interventions *	Interventions in a system
8 –The predictability of their consequences	Predictable: short-term *	Unpredictable: long-term *
9 – The environment	General interventions: Conceptualisation phase. *	Unique or contextual interventions: design, selection and implementation phase. *
10- Their size		See table 4 in appendix 1

Table 14: Characterisation of the interventions investigated in study 3 in relation to the categories explored in chapter 4

Hierarchies of interventions in the building environment according to their size			
Macro-systems of interventions Interventions at level 1, 2, 3, 4, 5 and 6 are normally composed of a system of interventions. Intervention system can be designed to influence any of these levels of social organisation but the scale of the interventions themselves is normally smaller. The system of interventions can be composed of interventions of all kinds. Not necessarily only interventions in the building environment	Macro Interventions <u>Urban planning and urban design</u>. Interventions of the urban scale.	<u>Architecture</u> Interventions of the scale of a building. *	**Micro Interventions** <u>Design.</u> Interventions in the elements from which buildings and places are made of.

Table15: Relation between hierarchies of social organisation and the hierarchical position of the interventions investigated in study 3

Relation between long-term intention and short-term action L1 World / L2 Continent / L 3 Country / L 4 Region / L5 Province / L 6 City / L 7 Neighbourhood / L 8 Place / L 9 Object / L 10 Basic elements of the system										
Long-term intention	L1	L 2	L3	L4	L5 *	L6	L7	L 8	L9	L10
Short-term action	L1	L 2	L3	L4	L5	L6	L7	L 8	L9 *	L10

Table 16: Relation between long-term intention and the short-term actions regarding the interventions investigated in study 3.

Key features of the study

The case study was limited by the number of students, time and place: data was collected from 7 students during a period of 3 month. Decisions regarding the sample constituency and the number of participating students were related primarily to the academic constraints of the discipline in which the research took place.

- The focus group was a 2009 group of final year architecture students from *Robert Gordon University* (RGU) – *Scott Sutherland School of Architecture and Build Environment*
- The system studied in study 3 was: Marta as researcher, Aberdeen, architecture, the research hypothesis, the research's exploratory framework (the EIMS-models), students, the teacher responsible for the group, the design process and the design object.

Aims of the data collection

In relation to the research's theoretical-background:

- Test the acceptance of the research's theoretical framework, namely concepts of self-organisation, unpredictability and governance as a process of nudging change.
- Develop an exploratory theory for a sustainable urban management.
- Gather contributions from the participants that might lead to other theoretical approaches.

In relation to the EIMS models:

- Test the acceptance and applicability of the exploratory model as a tool to support professionals such as architects to think and act in urban complex systems.
- Gather new ideas and contributions from the participants to design or to readjust EIMS-models.
- Analyse to what extent the EIMS models influenced participants to develop a more holistic view of Aberdeen city centre.
- Analyse to what extent the EIMS models influenced the design concept, the design process and the design object.

Methodology

This study was divided into four main phases. The last phase was subdivided into two different approaches to the study. Phase 1, 2 and 3 were introduced before the students started their design process while phase 4 took place a week before the final presentation.

Project Schedule	Analytical and Precedents' research	Conceptualisation of the project	Design process	Final presentation	Output
Phases of data collection		Introduction to the research: Phase 1: lecture Phase 2: questionnaire Phase 3: one-to-one meeting		Analyse the student's results Phase 4: Part 1: interview Part 2 : observation during the students' presentation	
Duration	1 month	1 week Phase 1: 1 day Phase 2: 1 week Phase 3: 1 day	3 month	1 week Part 1: 1 day Part 2 : 1day	1 day

Table 17: Relation between the pedagogical process of design and the phases and methods of data collection.

Phase 1 consisted of a lecture to introduce the research's theoretical background and the EIMS-models. Phase 2 consisted of a questionnaire which obliged the students to think about the urban system from the perspective of the EIMS models. In other words, the models were presented as a framework of thinking. The students were required to reflect on Aberdeen's urban environment based on the EIMS diagrams and they were given specific questions to guide them through that process.

Phase 3 consisted of a one-to-one meeting where the students were guided to relate the conclusions they took from the questionnaire with a design concept. At this stage students were introduced to the relevance of whole systems strategy and were guided to relate that to their design process (Blizzard and Klotz, 2012).

In the last phase of the study the students were interviewed and asked to reflect on the answers they gave in the questionnaire, which was presented to them at the beginning of the design process. In addition, they were asked to identify in what way phase 1, 2 and 3 influenced their initial opinions, their design concepts, their design process and their design object.

Following the interview, the researcher observed the last presentation in the classroom. The aim of the presentation was to help the students to focus on the most relevant aspects of their project and to guide them towards the final presentation. In this context, the researcher evaluated the projects both from the perspective of the research as well as from the perspective of an experienced architect and teacher. The aim was to analyse whether the students were able to express the considerations they took from a holistic analysis of the urban system in the design object.

Research findings and discussion

The conclusions taken from this study are a result of crossing information between all sources of data collection within the study. We crossed information collected from the students' analysis of the urban context on two different stages of the design process with the observation of their presentations and the critical analysis of their designs. Our conclusions are as following:

General findings

During the first stages of the case study; during phase 1, 2 and 3, the students were very enthusiastic about the thought of the city as a complex and unpredictable system. In addition, they showed interest in a more social orientated approach to design. As soon as they were left to work alone, they focused more in the aesthetics and technical aspects of the design.

This raised questions related to the lack of continuity in the use of the EIMS philosophy as part of the design process:

- Were the models not adequate?
- Was it a lack of the students' maturity as architects? (Akin, 2002)
- Was it the fact that the students were trained to be focused on other issues and that they were probably going to be evaluated according to different priorities? (Saint, 1983; Broadbent, 1995)[18]

In addition, we concluded that students generally did not relate their buildings with the macro-levels of the system. They also did not engage with thought related to unpredictability even if they were aware of the fact that the city was in continuous change. A sign of this is that most of the students did not think of alternative scenarios for the city nor they imagine alternative uses for their buildings, even if they were asked to.

In other words, most of the students related their designs to the "bigger picture" and thought about the possible influence of their interventions on urban and social development only because they were asked to at several stages of the research process.

Research findings related to the acceptance and applicability of the EIMS-models

Most of the students argue that the research's theoretical framework helped them to formulate their building's concept. Despite this fact, most of them say that it did not influence the shape of the design or their design process. The fact that students could not see the inconsistency of their statement raises questions about their maturity as architects. Especially because one of the main skills to learn in an architectural school is how to translate abstract concepts in material forms (Akin, 2002).

The students stated that the new theoretical framework was helpful to relate their projects to a context and its problems. It helped them to be more aware of the human aspect of things (Rapoport, 1977) rather than focusing exclusively on aesthetics and technical issues. We consider this a great achievement of the EIMS models because the gap between the students abstraction and human reality is well-known in the academic context of architecture (Stringer and Mikellides, 1980).

To help students to relate their projects with their physical and human context, schools such as *Sheffield School*, are experimenting with students' participation in real-life scenarios. Their reports show very satisfying outcomes (Barac, 2012). Study 3 suggests that the EIMS models could also be used as a tool to address this problem and therefore narrow the gap between architectural design, its context and its users.

Most of the students mentioned that the system did not create extra difficulties in the design process, nor in translating their design aims into a shape. It simply brought new priorities which gave new meanings to their concepts. Most of them argue that if the system had been introduced better at an earlier stage of their studies it would have changed the way they look at architecture and urban planning.

The fact that the social and human aspects of design were perceived as almost a novelty for the final year students of architecture raises questions regarding:

- The student's present awareness of cognition of space and in what way that shapes emotions and performances (Kuller, 1980).
- The relationship between design and ethics. It calls for the re-evaluation of the social and ethical dimension of aesthetics and design (Humphrey, 1980; Smith, 1980).
  It calls for a revaluation of the contributions of design in society both as a materialised form and a way of understanding the world (Alexander, 2003; Ehrenfeld, 2008).
- It makes us wonder about the way in which *design thinking* (Lawson and Dorst, 2009) is underestimated as a kind of knowledge (Sennett, 2008), and its potential to trigger innovations in human dynamics and society (Cross, 2011; Dorst, 2011).
- How we teach and define aesthetics (Berger, 1960) and design and in what way are we transmitting that knowledge to the students (Read, 2002). Above all it makes us wonder how we, lecturers, are relating architecture and design with the city and with human quality of life.

The critical analysis of the projects in the end of the design process showed that some projects did not express in their shape the concepts that originated them. This fact suggests a certain degree of the students' immaturity as professionals of architecture. In other words, this might express the difficulty students have giving shape to an idea. However, this finding requires further study, because it could also be related with design priorities established by the lecturer or by the university or it could be related to inadequate design processes and methods (Akin, 2002).

One of the projects which could generate a significant positive urban change in Aberdeen city was made by a student who was not interested in the bigger scale of the urban context. This particular student just considered the urban form to integrate the building in its direct surroundings. He focused on the object itself; its aesthetics and materialisation. Other studies must be undertaken with urban design students and architecture professionals and compare the results, but this finding opens a key question to this research: Do we have to clearly define the role of architects, urban designers and urban planners to assume that a good design is automatically a catalyst for improvements in the urban environment? What is more relevant for the appropriateness and adequacy of a strategic intervention, the quality of the design or the designers' awareness of urban and social complexity?

Study 3 also suggested that the students were influenced by the tutors and their contributions to the design. To take meaningful conclusions from this finding other studies should be carried out to address the questions:

- Would the EIMS models have more impact in the design process if the participants were less influential and more mature professionals? This would imply the test of the models among professionals rather that students.
- Would it make a difference for the students design process, concept and object if the EIMS models were introduced at earlier stages of their academic experience?

In short, the most relevant finding for this particular research was the fact that, according to most of the students interviewed, the EIMS models did not add further complexity to the design process and help them to be more realistic about their designs. In addition, most of the students argued that the models influenced their design concept. Even if they do not think that the models influenced their designed object it goes without saying that one is deeply related to the other.

This study also raised the question whether an awareness of the system is relevant in order to intervene strategically in the city. It introduced the question whether a good design is not enough to act as a catalyst to improve urban dynamics.

Emerging findings

By observing the tutors' comments given to the students before the final presentation, the researcher realised that lecturers did not place much emphasis on the topics related to the EIMS models. The focus was mainly on the aesthetics and technical issues of the design rather than on the social and human aspects of it. From the data collected we could also not see any examples of tutors' comments on the city as a complex system neither on the influence new buildings could have in the development of the city or even the site.[18]

We believe this finding deserves further study.

The fact that, as a teacher of architectural design, the researcher has identified gaps between the students' proposals and the topics mentioned above and the fact that those issues were not addressed by the tutors could be due to three possible reasons:

a) The human and social perspective of the design as well as the city complexity was addressed at the beginning of the design process. During the process of developing the building in more detail, both students and tutors stop relating their design decisions to the social and complexity aspects of the site.
b) As the critics were given just a week before the final presentation, the lecturers might have considered the level of critique which would stimulate the accomplishment of the project. In

other words, critiques evolving basic issues of the project could influence the students' determination to accomplish the assignment (Beinart, 1981).

c) The pedagogical emphasis either of the lecturer or the school is not on the issues pointed out by this research (Akin, 2002). Both lectures and academic institutions can focus on ideals of beauty or principles which are passed on in the format of precedents and literature. These pedagogic tools in turn will shape the students concepts as well as their architectural forms (Saint, 1983; Broadbent, 1995).

From these emergent findings we conclude that it is not only important to further investigate the reasons behind this particular finding, but also to study further the extension of the influence lecturers have on: the design concept, the design process and the design product.

There are studies which suggest that giving autonomy to students both during their analytical research as well as during the design process gives a sense of ownership and responsibility to the project which is normally translated into greater results (Manisa, 2012). Following this, and based on study 3's findings, we suggest that the EIMS models could contribute to the improvement of the student's performance by assisting them as individual thinkers; We argue that the EIMS models could support the individual process of collecting relevant data, make links across relevant information, draw conclusions from analysis and translate findings in design concepts and forms. In light of this, further studies should be undertaken to test the models as a tool to support the analytical research in a studio context and as a tool to support the design phases which link the design concept to a finished form.

It is important to take into consideration that all findings which emerged from case study 3 should be contextualised in the 2008/2009 RGU's academic year. In this context, guidelines for deliverables served as framework for the students' assessment and therefore as a constraint that shaped the students design process and design object.

Chapter summary

In the three case studies described above we have used the EIMS models to explore ways to select and design interventions more efficiently.

In the studies described, the research tested the EIMS models both in an academic context and in real 'applied' situations. From the three studies, we have concluded that the models were generally well accepted by participants. The EIMS models were efficient in helping to describe the character and the current state of a complex system and to identify relevant subsystems. They gave a sense of urgency to act and they helped to formulate an ambition for the future of a specific social system. In other words, the models helped participants to define intentions and identify key problems of the system. The models helped participants to think of social complex systems in more depth. They helped the participants to relate their action to micro and macro-levels of social systems and to relate their actions to different aspects of urban life and to different intervention areas.

We have also concluded that the participants who operated the models engaged with a deeper level of analysis than the participants who were just asked to use the model as a framework of thinking. The challenges found by the students to operate the models were used to improve them as well as to clearly establish a methodology to operate them.

In the real-life scenario of study 1, concepts of complex systems, unpredictability, dynamic change, nested hierarchies and others, proved to trigger relevant discussions about the problems Aberdeen city is facing today. Alongside that, questions related to these topics helped participants to reflect on the intentions behind the interventions they were suggesting for the city. In addition, such topics helped participants to engage with a more holistic perspective of the urban and social system to reflect on the consequences of their actions. In light of this, we argue that the EIMS models could eventually be a good basis for discussion and to establish strategies and priorities.

However, the arguments used to lead the participants to reflect according to the EIMS models proved inappropriate to help the selection of interventions. The EIMS strategy did not help to establish a common strategy and cooperation between different groups of participants. It did not influence the participants' preconceptions. The general character of the arguments introduced in the discussions was used to defend and justify very different interventions. This conclusion implies that further study should be carried out where the participants are asked to actively operate the models. Conclusions should then be drawn by comparing the results of both studies.

In studies 1 and 2 we used MIS (*The Micro-Intervention System* project) to investigate how open decision makers and students of building management were to the management approach suggested by the research. From these studies we have concluded that top-down protagonists were more supportive of larger scale interventions; generally speaking big-scale interventions were perceived as being more effective and the risks related to them were understood as necessary and worth taking. Students and representatives of the *Friends of Union Terrace Gardens* could easily identify the potentials of micro-interventions as a management tool.

In general, architecture students argued that the philosophy behind the models influenced their design concepts and did not add complexity to the design process. Some even argue that if such models had been presented earlier in their studies they would have influenced their priorities in design.

An analysis of the projects elaborated on by these students showed that they had difficulties giving shape to their concepts. In other words, the design object did not always satisfy their initial intentions. This fact needs further study because it does not necessarily imply a deficiency in the models. It can be related to the students' immaturity as a design professional or to the role of the teachers and the university in the design process.

In addition, we have concluded that one of the potentially more adequate projects to improve the urban character in Aberdeen city centre came from a student who was not particularly interested in the EIMS-models or in social or environmental concerns. This project was also one of the most developed ones and the student proved to be more confident in the design process than the average. In any case, this conclusion raises the questions whether to intervene in the city strategically one needs to be aware of its complexity.

As argued in chapter 3 we can estimate the short-term reactions of a complex system to a certain intervention. Nevertheless, in the long-term, we can never predict accurately the system's behaviour. Complex systems are unpredictable and regardless of how aware one is of the system, it is impossible for the human mind to really grasp its complexity. Therefore, it is impossible to define the long-term consequences of our actions.

Summary of the studies' Design			**Study 1**	**Study 2**	**Study 3**
Methodology	Qualitative research		*	*	*
	Case studies		*	*	*
Focus groups	People involved with the practice of urban planning		*		
	Academic environment			*	*
Intervention of focus: Strategic Interventions in the built environment.	Micro intervention		*	*	
	Mid-scale intervention				*
	Macro-interventions		*	*	
Data Collection	Semi-open interviews		*		*
	Questionnaires			*	*
	Observation		*	*	*
	Document's analysis		*	*	*
	Analysis of information on the internet		*		
	Sketches and notes		*	*	*
	Ethnography		*	*	*
Research context	Aberdeen city centre				*
	The Union Terrace Gardens - Aberdeen		*	*	
Research tools	**MIS:** Micro-intervention System Aim: Investigate the acceptance of the planning strategy explored by the research; The use of strategic interventions as a tool to nudge change.	Presented visually	*	*	
		Described orally	*	*	
	EIMS: Exploratory Intervention Management System Aim: Improve the models and test their applicability as a tool to imagine, create and select interventions that can lead to a more sustainable and human friendlier urban environments. Questions: - Are the EIMS models applicable in real-life scenarios; in what way? - Are they useful? - What are their potentials and weaknesses? - How can we improve them?	Presented visually		*	*
		Described orally	*	*	*
		Operated by the participants		*	

Table 18: Summary of the research studies' design

	Research aims	Study 1	Study 2	Study 3
General	Develop a deeper understanding of the dynamics in the design process of interventions in the built environment.			*
	Develop a deeper understanding of the dynamics in a real-life process of selecting interventions in the built environment.	*		
	Develop a deeper understanding of Aberdeen’s urban context and its built environment.	*		
	Develop a deeper understanding of the relations and dynamics between top-down and bottom-up forces in Aberdeen; Explore about the influence individual participants and organisations have in the decision process and in the decision product.	*		
	Develop an exploratory theory for a sustainable urban management. Gather contributions from the participants that might lead to new theoretical approaches.	*	*	*
	Explore the participants’ general innate awareness of the city as a complex and unpredictable system.	*	*	*
	Test the awareness of the change an intervention in the building environment can bring to the overall character and dynamics of the city.	*	*	*
MIS	Test the acceptance of micro-interventions as a tool to nudge urban change	*	*	
	Test the acceptance of self-organisation and unpredictability as part of governance and governance as a process of nudging change.	*	*	
EIMS	Test potential of the models to self-educate users and stimulate people to think in complex systems from a holistic perspective.	*	*	*
	Test the capacity of the models to be used as a common language and as a framework to cross information between all parties involved in the design and selection of interventions in the built environment.	*		
	Explore until what extend are the models able to help people to be aware of the unpredictable character of complex systems	*	*	*
	Test the applicability in a real life situation of the EIMS- models as a framework or a selection tool; Test the capacity of the models to improve the selection process of interventions.	*	*	
	Test the applicability in a real life situation of the EIMS- models as a framework or a design tool; Test the capacity of the models to improve the adequacy of design concepts, the quality of the design forms and the design process of interventions.			*
	Test the clarity of the models and identify the difficulties participants would have in operating them.		*	
	Investigate if a more holistic awareness of urban complex systems influence or adds complexity to the design process and their design object.			*

Table 19: Relation between the research aims and the studies’ explorations.

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Study 1	Aims	Findings	Literature
General findings	Develop a deeper understanding of the dynamics in a real-life process of selecting interventions in the built environment.	Study 1 reinforced the argument that every intervention is a result of the tensions between top-down and bottom-up forces	(McGee, 1971; Beer, 1983)
	Develop a deeper understanding of Aberdeen's urban context and its built environment.	The UTG are mis-used. The gardens are either under-valued or regarded as a key part of the city. There are differences in the city both across and within different urban heights.	
	Develop a deeper understanding of the relations and dynamics between top-down and bottom-up forces in Aberdeen; Explore about the influence individual participants and organisations have in the decision process and in the decision product.	Individuals had relatively less strategic power in the decision making process than organisations and institutions. However, their determination influenced significantly the decision-making process. Bottom-up participants felt their voice was not heard. Bottom-up participants and the private sector were expressive and enthusiastic about their position. The public sector was more reserved.	On the strategic power of bottom-up and top-down interventions: ((Loorbach, 2007; Lane, Maxfield, et al., 2009; Friedmann, 2011). (Greenleaf, 1977; Morgan, 1997; Knowles, 2002; Sheard and Kakabadse, 2007).
	Develop an exploratory theory for a sustainable urban management. Gather contributions from the participants that might lead to new theoretical approaches.	The study was relevant to reflect on the role of the self in the decision making process. This lead to include the decision maker as part of the system of analysis and its complexity. In turn this new perspective led to key readjustments in the organisation and in the methodology to operate the EIMS models	
	Explore the participants' general innate awareness of the city as a complex and unpredictable system.	All participants were able to relate the scale of the garden on a global scale. They were also able to relate the urban environment with other aspects of urban society and urban development. Nevertheless, these reflexions were to a certain extent simplistic and envisioned primarily the possible short-term direct consequences of an intervention. Participants did not reflect much on the unpredictable character of complex systems. They had defined ideas of how the future should be and had a clear image of how the future would be as a consequence of their elected intervention.	On creationist paradigms in architecture (Sitte, 1889; Benevolo, 1980)(Corbusier, 1924)

	Test the awareness of the change an intervention in the building environment can bring to the overall character and dynamics of the city.	All participants were aware of the relevance of interventions in the building environment as a tool to nudge urban change. They aimed to use the UTG to create Aberdeen's image and identity in relation to the world. They aimed to invite tourism and foreigners to live in the city and contradict in this way the fact that the city is losing its population	On iconic catalyst buildings: (Eben, 2001) (Acuto, 2010) (Debord, 1994) On tourism as a catalyst for urban development (Zukin, 1997)
Findings regarding MIS; The use of Strategic Micro Interventions as a tool do nudge emergent dynamic change	Test the acceptance of micro-interventions as a tool to nudge urban change	The MIS was accepted by bottom-up participants but it was disregarded by both private and public organisations. *Union Terrace Garden Friends* sow the potential of micro-interventions and added suggestions to the MIS. They suggested additional small interventions like recovering the public toilets and implementing a ramp to improve the access for the gardens. Organisations' representatives did not see how small scale interventions could bring greater benefits to the city.	On the relation of power and its symbolic manifestation in the building environment: (Huxtable, 1984; Leeuwen, 1992; Markus, 1993). This literature is relevant in the discussion which emerged from the comparison of these findings with the ones which emerged from study 2
	Test the acceptance of self-organisation and unpredictability as part of governance and governance as a process of nudging change.	The concept of human self-organisation as a relevant aspect of governance was not a relevant issue for most participants, both as individuals and as representatives of organisations. Representatives of organisations were happy to say that they were eager to take the risks implicit in unpredictable changes in the urban dynamics as a consequence of bigger scale intervention.	On a new paradigm for urban planning and urban design: (Alexander, 1966; Jacobs, 1970; Allen, 1981; Friedmann, 1997; Allmendinger, 2001; Marshall, 2012; Portugali, 2012; Salingaros and Caperna, 2013)
Findings regarding EIMS; The Exploratory management System	Test potential of the models to self-educate users and stimulate people to think in complex systems from a holistic perspective.	EIMS models helped participants to relate each intervention to the broader context of urban complex and dynamic change; it helped them to reflect on the problems in depth and relate them to different areas and levels of the system. EIMS models helped participants to formulate questions and look at the problems from different perspective reducing significantly	On the need for a holistic and systematic thinking to reduce the possibility of overlooking relevant information: (Hammond, Keeney, et al., 2006)

		the possibility of overlooking important information	
	Test the capacity of the models to be used as a common language and as a framework to cross information between all parties involved in the design and selection of interventions in the built environment.	EIMS models were a good basis for discussion. The strategic questions posed during the meetings were useful tool to establish priorities and visualise the targets aimed to be achieved.	On the need for a common language for a sustainable urban management and design: (Ostrom, 1990; Alexander, 2003; Bortoft, 2010; Friedmann, 2011; Wilson, 2011)
	Explore to what extent the models are able to help people to be aware of the unpredictable character of complex systems.	EIMS trigger thoughts on how to use the interventions suggested in alternative ways, which demonstrated an increase of awareness of the unpredictable character of dynamic change. Nevertheless, EIMS was not able to make participants question the benefits of small scale interventions.	
	Test the applicability in a real-life situation of the EIMS- models as a framework or a selection tool; Test the capacity of the models to improve the selection process of interventions.	EIMS did not influence the selection of intervention.	
Emergent Findings	The use of 3D images influenced participants' perception of the interventions		(Landa, Schoutenb, et al., 2013)
	The self; personal perceptions and emotions influence indeed the selection of interventions and therefore influenced the decision making process. Ideals and visions are both based on emotional and rational perspectives of the world and these are very hard to change.		On the influence of the self in the decision making process: (Koprowski, 1983; Bazerman and Chugh, 2006; Morse, 2006)
	People self-organise and form groups; They cooperated on the basis of how similarly they interpret events and give a meaning to things, and that meaning does not have to be exactly the same.		On group formations in organisations and society: (Greenleaf, 1977; Morgan, 1997; Richerson, Boyd, et al., 2001; Knowles, 2002; Sheard and Kakabadse, 2007)

Table 20: Summary of the findings which emerged from study 1

Study 2	Aims	Findings	Literature
General findings	Develop an exploratory theory for a sustainable urban management. Gather contributions from the participants that might lead to new theoretical approaches.	To clarify important concepts and relate them to the models there was the need to explore further: - interventions' categories - concept of nested hierarchies - how to define internally a complex system and how to relate the system to external conditions which influence it. - the strategic relevance of intentionality - alternative methodologies to operate the models	On nested hierarchies: (Alexander, 1977; Miller, 1978) On the notion of system internal and system external see: (Loorbach, 2007) On the relevance of intentionality to speed up and direct change see:(Ostrom, 1990; Loorbach, 2007) On how to operate frameworks and models as a tool to guide change see: (Loorbach, 2007)
	Explore the participants' general innate awareness of the city as a complex and unpredictable system.	Similarly to the findings which emerged from study 1, without the presence of EIMS models students did not engage with notions of complexity or unpredictability. All their statements about the future of Aberdeen as a consequence of an intervention were certain.	
	Test the awareness of the change an intervention in the building environment can bring to the overall character and dynamics of the city.	Similarly to the findings which emerged from study 1, all participants were aware of the relevance of interventions in the building environment as a tool to nudge urban change.	
Findings regarding MIS; The use of Strategic Micro-interventions as a tool do nudge emergent dynamic change	Test the acceptance of micro-interventions as a tool to nudge urban change.	The use of micro-interventions as a tool to nudge urban change was well accepted among the participants.	On the relation of power and its symbolic manifestation in the building environment: (Huxtable, 1984; Leeuwen, 1992; Markus, 1993). This literature is relevant in the discussion which emerged from the comparison of these findings with the ones which emerged from study 1

	Test the acceptance of self-organisation and unpredictability as part of governance and governance as a process of nudging change.	Students' perceived the research approach towards governance as a novelty. Nevertheless, they showed great interest and acceptance.	
Findings regarding EIMS; The Exploratory management System	Test potential of the models to self-educate users and stimulate people to think in complex systems from a holistic perspective.	Students who dealt with the physical representation of the EIMS basic model could relate short-term actions with open-end future scenarios for the city as a whole. Operating the model influenced the depth of the student's analysis of the urban system	
	Explore to what extent the models are able to help people to be aware of the unpredictable character of complex systems.	Students who dealt with the physical representation of the EIMS dynamic model engaged with the notions of unpredictability and dynamic change; they could perceive a sequence of events over longer periods of time. Operating the model influenced the depth of the student's analysis of the urban system.	
	Test the applicability in a real-life situation of the EIMS- models as a framework or a selection tool; Test the capacity of the models to improve the selection process of interventions.	The study was not conclusive because the selection process happened within a closed group and we only had access to the group's final conclusion. Further tests should be carried out using a different methodology to collect data	
	Test the clarity of the models and identify the difficulties participants would have in operating them.	The participants were not using the model as expected; therefore key changes had to be made in order to make the models more operational. The group of students who operated the model noticed a shortage of areas available to represent interventions in relation to urban complex systems. In addition, to complete the assignment the students felt the need for more adequate intersections in the EIMS basic model; intersections which would represent their interventions of focus more adequately.	

Table 21: Summary of the findings which emerged from study 2

Study 3	Aims	Findings	Literature
General findings	Test the acceptance of the research theoretical framework, namely concepts of self-organisation, unpredictability and governance as a process of nudging change.	The research theoretical approach was well accepted among the participants.	
	Develop an exploratory theory for sustainable urban management. Gather contributions from the participants that might lead to new theoretical approaches.	The students suggested introducing the EIMS concepts earlier in their learning process and evaluate how that would influence their development as architects.	
	Explore the participants' general innate awareness of the city as a complex and unpredictable system.	Students generally did not relate their buildings with the macro-levels of the system. They also did not engage with thought related to unpredictability even if they were aware of the fact that the city was in continuous change	
	Test the awareness of the change an intervention in the building environment can add to the overall character and dynamics of the city.	All students aimed to use architecture to address an urban problem.	
Findings regarding EIMS; The Exploratory management System	Test potential of the models to self-educate users and stimulate people to think in complex systems from a holistic perspective.	The models led the students to engage with a deeper evaluation of the social and human aspects of design. This exploration was perceived as almost a novelty for the final year students of architecture.	On cognition of space and in what way that shapes emotions and performances (Kuller, 1980) On the re-evaluation of the social and ethical dimension of aesthetics and design (Humphrey, 1980; Smith, 1980) and (Alexander, 2003; Ehrenfeld, 2008).
	Explore to what extent the models are able to help people be aware of the unpredictable character of complex systems.	Most students did not explore any alternative use for their buildings even if they were explicitly asked to.	On the ways which design thinking is underestimated as a kind of knowledge and its potential to trigger innovations in

			human dynamics and society (Sennett, 2008; Lawson and Dorst, 2009; Cross, 2011; Dorst, 2011).
	Test the applicability in a real-life situation of the EIMS-models as a framework or a design tool; Test the capacity of the models to improve the adequacy of design concepts, the quality of the design forms and the design process of interventions.	Most of the students argue that the research's theoretical framework helped them to formulate their building's concept. They stated that the new theoretical framework was helpful to relate their projects to a context and its problems. It helped them to be more aware of the human aspect of things rather than focusing exclusively on aesthetics and technical issues.	On the human aspects of the urban form. (Rapoport, 1977) On the gap between the students abstraction and human reality (Stringer and Mikellides, 1980)
	Investigate if a more holistic awareness of urban complex systems influence or adds complexity to the design process and their design object.	Most of the students mentioned that the research's theoretical approach did not create extra difficulties in the design process, nor in translating their design aims into a shape. It simply brought new priorities which gave new meanings to their concepts.	
Emergent Findings	The students were very enthusiastic about the thought of the city as a complex and unpredictable system. In addition, they showed interest in a more social orientated approach to design. As soon as they were left to work without the guidance of the model's philosophy, they focused more on the aesthetics and technical aspects of the design.		On the way we are transmitting knowledge on aesthetics and design to the students (Read, 2002)
	The critical analysis of the projects at the end of the design process showed that some projects did not express in their shape the concepts that originated them.		On the lack of students' maturity as architects (Akin, 2002)
	One of the projects which could generate a significant positive urban change in Aberdeen city was made by a student who focused on the object itself; its aesthetics and materialisation.		
	The students were influenced by the tutors and their contributions for the design.		On the relation between the student's design and priorities of assessment (Saint, 1983; Broadbent, 1995)

Table 22: Summary of the findings which emerged from study 3

Chapter 7: Conclusions

At the outset, we introduced the research hypothesis and two associated aims. These were directed towards investigating urban change from the perspective of human actions and to explore the possibilities of a kind of urban planning focused on the management of human actions rather than on the management of the urban space. We focused on the relation between urban complexity, human interventions and urban dynamic change. The knowledge which emerged from this study has been used to suggest ways to use human actions strategically to manipulate the process of urban development intentionally.

How do we relate the city, its complexity and its dynamic character with human interventions?

In chapter 2 we focused on the following two research objectives to answer the first research question.

a) To investigate how cities emerge from the perspective of human actions. Establish a relation between urban evolution and urban character.
b) To establish the role of top-down and bottom-up actions in relation to urban and social development. Establish their risks and their potentials.

In chapter 2 we concluded that all urban organisations are a combination of both bottom-up and top-down interventions. We can conclude that different kinds of interventions play a different role in the urban development. We concluded that the nature of urban development as well as the urban character are extremely related to the nature of interventions in the urban environment. The combination of different interventions gives the cities their unique character, its potential and its challenges.

To understand better the role of top-down and bottom-up interventions we have divided cities in two kinds; the natural city and the planned city. We have concluded that the *natural city* emerges from the merging of small individual interventions or actions. These interventions are normally focused on individual interests; they emerge from everyday needs such as the need for work, food, shelter, entertainment, education... and are translated in everyday life choices. Bottom-up interventions in the building environment are by nature of a small scale due to the nature of the interest behind them as well as the restricted resources available. Bottom-up-interventions in the urban environment are typically the construction of a family house, of a place to work, decoration of the front door area... The natural city is therefore characterised by small buildings and more narrow and organic streets. It emerges slowly by the continued addition of small parts which merge together to form the city as a whole. The natural city is normally more complex; it hosts more diversity of urban functions and human relation (Jacobs, 1970). This kind of city tends to have a more human scale and give people a sense of belonging (Alexander, 1966).

In contrast, we have concluded that the artificial or planned city emerges from larger scale interventions normally originating from the top-down. These interventions normally address the needs of a community. Typical top-down interventions in the city are schools, hospitals, water and sewage networks... This shift in focus is translated in the scale and nature of the buildings implemented in the city. Top-down actors normally do not build one house, they build an apartment block; they don't build a workshop, they build office areas; they do not build a tent in a market, they build a shopping mall. Top-down interventions are normally meticulously planned and designed. Due to the complexity and scale of some top-down interventions they normally require more logistics and resources. In addition, they change the city more dramatically and influence the life of a larger number of people. In opposition to the natural city, the artificial city emerges quite fast because big scale urban areas can change between the time of design and implementation of a building's project. The artificial city is therefore characterised by bigger scale buildings and broader and straighter streets; streets which are normally designed to serve not only pedestrians but the increasing demand for motorised vehicles. In many examples the city becomes more sectarian and less complex (Alexander, 1966). In other words, when the city is thought of from the top-down it is automatically simplified by the human mind which does not have the capacity to imagine the complexity of human relations that emerge naturally in the public space (Bortoft, 2010). The top-down city tends to be perceived as more hostile and less human friendly (Jacobs, 1961; Alexander, 1966).

The risks and potential of bottom-up and top-down interventions in relation to the urban character and urban development can be addressed from two different perspectives:

From the perspective of the intervention's nature: We have concluded that bottom-up interventions, due to their small scale, merge quite easily with the city as a whole (Marshall, 2009). In contrast to large-scale interventions, even if they don't work as expected the side effects are not very relevant in relation to the bigger picture. In addition - due to their normally small scale - the resources lost, in case of the failure, are much less significant compared to larger scale, top-down actions (Coleman, 1985; Panerai, Depaule, et al., 2004; Pearson, 2006).

From the perspective of urban organisation, urban character and urban development, we can conclude that bottom-up interventions give continuity to urban change (Alexander, 1966) and top-down interventions have the capacity to shift the direction of urban change quite dramatically (Lane, Maxfield, et al., 2009). Both kinds of interventions have advantages and a role to play in urban management but both can also lead to urban problems. On the one hand, continuity gives a sense of place to people and stimulates more in-depth and complex human relations. However, altering intentionally urban development can prove to be vital to address urban and social challenges. The self-organising city can lead to urban sprawl and social segregation (Batty, 2005). And, the planed city can lead to isolation and depression among other things (Jacobs, 1961).

In light of these conclusions we argue that some kind of top-down management is needed. Our findings in chapter 2 suggest the need to be cautious when intervening in the urban environment. In addition, the findings in the literature review establish a clear role for top-down and bottom-up interventions in relation to the urban development. Consequently, this research suggests considering the potential of top-down and bottom-up interventions as a tool to support a new kind of management. In other words, from the conclusion taken in chapter 2 we suggest a management that values the benefits of urban self-organising systems but that recognises that adjustments have to be made to address urban problems which will inevitably emerge (Thaler and Sunstein, 2008).

In chapter 3 we used complexity theory applied to the study of cities and evolutionary theory to investigate further the assumptions made in chapter 2 (Allen, 1997; Spencer, 2009).

Complexity and evolutionary theory helped justify the research hypothesis and the kind of management it suggests; a management based on the process of change and on the gentle nudging of the natural emergent change of complex urban systems. In other words, in chapter 3 we used complexity theory to emphasise the argument that self-organising systems do not always develop in positive ways (Prigogine and Nicolis, 1977; Portugali, 2000). This argument led to the assumption that a certain kind of top-down management is needed to monitor the development of urban complex systems (Portugali and Alfasi, 2007; Marshall, 2012; Portugali, 2012).

The evolutionary perspective on the study of cities contributed firstly to justify the relevance of urban continuity for human quality of life (Wilson, 2011); it reinforces the need to nurture the self-organisation of urban systems and their emergent character (Allen, 2012). Evolution frames the inter-relationship between humans and the environment as forms of adaptation (Mayr, 1977; Ramírez, 2000; Ridley, 2004). Certain aspects of adaptation need time; therefore continuity is the basis for human adaptation and identification with the environment (Futuyma, 2005; Douglas, 2006). This conclusion is the foundation of the research hypothesis which suggests acting on the urban natural development of the city only when necessary (Portugali, 2004; 2008; Thaler and Sunstein, 2008). In addition, this conclusion justified the relevance of small-scale actions and the danger of large scale interventions. It justifies the argument that large scale interventions can easily disturb existing relations and symbioses between people and the physical and social environment around them (Marshall, 2009).

Secondly, evolutionary theory explained why actions focused on the self can lead to social imbalances (Strickberger, 2000; Gibbons and Sherratt, 2007). We used the work of Miller (1978) to justify the relevance of some kind of social and political hierarchical organisation to address the common good and the needs of a community. We used the work of Wilson (2011) and Elionor Ostrom (1990) to suggest the need for top-down regulations to induce social cooperation and give a direction for social and urban development. In other words, evolutionary theory applied to the study of social systems justified the need for top-down management based on the notion of nested hierarchies (Miller, 1978); the top-down control suggested by the research findings is based on the idea that the wellbeing of a given social hierarchy is dependent on the wellbeing of lower hierarchies and is vital for the well-being of the higher ones.

Based on the literature available on complexity theory we argue that the unpredictable nature of cities makes it humanly impossible to predict change and to prepare for all emergent social organisations and challenges (Portugali, 2008). Therefore, we suggest a management which addresses human needs as they emerge or as they are predicted. The research findings suggest that urban planning and urban management should happen in constant dialogue with the natural self-organisation of the city. We should assume the fact that we cannot control or predict change and that will lead us to a new approach towards planning (Portugali and Alfasi, 2007; Marshall, 2012; Portugali, 2012).

In short, in chapter 2 and 3 we demonstrated the need for a kind of top-down management that respects and nurtures the self-organisation of the urban system and re-adjusts it accordingly. The findings suggest a kind of management that changes with the city; a management as a process parallel to the overall change of the urban system. We have concluded that bottom-up interventions have the potential to give the city a human scale and therefore give people a sense of belonging. Top-down interventions have the ability to speed up and influence the directions of urban change. The conclusions gathered in chapter 2 and 3 establish the ground to suggest a management based on the continuous and endless process of design and selection of *intentional strategic actions* to address emergent problems or re-direct urban change.

In other words, the conclusions which emerged from chapter 2 and 3 suggests the <u>hypothesis of using top down strategic interventions as a tool to nudge change and address urban problems within the modern complex urban environment</u>**.**

How can we use “urban interventions” to nudge urban and social change?

In chapter 3, as well as reinforcing the arguments made in chapter 2 we have investigated in more depth the meaning *of human strategic intervention in the building environment* and how they relate to urban systems. This theme was further explored in chapter 4 where we exclusively focused on the notion and categorisation of interventions within the context of urban change.

In light of this we used chapter 3 and 4 to:

c) Explore the meaning of *strategic- interventions* in relation to the composition and structure of urban complex systems. Are strategic interventions a synonym of *catalyst interventions?* What are the components of a complex system that can influence the system as a whole?
d) Investigate the relationship between the scale of intervention in cities, and the scale of their effect. Can small and discreet interventions induce great changes in urban complex systems?
e) Explore the relationships between short-term actions and long-term visions.

Both complexity and evolutionary theory suggest that interventions made in the basic elements from which a complex system emerges have the capacity to change that system as a whole (Miller, 1978; Allen, 1997; Marshall, 2009; Spencer, 2009). This conclusion supports not only the hypothesis of using interventions to nudge urban change but also raises the relevance of *micro-interventions* as a tool to nudge change in complex systems (Portugali, 2008; 2012). The findings in chapter 3 suggest that when we plan an intervention as a finished whole, we consider the urban environment as we know it or as we imagine it. The interventions we design are therefore a result of that image. If the environment changes in ways that we could not predict the intervention becomes automatically obsolete or it has to have the capacity to adapt to new circumstances (Marshall, 2009).

In contrast, if we intervene on the elements which make the system, the system as a whole transforms with it. In other words, from an emergent perspective, when the components which compose the city change, the shape of the city changes automatically accordingly. In light of this, and having taken into consideration the unpredictable character of complex systems, we argue that strategic interventions, and in particular micro-interventions, can be used to open barriers and create possibilities for the system to improve naturally. The management strategy suggested by this research can also be seen as a way to test urban tendencies and therefore avoid unnecessary top-down mistakes.

In light of the conclusions taken from chapter 3 we suggest that *Strategic interventions* are not necessarily micro-interventions, but they are preferably small. A *strategic intervention* acts on the elements from which the complex systems emerge and have the intention to manipulate the system as a whole. *Strategic interventions* are not necessarily originated from the top-down but it is the responsibility of top-down organisations to focus on the common good rather than on the self (Smith, 1776; Keller, 2007). *Strategic interventions* are a consequence of a holistic awareness of the complexity of an urban and social system.

The research suggests that the awareness of the complexity of the urban system and its unpredictability will lead humans to be more cautious when intervening in the city (Loorbach, 2007). Furthermore, it suggests that not only top-down interventions, but all interventions in the building environment can be intentionally and strategically used as catalysts for change. With time, all interventions, strategic and others merge together. They form the city as a whole and establish the direction for urban development (Batty, 2005).

Due to the extent of the meaning of *interventions* there was the need to contextualise *strategic interventions* and more specifically, *strategic interventions in the building environment;* this research studies' interventions of focus. Therefore, in chapter 4 we categorised interventions and related them to the potential influence they could have in the urban environment and urban development.

We used notions of nested hierarchies to establish the relations between scales of complex systems (Miller, 1978) and scales of interventions (Alexander, 1977) and, based on that framework we established the relevance of micro-interventions as tools to nudge urban change as a whole.

To answer the question of how to use strategic interventions to nudge urban change we focused on the role of design and selection as a short-term action in relation to intentions as a long-term vision for the future.

Following Marshall's (2009) arguments and the evolutionary perspective, we framed *design* as both a form of adaptation and of reproduction. As a form of adaptation humans use design to manipulate or change the environment to better serve their needs (Hansell, 2007). As a reproduction process *design* has the capacity to adapt existing models to new situations (Stedman, 1979; Marshall, 2009). It has the capacity to select the elements which already proved to be efficient and invent new alternatives to solve emergent problems. In other words, design has the capacity to create variation based on inheritance.

In addition, the design process is based on rational decisions and choices and the design object is a consequence of these rational choices. Artificial selection, in the context of design or not, has the capacity to speed up and direct change (Lane, Maxfield, et al., 2009). In light of this, we conclude that both design and rational selection can be seen as means for short-term change or as a single step further in the evolutionary process. Nevertheless, we argue that each step of the evolutionary process can be used as the step to change the evolutionary path. In other words, we argue that even if design and selection are short -term actions they can relate the present with the future; they can relate short-term actions with long-term intentions (Loorbach, 2007).

Evolutionary theory suggests that long-term common intentions play an important role in the human and urban evolutionary process. They help focus the reason behind human actions in one direction. This increases the cooperation for a common good (Ostrom, 1990; Wilson, 2011), and optimises and speeds up development in a given direction..

From the perspective of complexity theory, a clear intention or a long-term vision enables individuals to find their own position in relation to the system as a whole. The combination of complexity theory and the evolutionary approach suggest that a common vision gives individuals the freedom to self-organise within hierarchical levels of social organisation and intervene in the urban environment knowing that ultimately, regardless of the nature of the intervention, they are contributing to the common good (Wilson, 2011).

Bortoft (2010) frames the notion of long-term intention as the meaning behind human actions, as the *active absence* that gives coherence to the parts in relation to the whole and links short-term intervention and long-term changes.

For Loorbach (2007) long-term intentions define the methodology needed to bring an action forward across all level of social and political organisation.

Following the literature review findings, long-term intentions should be based on concepts of sustainability and resilience. They should open ways to explore interventions which facilitate humans to flourish on the planet rather than exclusively fight for their survival (Ehrenfeld, 2008).

It is important to address human intentions as ideas in evolution; concepts that change with people and the ways they perceive the world around them (Richerson, Boyd, et al., 2001; Read, 2005; Mindell, 2006). Humans are the basic elements of society and the creators of the urban environment. They are parts of a whole and therefore reflect of the environment around them (Ponty, 1962). As the environment change humans change with it, as well as human actions and intentions (Mindell, 2006). In other words, *Intentions* will change with human and urban development, but despite that fact they serve as an objective that focuses resources and actions.

In chapter 5 alongside a generic introduction on qualitative research and case studies as the basis for the research methodology, we explored models that would translate in the visual form the conclusion taken from the literature review. A summary of the conclusions taken from the literature review were translated in the form of explorative research tools which worked as a framework for the studies' explorations.

In other words, in chapter 5 we explore the potential of the studies used and qualitative research to test and develop the EIMS' models and to test the acceptance of the management approach suggested by the MIS project.

The models explored by the research methodology addressed the last two research objectives:

f) Explore how we can improve the design of interventions so that they can improve the urban environment more efficiently.
g) To postulate an operational framework based on the research's theoretical approach that would lead to the design and selection of more innovative and sustainable interventions and strategies.

Following the findings which emerged from the research's literature review we developed two research tools or frameworks which were used as the basis for the research methodology.

On the one hand, we developed two explorative models to support professionals such as designers and decision makers to intervene in the city more adequately. We called these models *The Exploratory Intervention Management Systems* – the EIMS.

The EIMS models are pragmatic and a simple visual representation of complex concepts which emerged from the study of complexity sciences and evolutionary theory applied to social and urban systems.

They aim of the models was to improve the design and selection of interventions in the urban environment and contribute in this way to facilitating the kind of management suggested by this research. The intention behind the EIMS models was to support urban actors to reflect on the consequence of their actions and on the interrelations between different aspects of society. With this we expect to make people feel more responsible for their acts and more aware of the unpredictable reactions of the city.

On the other hand, we translated in plans and drawings the management strategy suggested by the literature review and we used that as a base to test its acceptance.

The management approach this research suggests relies on the self-organisation of the systems and therefore nourishes and improves bottom-up initiatives. In this approach top-down interventions are only applied in the system to gently redirect its development in case it is needed or previously forecasted. Such an approach suggests delicate and gentle interventions; what we called in chapter 4 *micro-interventions*.

In light of this, we developed a system of micro-interventions to trigger change in the overall dynamics of Aberdeen city. In other words, we represented, in the form of an urban project, an urban strategy which mirrored the research findings. This project was supported by the *Princess Foundation* and suggested to the Lord Provost as adequate to improve Aberdeen's dynamics and development. We called this project *The Micro-Intervention System* (MIS)

In chapter 6 we describe three studies and we discuss their findings. On the one hand we tested the EIMS models both in a real-life situation and in the academic context. The response of the participants suggested that:

- The models were indeed a relevant tool to consider in the design and decision making context. In general the models were well accepted. The conclusions taken from the studies reveal that such models can indeed lead people to reflect on urban organisations in more depth. They can be used as a basis for communication and exchange of knowledge as well as a tool to justify intentions and actions. In other words, they can be used as a tool to relate short-term action with long-term intentions for the city.
- The models were inefficient to influence peoples' pre-established opinions; therefore were inefficient as a selection tool.

- The models could influence design and designers. The models influenced the design concepts and many argued that they did not add complexity to the design process.

In addition, all three studies, opened new research areas in this and contributed to adjusting the initial models and redefining the methodology to operate them.

On the other hand, we used case studies 1 and 2 to investigate the acceptance of the kind of management suggested by this thesis. To support this investigation we used *The Micro-Intervention System* (MIS) as a research framework.

From the case studies, we have concluded that the use of strategic micro-interventions in the building environment as a tool to nudge urban change was welcome in the academic environment and by the people defending the maintenance of the intervention site. Organisations and top-down protagonists did not take the relevance of micro-interventions in the urban environment seriously. Instead, they focused on larger scale interventions arguing that they had greater potential to improve the system as a whole and the risks involved in the process were worth taking.

In other words, the case studies suggest the kind of management suggested by the research was not easily accepted by top-down protagonists. This does not necessarily contradict the validity of the research hypothesis. It rather raises questions related to:

- The relationship between power and scale of interventions in the building environment.
- The influence of the self and pre-established convictions in the decision making process.
- The use of 3D renderings and images as tools to manipulate human cognition and therefore influence selection.

Even if the MIS was not well accepted among top-down protagonists and the EIMS models was not helpful to change people’s minds, the studies suggest that the EIMS models were a relevant tool to improve communication and in-depth thinking of complex systems. The models helped people to think in the urban system in a holistic manner, it helped them to relate short-term action with intentions and it suggested other areas of interventions to manipulate the system as a whole.

In addition, the studies suggested the EIMS models could be relevant to redirect the focus of design. Study 3 left open questions regarding the influence of lecturers and university philosophies and methodologies in the shaping of architectural professionals. It also raised questions about the relationship between the quality of design and its appropriateness to improve the character of the system and its dynamics.

The research suggests interesting findings which in our opinion are worth exploring further in different environments, under different theoretical backgrounds and eventually adjusting the research methodology.

We used management theory to discuss the research's findings. As we explored the research hypothesis under the umbrella of complexity sciences and evolutionary theory, one could argue that it would make sense to use the same theory background to discuss the research conclusions. As a matter-of-fact we could have used evolutionary theory to inform the fact that top-down protagonists felt the need to demonstrate power in a materialised form. We could also have used it to justify the need to cooperate to survive. In other words, we could have related the fact that people representing positions of power preferred iconic interventions rather than discreet ones with other examples of species which use icons to be recognised as leaders (Hansell, 2007). We could have related the coalitions made during the study with notions of cooperation and relate that to human evolution (Strickberger, 2000; Richerson, Boyd, et al., 2001; Ridley, 2004; Futuyma, 2005). The fact that we choose to discuss the findings under another scientific umbrella aims to help open doors between scientific fields. It aims to help to see a greater perspective of the relationship between facts. It aims to explore a truly interdisciplinary approach to investigate a given subject. We are not experts in management theory, complexity theory or evolutionary theory. Nevertheless, the contribution of this research is in the connection between disciplines rather than in their in-depth knowledge. Hopefully this research helps to open doors between disciplines and offers grounds for a truly interdisciplinary approach to the study of cities and urban development. Hopefully, we were able to establish some kind of link between disciplines such us urban theory, complexity sciences, evolutionary theory, management, design and architecture.

Above all, it is hoped that the research can inspire people to explore further a similar approach towards scientific research.

Limitations of the research

The objectivity and relevance of the conclusions taken from the use of the EIMS models

The methodology to characterise the EIMS models and the methods used to analyse them reflect the pragmatic perspective of a decision maker or a professional of urban renewal. Nevertheless, we argue that an analytical analysis of such a system is extremely complex and not necessarily less subjective.

The complexity of an analytical analysis of a complex system is related to the infinite number of subsystems and their intersections and the fact that all different hierarchies of the system influence all the others (Portugali, 2000; Batty, 2005). An everyday user of the EIMS system probably won't be able to clearly define all the subsystems that characterise an urban settlement in a scientific methodological way. Nor they will be able to relate systematically the different hierarchies in a component of the system with the different hierarchies of the other system components. Nevertheless, would a more profound analytic research of a complex system be efficient in terms of operatively and time of research? Would it be pragmatic in terms of the complexity of the findings in order to efficiently support the creations and selections of everyday human actions?

We suggest that perhaps a more pragmatic and simple model which relies on the human innate capacity to deal with complexity would prove to be more efficient. In other words, we suggest a model that trusts the human capacity to deal with the complexity of everyday life. The model is used as a guide to bring that innate knowledge to light and support people to draw conclusions from their own analysis of the system. We argue that such an approach can prove to be more efficient to inform and guide professional's everyday actions.

Another issue one might raise is related to the subjectivity imbedded in the characterisation and interpretation of EIMS-models. On the one hand, it is a fact that the conclusions one takes from the use of the model are related to the perspective from which one analyses the system. This perspective is one view of the world; it is related to personal beliefs and world views (Grosskurth and Rotmans, 2005). On the other hand, one can never take into consideration all the aspects or elements of a complex system and all the dynamics between them. In other words, there are infinite perspectives from which one system can be analysed and they are all valid aspects of reality (Bortoft, 2010).

The methodology used to operate the EIMS models depends on the perspective taken to analyse a given system. That perspective will influence the selection of relevant subsystems of analyses and the perspective the analysis will take. Consequently, the analyses of these subsystems give a certain image of a social reality. The combination of different perspectives or the combination of the analysis of different subsystems allows one to have a more integrated image of that system. In other words, the different pictures of society or the intersection of the conclusions drawn from the analysis of different subsystems will help to characterise a specific reality. Regardless of the specificity of the perspectives one might take from the analysis of a complex system based on the EIMS models, the conclusions drawn are always regarded in relation to the system as a whole. This allows one to change perspective, add information and compare ideas and points of view based on the same diagram.

In other words, the EIMS models allow one to define and identify personal choices and world views and relate them both to the process and the methodology needed to use the model as well as to the conclusions taken from it. The conclusions taken from the use of the EIMS models emerge from the priorities and choices of its user. Nevertheless, the choices made to analyse a system are taken into consideration in the specific context of that analysis and not as a general truth. The fact that the EIMS models situate the users' choices within the framework of analysis opens the door to share information, to compare findings and use them in other circumstances.

Relation between the relevance of informed interventions and the unpredictable character of complex systems

The long-term consequences of an action are something we can try to estimate but we cannot really predict. This unpredictability increases with the increase of time we aim to foresee. External conditions and the non-linear character of any complex system make all provisions mere expectations in a world of unpredictability (Portugali, 1997; Batty, 2005). The unpredictability of the consequence of human actions might raise questions for the relevance of analysing our actions in relation to any social system.

We argue that having an awareness of whole complex systems and being induced to formulate both the problems and the solutions from different perspectives might lead to take into consideration factors that otherwise would be forgotten (Hammond, Keeney, et al., 2006). The methodology suggested by the research can also bring forward things that, because of personal preconceptions or other reasons, would not be given enough relevance (Bazerman and Chugh, 2006). We argue that from a short-term perspective this increase of awareness might improve the adequacy of interventions in the urban environment and therefore increase human quality of life.

We are aware of the fact that ultimately, in the long term, one can just hope for the best, as reality can unfold in surprising ways. Therefore, we argue that a sustainable management of human development has to be a process parallel to the process of human evolution. To manage human development towards a sustainable path one has to monitor the events and happenings which emerged as a consequence of a given intervention and readjust things when necessary.

Defining, selecting and designing an intervention based on the conclusions taken from the EIMS models both as an individual and as a group

This process should happen smoothly if both the analysis and the intervention are a product of a single individual. In other words, if the models were built by one single person the intention behind the interventions and the focus of the system are directly related to this person's world views. This will influence the knowledge obtained by defining the EIMS model and will help building design concepts from which future projects will emerge. In this context, the EIMS models can help to design or conceptualise a strategy but they are not used to mediate common ideals.

Things get a bit more difficult when different actors need to agree on a shared vision of a situation and on the strategies to follow. At this point disagreements and different interpretations of the conclusions taken might emerge. As we can see in study 1, actors might even agree on the conclusions taken from the EIMS models but they can disagree on the strategies to address the problems.

Moreover, they might even agree on the strategy, and disagree with the character of the interventions. Tuning ideas might not be easy due to the fact that both the model and the consequences of their analyses operate in the context of uncertainty (Rosenhead, 1998). Furthermore, as we have concluded from our studies, the personal imagery of an apparent shared idea can vary drastically (Ponty, 1962).

Nevertheless, from the conclusions we took from our studies we can say that even if participants did not agree on a common strategy, at least discussion was triggered by considering relevant concepts related to the EIMS model, such as whole systems, complexity, unpredictability, human and urban evolution. In addition, each urban actor used the philosophy behind the models to justify and further develop their arguments. From this research's perspective, this in itself is already an achievement.

The use of micro-interventions as explorations to find more appropriate permanent interventions

EIMS models support the design and selection of strategic interventions regardless of their scale. In other words, the models are mainly conceptualised to relate design objects with their context and to offer the grounds to explore optimal solutions. Nevertheless, the theoretical arguments which emerged from this research suggest that small scale interventions have key attributes able to operate from within complex systems. Therefore, this suggests that micro-interventions are mostly relevant tools to consider to manipulate urban change.

Loorbach (2007) in the context of *transition management* suggests the need for the formulation of different strategies to achieve similar goals. This approach builds on the unpredictability of the system and its uncertainty factor. This research argues that by leaving several options open or by implementing a variety of small interventions we are testing the best possibilities, the best strategies and the best combination of interventions. In other words we are letting the system select the best strategy to achieve a certain goal.

This intervention management strategy was not sufficiently tested in the context of this research, but there are approaches to the subject that are worth mentioning:

First, in the context of *transition management*, the different strategies are related to the diversity of strategic actors which are involved in the process of change and the coalitions they form. This research addressed the need for variation or the need to test several alternatives in the system by giving the tools for each individual to create and test their own strategy. In other words, this research focused on testing the ability of the EIMS models to help single individuals to self-develop their awareness of complex systems. The EIMS models are shaped by personal perspective and individual analyses of a context. Consequently, this individual characterisation of the EIMS models shaped individual views for the future of the social organisation in analysis, which, in turn, led to the development of individual intentions for the system. These individual intentions led to personal strategies to achieve the initial aims and consequently give shape to interventions deeply related to the individual that created them.

Second, this research focused on interventions in the building environment. These kinds of interventions, depending on their scale and nature can involve large investments which make it impossible to test before being actually implemented. This fact put more pressure on the model as a framework to efficiently conceptualise sustainable interventions once the success of the intervention will, in most cases, only be tested after they are actually implemented in the urban fabric. To be able to explore a variety of alternatives to induce a specific urban change, we designed an intervention strategy based on a system of micro-interventions (MIS). Each intervention was conceptualised to revitalise the character and the use of UTG, both as an independent element and as part of a system. The *micro- intervention* strategy would also allow testing several options and letting the system select by itself the best solution or the best combination of solutions.

This alternative solution was tested in comparison to other two larger scale alternatives. Due to their scale the other alternatives were automatically more expensive, more permanent and therefore more rigid. We can conclude that the *micro-system* alternative offered the possibility to try things and explore new possibilities in the urban environment.

In light of these conclusions we argue that the use of micro-intervention as a tool to nudge urban change should be further tested. There is the need to search for more conclusive findings that relate:

a) The scale and kind of intervention with the changes they produce.
b) The relationship between the exploratory interventions to which the system reacts desirably and more permanent solutions designed as a consolidation of the system's tendency.

Recommendations for further research

Future research should be undertaken to further test the validity of the EIMS models. That research should test the efficiency of the EIMS models as a framework for a more integrated and holistic way of thinking on complex systems. There is the need to:

1 - Establish a clear relation between the methodologies to operate the models with human thinking processes. We need to test the relationship of the methods used to operate the EIMS models in relation to different kind of users' thinking process, such as managers, architects, planners and decision makers.

2 - Establish objectively the relevance and role of the EIMS-models in:

a) The analyses of a complex system. Conclusions should be taken from more studies comparing the conclusions drawn from the analyses of a system based on the EIMS-models with an analyses made of the same system in the absence of the models.

b) The process of selection of an intervention. Participants engaged with a real-life selection process should be asked to operate the EIMS models and these models should be introduced during the first phases of the selection process. The conclusions should be compared with the conclusions taken from study 1.

c) The design process. Studies following the same methodology should be carried out focusing on both students and professionals of architecture. Conclusions should be drawn by comparing the data collected. The data collected from these studies should be also compared with data collected from professionals who intervened in similar contexts without considering the EIMS-models.

Another relevant study would consider introduction of the EIMS model in the early stages of the study of architectural education, and encourage the students to use the model during their studies. Conclusions could be drawn from the comparison of the analysis of the projects of final year students who use the EIMS model during their learning process with the projects of students who didn’t.

3 - Test the capacity of the models to help users to detach from personal beliefs and base their decisions on rational analyses. For this, additional studies should be carried out in a real-life context such as the one presented in case study 1. Such studies should focus on testing:

- A different methodology and a more a specific framework.
- The influence of the self in the decision making process.
- The way human individual imaginary gives a new meaning and shape to an external object.
- The influence the visualisation of the EIMS models would have in changing human preconceptions.
- Establish objectively how the models lead the user to think about each aspect of society and about notions such as complexity, sustainability, dynamic change, short and long-time actions and intention, nested hierarchies and so on.

One of the studies could use a similar methodology to the one used in study 2 but instead of focusing on past interventions it should focus on future ones. We could draw relevant conclusion by suggesting participants to operate the model and compare the results with the ones collected in study 2.

4 – Investigate further the *micro-intervention system* approach. Tests should be carried out in real-life scenarios to test the potential strategic micro-interventions can have as a tool to:

a) Investigate different approaches to act in the urban building environment.

b) Trigger change in the system as a whole.

Should this thesis be extended to a PhD we would preferably focus on one of the following research subjects:

- Investigating further the influence the EIMS models have in the context of architectural design; Investigate further how the EIMS models influence architectural students' concepts, design process and the design objects.
- Test in a real-life situation the potential of micro-interventions as a tool to test the system's emergent responses and as a tool to trigger change in it as a whole.

Endnotes

Personal statement and motivation for the research

1. For a description of the city and urban change from the perspective of emergence see: Marshall (2009:185, 209); Portugali (1997: 353,380), (2000); Batty (1994). For a description of the city and urban design in the context of complexity sciences see: Salingoros (1998; 2005; 2006); Alexander (1965). For a description of the city from a sociological perspective see: Jacobs (1970) ;(1972). For a description of the city from an evolutionary perspective see: Geddes (1915); Wilson (2011). For a multidisciplinary analysis of the city from the perspective of sustainable ecological systems see *PermaCity, e*dited by Rosemann (2007).
2. See: Cruz, T. (2013). How architectural innovations migrate across borders, TEDGlobal: 13:14.

Chapter 1: Introduction

1 On the global city from the perspective of the relation between information society, communication and globalization see: Sassen (2000: 143,159; 2001; 2011), Castells (1989; 1996; 2000) or Harver (1989). From the perspective of global migrations see: Castells (1998); Sassen (1988; 2001); Storper & Manville (2006). On technology and the city see: Ihde (1990) or Marc Augé (1995).

2 On explorations of new kinds of urbanism see: Sandercock (2010). See also: Friedmann (1997); Font (2002-2003); Portugali and Alfasi (2007); Marshall (2012); Portugali (2012); Roo and Rauws (2012)

3 Communicative and strategic planning for example emerged from the urge to manage the postmodern city. Actually, the work of Harvey (1989) The *Condition o Post modernity* and of Castells (1996) *The Rise of the Network Society* inspired several responses that dominate contemporary urban planning approaches today; namely the communicative approach (Hearley, 2007), strategic urban planning/ governance and New Urbanism. (Portugali, 2012)

4 On how technology shapes urban life, urban dynamics and consequently the urban form see: Duarte and Firmino (2009); Ihde (1990) and Augé (2008) ; On a view of the future society as a consequence of globalization and technology Chareonwongsak (2002). On a new form of self-organisation in urban neighbourhoods see: (Kotus and Hlawka 2010); On the influence internet has in city centres Weltevreden and Mindali (2009); Weltevreden (2007); On the influence of phatic technologies in modern society Wang, Tucker et al. (2012). From a sociological perspective see: Sassen (2001). For a view from the perspective of urban management see: Sandercock (1998)

5 On criticism towards traditional planning practices see Marshall (2009) or Koolhaas and Mau (1995: 961, 971) , Friedmann (2011); Sandercock (1998; 2010); Allmendinger (2001)

6 For critical perspectives of the modernist movement see: Alex Marshall (2000); Coleman (1985) - Coleman, A.M. (1985), Utopia on trial: Vision and reality in planned housing. London: Hilary Shipman; Panerai et al. (2004:116,118,156) and Sandercock and Lyssiotis (2003). For specific examples of modernist failures see: Alex Marshall (2000) for the example of Norfolk Verginia; Jodison and Kieran (2003) make a list of what they entitle as “crap towns”; Pearson (2006) describes Cumbernauld as a ‘horrible place’.

7 For a better understanding of the morphology of cities from an historical perspective see the example of Mediterranean cities from in the work of Braudel (2002); For an interpretation of an urban unit from the perspective of urban morphology and space syntax see: Marshall (2009: 59,88).

8 For a sociological critique on top-down designed cities see: Jacobs (1970; 1972). For a critique from the perspective of design see: Alexander (1966); For a critique from the

perspective of Complexity theory see: Portugali and Alfasi (2007; Portugali (2012); For a critique from the perspective of Evolutionary theory see: Marshall (2009)

9 For a theoretical critique on modernism and planning see: Campell and Marshall (2002:22); Friedmann (2003); Sandercock (1998, 2003): Allmendinger (2001)

10 We focus our argument on New Urbanism because it is focused on interventions in the building environment rather than on planning policies.

11 Neo-traditional (n.d.) is defined as:
"*reviving traditional methods; combining tradition with newer elements*". Retrieved November 11, 2013, from Dictionary.com
website: http://dictionary.reference.com/browse/neo-traditional
On the influence of traditional cities in the 'neo-traditionalist' movement as a reaction to the modernist one see: Rowe and Koetter (1978); Jencks (1981, 1987); Hanson and Younes, (2001); Banai (1996); Campell and Cowan (2002)
New urbanism is an urban design movement which started in the United States around the 1980s. It promotes walkable cities and mixed urban functions. It has ecological concerns and addresses problems related to urban sprawl.
The terms of *neo-traditional* planning and *new urbanism* movement are normally associated see: Kreiger and Lennertz (1991); Calthorpe (1993); Katz (1994); Leccese and Mc Cormick (2000).
On the neo-traditional awareness for the need of eco-friendly places see: Barton et al. (1995; 2003); on sustainable new towns see Battle and McCarthy (1994); Frey, (1999). For details on New Urbanism's projects see www.cnu.org. The reaction to modernism is happening in many parts of the world and is not only becoming increasingly influential but it is also completing successfully numerous projects of all scales. Herbert (2005a); Southworth (2003)

12 See also: Dutton (2000).

13 For a critique on the relation between the planning process and urban change see also: Marshall (2009) and Peranerai et al. (2004:179). Post modern planners such as (Kreiger and Lennertz 1991; Katz 1994; Herbbert 2003; Marshall 2009) researched for other and more interactive and sensible planning.

14 See also: Rowe and Koetter (1978); Jencks (1981, 1987); Hanson and Younes (2001) ; Banai (1996); Campell and Cowan (2002); (Portugali 2004; Portugali and Alfasi 2007; Portugali 2012)

15 On the death of a certain kind of planning see: Turner (1996). On the death of a planning based on an overview of the city see: Allmendinger (2001: 116)

16 See also: Batty (2005: 18), Koolhaas (2005), Batty (2008 a); Davis (2006)

17 Some authors relate the urban sprawl with the developments in transportation and communication networks. For more details on this approach see: Salingaros (2013); Marshall (2003;2005;2006b); Banister (2002): Brandon (2002) About the logic of public transport: Marshall (2005). About the logic of accessibility (2006b), Marshall (2009:209)
See: Sassen (2000) on the relation between global economy and new centralities. For the example of Africa see: Parnell, Pieterse et al. (2009)

18 Ihde (1990) elaborates on the relationship between technology, the city and humankind.

19 We will explore this argument in chapter 3 in the light of evolutionary theory

20 See: Alexander (2003) for an approach on the relevance of architecture in the understanding and manipulation of the urban environment. For a view on interventions in the urban environment as a tool to trigger change see: Lerner (2003); Alexander (2006); Batty (2005); Marshall (2009); Portugali (2004).

21 For more information on unpredictability in complex systems. See: Johnson (2012) for a perspective based on complex multilevel systems. See: Portugali (1997; 2004; 2008; 2012) for a perspective of urban planning paradoxes. See: Dixon (2001) for a perspective of management and problem solving.

22 See: Geddes (1915/1949) for the first explanation of human evolution from a biological perspective. See: Alexander (2003) to read about the relation between human interventions in the building environment, namely architecture and human evolution. See: Marshall (2009) to read about emergence of cities from the perspective of space syntax, complexity and

evolutionary theory. See: Portugali (2011) for a relation between human actions, urban change and human cognition.

23 This argument opposes what was defended earlier by Simpson in his book *The Science of the Artificial* (1981). In addition, Alexander (Alexander, 2003) and Simpson (1981) suggests that the study of human artefacts should become a science. The problem is precisely the fact that the product of human artefacts are other human artefacts and artefacts are out of the scientific domain (Portugali, 2003).

24 See also: Portugali and Alfasi (2007) chapter 1.

25 Stafford Beer explores this subject further in a talk available on You-Tube (https://www.youtube.com/watch?v=JJ6orMfmorg). The film belongs to John Moore University's Stafford Beer collection.

26 See: http://www.socialresearchmethods.net/kb/dedind.php

27 In chapter 4 we will define strategic interventions. In addition, we will argue that every human action can be intentionally designed to become a strategic intervention. Nevertheless, it is the responsibility of top-down management to design and select strategic interventions.

28 In addition, even if large scale-top-down interventions can be seen as a proactive way of '*taking care about the future'* they carry the risk of stifling creativity. Imposed top-down interventions can damage the emergent order that gave life to a place, therefore they should be used delicately and only when necessary. In chapter 4 we will use evolutionary theory to argue that humans normally need time to adapt their daily habits and to new urban structures.

29 Two examples of how our daily lives and our cities reconfigure around new technical-cultural interventions are the social and urban changes that emerged from the increase in use of the car and internet.

30 *Strategic Interventions* is the name we give to human intentional actions applied in the urban system. Strategic top-down interventions should emerge as a response to the system imbalances and should be used to nudge the emergent development of urban change. In other words, we address as *strategic interventions* intentional actions used as catalysts to improve the urban system and to direct urban change.

31 In cybernetics the systems which are capable of having an independent existence are called viable systems (Beer, 1983) . For an introduction on Synergetic see: Haken 1996; (Haken, Wunderlin, et al., 1995). For its application to urban planning see: Portugali (2002; 2003).

Chapter 2: The city

1 This argument expresses a preferable tendency not a rule. Each context is unique and large-scale top-down interventions might prove to be the best *Intentional Strategic Action* to re-direct urban development towards a sustainable path. The argument made here also depends significantly on whether we are intervening in a well established urban structure or we are creating one.

2 Benevolo (1980: 60, 72) describes the city as a united social and political entity.

3 See also: Alexander et al. (1977: 940-945,469)

4 In an interview in 2008, Byrne, a fellow Portuguese architect, named the public spaces of the city such as the street and the squares “the empty spaces”. This way of addressing the public spaces is from the building environment perspective. It relates to the empty spaces which connect all the built volumes.

5 On how technology shapes urban life, urban dynamics and consequently the urban form see: Ihde (1990); Duarte and Firmino (2009) and Augé (2008) ; For a view of the future society as a consequence of globalization and technology Chareonwongsak (2002). For a new form of self-organisation in urban neighbourhoods see: Kotus and Hlawka (2010); On the influence internet has in city centres Weltevreden (2007); Weltevreden and Mindali (2009) ; On the influence of Phatic technologies in modern society Wang, Tucker et al. (2012). From a sociological perspective see: Sassen (2001; 2005). For a view from the perspective of urban management see: Sandercock (1998).

6 Paper presented at ARI’s conference - *Intercity Networks and Urban governance in Asia* 8-9 March 2012- by Teddy G. McGee, *The Role of Translocal and Intercity Networks in the Development process: Resolving the contradictions of Mega-Urban Development in Southeast* Asia.

7 The kind of city that emerges from the bottom-up is addressed by some authors as the organic city. The term organic city is used to define a vast number of perspectives and theoretical considerations about the urban form. Therefore, to avoid miss interpretations, we have decided to follow the terminology used by Batty (Batty, 1994) in his book *Fractal Cities* coined by Alexander (Alexander, 1966) in his famous article *A city is not a tree*. In light of this we’ll refer to the organic city as natural city.

8 Wilson calls this the human capacity to escape a path dependence “*Cultural Evolution, like biological evolution, is path dependent. You can’t always get there from here*.” (Wilson, 2011)p 124 ; Alexander (1965): Jane Jacobs (1970); (1972): Marshall (2009)

9 ‘*Hopeful monsters’* was a term coined by Goldschmidt and it refers to large mutation in organisms (Dennett, 1996). The same term was used by Marshall (2009) to explain the risk of breaking the continuity of the evolutionary process.

10 Both Modernism and Neo-traditionalist movements are an example of this top-down urban design approach.

11 He explored this idea further in his book *Pattern Language* (Alexander, 1977)

12 On the human need to simplify reality in other to perceive it see: Alexander (1966; 2003). See also: Ehrenfeld (2008) or Bortoft (2010). On the relevance of studying emergent human interventions in the building environment to the understanding of the quality of life in the city see: Alexander (2003-2004); About public realm policies (Which are mostly related to health and safety) see: Lang (2005).

13 For a description of the city and urban design in the context of complexity sciences see: Salingaros (1998; 2005; 2006).

Chapter 3: Human and urban change

Introduction:

1 This theoretical background was the basis for our *Explorative Intervention Management* System (EIMS); a framework to design, analyse and select interventions in the context of complex and dynamic urban system. To learn more about EIMS (the exploratory intervention management system) see chapter 5 p. 154.

2 See also: Portugali (2012) and Read (2012); The gap between theory and practice is an aspect we want to avoid. Complexity theory was used as the background body of knowledge to design the exploratory framework which will support the research’s methodology and eventually serve as a tool to support design and selection of urban interventions. To learn more about EIMS (the exploratory intervention management system) see chapter 5 p. 154.

3 Cited in Marshall (2009: 129) and in Kostof (1991: 86);

4 On the relevance of the use of micro-interventions to nudge urban change see chapter 4 p.134.

5 Cited by Marshall (2009: 129).

6 See: Jacobs (1965).

7 As we have seen in chapter 2, in his article *The City is not a Tree* (Alexander, 1966), Alexander argues that most problems in planed cities are related to the simplistic character of design. He suggests that natural cities have a deeper order which echoes the human relations and the urban functions which compose it.

8 This notion is very closely related to the biological notion of nested hierarchies. See: Miller (1978); Alexander (1979 and Marshall (2009).

9 Haken was the founder of the theory of Synergetic (Haken, Wunderlin, et al., 1995) and of a new domain of complexity and self-organisation theories.

10 For an analogy between complexity theory in the study of cities and social senses see: Portugali (2012)

11 For examples of computer models to study the city based on fractal geometry and complexity theory see http://www.complexcity.info/media/software.
PSS is an example of a tool to support urban design and management based on 3 components: Simulation models based on complexity theories, GIS (Geographic information system) and visualisation models such as VR (virtual reality). This tool allows us to test future scenarios for the city and try different strategies. It is reasonably easy to operate and its application in real-life scenarios is slowly increasing. See: Geertmana and Stillwellb (2004) for inventory of the use of PSS among urban planners. See http://www.whatifinc.biz/ for an introduction to a planning support system named What if. See http://www.whatifinc.biz/publications.php for publication on the subject. See also http://www.complexcity.info/media/software/

12 Portugali highlights the fact that users of PSS models which in theory should approach the city as an open unpredictable and self-organising system often treat it according to the classical approach (Portugali, 2012:232).

13 See the example of Tel Aviv balconies in Portugali (2012).

14 See: Strickberger (2000); Ridley (2004); Futuyma (2005); Lynch (2007).

15 See for example *Oxford Dictionary* on line http://oxforddictionaries.com

16 Cited also in Marshall (2009:161).

17 See: Thaler and Sunstein (2008); Ariely (2008) and Akerlof and Shiller (2009).

18 See http://www.centrodeoperacoes.rio.gov.br/

19 See the example of the parable of the immune system in Wilson (2011:125-137).

What is common to all cities?

20 The word fractal was coin by Benoit Mandelbrot (1982). In the book *The Fractal Geometry of Nature*, Mandelbrot (1982) argues that apparent random mathematical shapes actually follow a pattern if they are seen from the perspective of a single repeating unit.
To know more about fractal analyses in social complex systems see: (Falconer (1990) and Brown and Liebovich (2010).

21 For a description of a fractal from the urban perspective see: Marshall (2009); From a design's perspective see: Mitchell (1990: 103-104); From the perspective of whole systems see: Bortoft (2010).

22 For a description of humanity and the natural world from the perspective of *emergence* see: Gribbin (2005). For a description of *emergence* from the perspective of human behaviour or, more specifically, from the perspective of market behaviour see: Smith (1776).

23 See: Ramírez (2000) for an analogy between the beehive and the city from the perspective of *emergence*.

24 Bottom-up actions emergent from individual needs. They are focused on the self. Top–down decisions consider time, budged and cost in relation to overall urban dynamics, such as closeness to '*workplace or workforce, market or customers, civic facilities or constituents*'. About the logic of public transport see: Marshall (2005).

25 Lynch (1981) mentions how it is difficult for us to conceive forms-in-progress. Perhaps this has to do with planners' speciality on a targeted kind of design that is typically fixed in form.

26 Modernist city planning is an example of such analysis of the city form, see projects such as: Ville Radieuse by Le Corbusier; The garden city Ebenezer Howard ; Ciudade Lineal by Arturo Soria's and others.

27 Marshall (2009:187) demonstrates how urban forms such as *concentric settlements*, which happen spontaneously according to logical individual choices, served later as a model of how a city should be. He shows how something organic becomes rigid by the means of planning and design. Modern and Neo-modern planned towns are examples of that; they are a consequence of focusing on the overall shape rather than on the rules that it originated from.

Why are cities unique?

28 Dawkins (1976; 1997:13) makes a similar remark about wasps.
29 See chapter 5 p.160 for more information about EIMS' models.
30 The scope of (Geddes, 1915/1949) *Cities in Evolution* is best summed up by its subtitle: *An Introduction to the town planning movement and to the study of civics.*
31 Ernst Mayr (1977) called *population thinking* to refer to a society which emerged from individuals. Lane (Lane, Maxfield, et al., 2009) refers to *organizational thinking* as a society which emerges from groups of people.
By *organizations* Lane refers to physical, biological and human *socio-cultural* groups.
32 This description relates to the biological concept of *nested hierarchies* Miller (1978) and to Wilson's (2011) ideas of a possible hierarchical organisation of society.
33 Wilson (2011:318), Vermeij (2004) and Dawkins (1976) look at complex human adaptations such as culture and religion as complex systems like organisms. Both culture and religion receive information from the environment, interpret it and react accordingly. Furthermore, they have to be sophisticated enough to survive and reproduce in the world. Both authors explain cultural and religious diversity in detail from an evolutionary perspective and make constant analogies with biology. Their opinions differ however in relation to the benefits religion can bring to humankind, but this is not relevant for the argument we are trying to make.
Culture and religions evolution however differ from biological evolution in several aspects such as the way they reproduce. In contrast to what is generally known in biological evolution (even if there are new understandings on this matter since there are more knowledge on the movement of genes across taxonomic boundaries (Zhaxybayeva and Gogarten 2004; Ge, Wang, et al., 2005) cultures can derivate from different ancestral species.
"A given religion can borrow elements from many other religions and nonreligious traditions, but the fate of each element in competition with other elements is still a matter of cultural Evolution." (Wilson, 2011: 319)
The rules of cultural selection are not known to people. They can either be invented or inherited like genes. People have the capacity to decide their own selection rules which will guide them through the path of development they aim for themselves. But it is not said that those guide lines will work. Especially because they have to interact with guidelines of other people and relate to the motion of the whole. The outcome of such complex systems is impossible to predict. As we have seen before *change* and therefore *evolution* is unpredictable and the future is unforeseen.
"Life is complex, and our understanding is severely limited. At the end of the day, we need to try out multiple solutions, designing them as best as we can, and select the ones that work based on a careful evaluation of their consequences. We need to manage the process of cultural Evolution." (Wilson, 2011: 354)
34 Wilson (2011) took samples of DNA of a vast number of individuals as part of the data collection made for the studies presented in the book *The neighbourhood project.* Previously he made a study on elderly people based on DNA samples and interviews.
35 On the idea of 'hopeful monsters' see: Dennett (1996) and Marshall (2009).
36 On social and cultural evolution see also: Dawkins (2004: 133). On the evolution of religion see: Hopkins (1999) or Mindell (2006).
37 See also: Dawkins (1197:13).
38 Lane, Maxfield et al. (2009:28-36). Note: By *artefact* Lane implies something produced by humans for their own use. By *agents* Lane implies '*an organization of human beings and artefacts, in the name of which social action is initiated and executed'*. With *attributes* is implied the characteristics which specify the identity of the agents and of the artefacts.
39 Because of the deep symbioses between the organisms and their environment, Marshall suggests referring to *evolution* as *adaptative emergence* (Marshall, 2009).

Introduction to Intervention Management and design

40 See http://nymag.com/arts/art/features/51163/ and http://www.allvisualarts.org/artists/hilary-berseth.aspx
41 The idea of nested hierarchies is described here as a world view. In chapter 4 we will relate this world view with different scales of interventions and emergent reactions from the urban environment see p. 129
42 It is a fact that cities are not in equilibrium and they don't emerge necessarily to that state but it is inherent to complex system to self-organise in an attempt to achieve a certain kind of balance even if that balance does not necessarily favours the good of the system as a whole (Portugali, 2000; Batty, 2005). See: Banathy (1996) for a perspective of systems theory.
43 See: Valerie and Allen (1996) and Lane (2006).
44 Just as Wilson (2011) implies when establishing the *Evolutionary Paradigm* as a common language across all scientific fields.
45 This argument informed the research methodology where participants are asked to define their system of analyses as well as its most relevant subsystems.
46 *Inter-level generalization* is "*the assumption that each of the levels of life, from cell to society, is composed of systems of the previous lower level*." All living systems "*are composed of comparable carbon-hydrogen-nitrogen constituents, most importantly a score of amino acids organized into similar proteins, they all need water and oxygen to survive. They all decent from a common evolutionary rout. These are important uniformities that enable certain generalisation across levels and even across kinds of living system*." (Miller, 1978) These generalisations can help us to make predictions and identify problems even before they occur. See also http://www.panarchy.org/miller/livingsystems.html
47 Like the water striders (Wilson, 2011).
48 Mike Mesterton-Gibbons (Gibbons and Sherratt, 2007), attempted to shed light on the conditions in which cooperation will emerge as well as to the conditions under which individuals might form fighting coalitions.
49 Adam Smith (1723- 1790) when he observed the self-organising character of human organisations did not imply that humans were particularly selfish and self interested. He rather emphasised the natural human concern for others as part of human nature. Still, as we will see this empathy is related to the scale of the group where individuals operate.
50 Politics and Religion for example have the capacity to give a greater meaning to the lives of individuals and make them part of something larger then themselves. Nevertheless, Religion has both the power to make people cooperate and increase human segregation and aggression (Dennett, (1996); Dawkins, (2006); Dennett, (2006). Even in a rigidly structured and ethical orientated believe system such as religion, there is space for individualism and for exploitation.
51 Wilson suggests the following Norms:

- *" To defy the authority of empirical evidence is to disqualify one-self as someone worthy of critical engagement in a dialog*"

(Dalai Lama, 2005: 76)

- *"If you're undermining the commons, then you're degrading your soul"*

(Wilson, 2011: 376)

He names these norms as *ant commandment*. The first *ant commandment* is broadly used in science but is now used in politics and among people engaged with the management of public good. Furthermore, is more used in some contexts then others "the norm is more solidly established in Denmark then in America". This commandment would establish the grounds for discussion and for scientific knowledge to engage it's know-how with actually solving real problems.
The second commandment is important once, as we have seen with the example of the world economy, emergence does not necessarily promote a common good. Self-interest can develop in dangerous and even auto-destructive forms. Furthermore, the second commandment is important to regulate choices and stop personal interests overcome the common good.

"*When we are attempting actively to make a decision, however, our decisions become the winnowing process. If we are not making decisions on behalf of the common good, then we will be generating conflict, neglect, and decay at some level of the multitier hierarchy*"

(Wilson, 2012: 377)

52 According to Wilson, this database should include not only the genetic information of the citizens, but also their economical and social background, profession and previous professions, address and previous addresses… everything that would help build an image of each individual and his surroundings. Of course this could bring ethical problems and there would also be problems associated with the mis-use of the information, but those issues are left for others to study further. The point we would like to make is that both the city and that kind of database would work as an input of information. This information could then be processed either to monitor the city's development or support a new direction of growth. As the immune system parable suggested us, to address any problem or even to avoid it in the first place we need to understand it in order to make the appropriate decisions. To understand a situation or a context we need as much information as possible.

53 See chapter 5 p.160 for more information about EIMS' models.

54 See Chapter 4

55 Legal and social control, for example, has to exist even if it is to avoid stealing and the destruction of the neighbour's front door. Furthermore, top-down social control can deal with issues like segregation, poverty, crime, urban sprawl, etc.

56 These aspects of city planning shaped our exploratory models which were used as the research methodology. See chapter 5 p.160

57 Adaptive management is based on the feedback learning from the environment. It aims to respond adequately to the feedback of the environment rather that blocking it. It relates uncertainty and unpredictability with ecosystems. Therefore, it emphasises the relevance of a management system as a process parallel to ecological cycles. It is designed to improve based on a trial and error approach. Relating adaptive management with the kind of management suggested in this research could be an interesting topic for further research a future paper. For a better understanding on adaptive management see: Berkes, Colding, et al., (2000).

58 Ijburg islands, in Amsterdam can be seen as an example of such approach of planning. See http://globalsiteplans.com/environmental-design/ijburg-amsterdam-innovative-neighborhood-on-artificial-islands/

59 See the Italian example. http://mostlyeconomics.wordpress.com/2013/02/27/decentralisation-gone-wrong-in-italy/

Chapter 4: Categorising Interventions

1. Stafford Beer (1983) in his article *The will of the people* applies cybernetics to the understanding of social systems. In this article he shows how feedback reactions of the system can take over the system but not always in desirable ways.
2. To read more about adaptive governance in relation to *the intervention management system* see chapter 3, p.100.
3. To read more about what we consider being genuine public participation see chapter 3 p. 108 *Dissolve decision-making.*
4. See: Morgan (2008: 18). The letter written in February 1804 by the provost Thomas Leys was a key intervention responsible for the fine character of Union Street today.
5. We used this example because Aberdeen is the urban context of these studies. The example is only used to make a point on the connection between contextual action and emergent contextual reactions.
6. See page 96 of this thesis.
7. Interventions design and selected with an intention to trigger or direct change
8. See: http://www.britannica.com
9. See also: Ihde (1990).
10. See table 4, p.178.

11. The Natural and artificial city were the theme of chapter 2. "Urban emergence" is explored in chapter 3 from the perspective of complexity and evolutionary theory.
12. Associations such as EDRA (The Environmental Design Research Association) and IAPS (International association People-Environment Studies) are of key importance in this topic. For both associations the symbiotic relationship between humans and their environment is central to research efforts. See http://www.edra.org/ and http://www.iaps-association.org/
13. See chapter 3, p.85 for *Design* and p. For *Artificial Selection* see p.84
14. Loorbach (2007) studies change from the perspective of *Transition Management*. The models used in his work were valuable for the design of this research's explorative models.
15. The word *Insurgencies* has a wide meaning. Some writers mean just protests or movements against the state. Others, like John Friedmann (2011), would include projects for alternative life-spaces that go against prevailing structures of power. In light of this emerged the idea of *insurgent planning* such approach privileges bottom-up interventions such as e.g., occupying abandoned land to grow food for social rather than market consumption. This was the theme of the conference organised by the Asian Research institute (ARI) on the 3rd and 4th of May 2012 (Global Insurgencies. Remaking the public city in Asia). There is key literature on this theme which was not included in the literature review presented in this thesis. Relevant books on the theme of insurgent planning and insurgencies are: Castells (1983); Lefebvre (1991); Holston (1998); Purcell (2002); Mitchell (2003); Purcell (2003); Harvey (2008); Marcuse (2009); Miraftab (2009); Sweet and Chakars (2010); Harvey (2012).
16. One problem arises when top-down visions focused on the self. In light of this Marshall (2009) suggests that planning also should have the responsibility of identifying the decision making protagonists and taking into account the influence they can have in the decision-making process. In other words, urban management should have the responsibility to reveal if the urban vision is social based of individual based. '*It is not just a matter of having a vision, but taking care with who's vision, and for whose benefit*.' As we will see from study 1 findings, this is possibly the most challenging aspect of the decision makes' and planners' roles, once as individuals they cannot be detached from a personal perspective of the world and personal relations. Therefore, their appreciations are always subjective. The influence of decision-makers and practitioners is merged with the process of planning and should be regarded as such.
17. As argued in chapter 3, in the context of the research exploration for a new kind of planning (see p. p. 92), we suggest nurturing the self by nurturing and encourage bottom-up interventions in the city. In other words, we argue that the self should be nurtured by the respect for the emergent character of the system.
18. Interventions such as war can also be considered top-down intentional interventions. Such interventions imply destructive actions and from the perspective of the higher levels of the system they emerge from competition rather that cooperation. In addition, there are obvious questions regarding the both the good of both the higher and lower levels of the system. In light of this, in general terms, they should not be considered as appropriate options, regardless of the fact that they sure make part of humankind's evolutionary process. Such interventions should also be considered under a contextual and ethical analysis of the subject. This would require a vast literature review which was not the focus of this thesis.
19. For more information on *insurgent planning* and *insurgencies* see note 15. To illustrate examples of insurgent action from the perspective of the tension between top-up and bottom-down forces, see the case of the UTG in Aberdeen http://www.youtube.com/watch?v=G4OzzPwFFDQ and of Ha Noi: http://www.youtube.com/watch?v=-lvnXU3Epp0. Both cases illustrate the tension between private top-down forces allied with governmental ones against the civil bottom-up aims and needs.
20. There are several explorations on new strategies to empower bottom-up interventions and give them more protagonism in the urban evolutionary path. Namely the ones suggested by Portugali (2012) and by Marshall (2012), both following the findings which emerged from complexity theory in the study of cities. There are also relevant studies on insurgent planning, which open doors for the consideration of alternative bottom-up kinds of urban planning (Friedmann, 1997; 2011). See note 15 of this chapter.

21. Figure 9 diagram was presented at a conference on held on the 8th and 9th of March 2012 at ARI - Singapore. The paper presented by Terry G. McGee was entitled as *The role of Translocal and Intercity Networks in the Development process: Resolving the contradictions of Mega-Urban Development in Southeast Asia*
22. Such a diagram could inform the models explored in chapter 5.
23. In chapter 5 p.154 we will use an exploratory model to relate interventions in the urban environment with the other areas of interventions which are relevant to describe social complex systems.
24. See chapter 3 p. 59
25. The generative elements or the self-similar aspects of a complex system are those which repeat themselves over and over again through long periods of time. These are the elements from which a complex system emerges and self-organises (Batty, 1994; Portugali, 1997; Portugali, 2000; Batty, 2005).
26. Marshall (2009:194) refers to the notion of probability in emergent cities to demonstrate how and why certain outcomes in urban morphology or some urban patterns are more probable then others. '*That is, although a situation may be random, this does not mean that all outcomes are equal likely – a natural level playing field of probability. Rather, there is a varying landscape probability, in which some outcomes are more likely than others.*' For example, Marshall demonstrates that the emergent city is likely to be more irregular and heterogeneous rather than regular as the 'planed city. '*What makes a given structure unlikely is that only a few paths lead to it… A regular structure is unlikely not because it is regular as such, but because to create the regularity one must not deviate from a given path, or limited set of paths*.' According to Marshal, the unlikeness of a given structure is also related to how tightly it is defined. E.g. it is more likely that a city pattern is based on an orthogonal grid rather than a hexagonal pattern. Still, if the units which generated the pattern are hexagonal, the hexagonal urban pattern would be likely Marshall (2009:200, 207) ; (Stedman, 2006). Those considerations on probability are important to justify the application of complexity sciences and cellular automata programs to the study of cities and as a tool to support urban planning and urban management. Computer models, regardless of how accurate then can be, they cannot replace reality nor dictate the path of development of a city, but they can be of great importance to acknowledge the range of probable urban development paths and to analyse the most probable consequences of an action in the urban structure.
27. Just like the example of Aberdeen (Morgan, 2008).
28. See chapter 3, p. 60.
29. See chapter 3, p. 60.
30. On the relation between the complexity of human perception in relation to the ways we organise to optimise human development, see: Lane, Maxfield et al. (2009); On human perceptions in relation to human condition and to the environment see: Ponty (1962).
31. See chapter 3. Human actions as adaptations to the environment p.66
32. We used Alexander's work to define the concept of artificial and natural city see chapter 2; we used his vision of the world to reinforce the relevance for a holistic study of things and the need for a serious study of human actions. In addition, in chapter 4 we used his work to define interventions of events and of space.
33. IAF will be the heart of our *Exploratory Intervention Management System* (EIMS). See chapter 5, p.160.
34. There are explorations on how to translate these basic elements in software designs to support the design of more appropriate interventions. See: Salingaros (2000; 2005).
35. Examples of man who change the way we see and act on the environment are people such as Nelson Mandela, Winston Churchill, Bill Gates, Elvis Presley, Charles Darwin, Sir Isaac Newton and so many others; Examples of buildings which influence the dynamics of a country and the ways we build are the pyramids in Egypt, Eiffel Tower in Paris, the Guggenheim Museum in new York or in Bilbao and so many others.
36. For Alexander, human survival depends on the research and good application of insides from generative methodologies which need further study in all fields of science (Alexander, 2006).
37. Exxon, Shell, Microsoft, BP or Philips as the majority of global private companies have a great influence in countries as well as in the world economy.

38. The example of this intervention was suggested by one of the participants in study 2 (Sue Keating) . See also http://www.hsme.co.uk/
39. More studies based on such a framework can help to inform us about the relationship between kinds and scales of intervention, areas of intervention and the scale and nature of their impact on urban systems. In other words, the categorisation of interventions establishes a framework to study them and to address the questions such as: How can we design and select strategic interventions more efficiently? And how can an adequate management of interventions be reflected on a more efficient management of urban change?
This research explored and tested a framework to address this first question. Nevertheless, further tests must be done to relate our finding with innovative management systems, with institutionalised kinds of governance (Termeer, Dewulf, et al., 2010) and with our explorations made in chapter 3.

Chapter 5 - Research methodology

Qualitative inquiry

1 See: Packer (2010: 164-166).
2 On *radical realism* see: Packer (2010: 203) and table on p.206.

Research's design: The *Exploratory Intervention management system* (The EIMS)

3 There are several models that attempt to represent the different levels of complexity of a system in relation to the environment. These models were developed to address different kinds of complex systems (Jacobson and Wilensky, 2006; Leiba, Zuzovsky, et al., 2012) and emerged from different research's needs. Previous research detected several difficulties or challenges in using some of these models as a tool to understand complex system's behaviour (Jacobson, 2001; Hmelo-Silver and Pfeffer, 2004; Assaraf and N 2005). Following the findings above, several models have been explored and combined in an attempt to understand urban system's dynamics and development from the perspective of human actions.

- SPCity models emerged from a view of the city similar to the EIMS models and aimed to address similar problems (Portugali, 2012). Because of this the SPCity models helped give validity and structure to the EIMS models. Nevertheless, their objectives are rather different; among other things SPCity models were designed as a tool to support organisations of institutionalised systems and we focused on the individual as the basic element of society and organisations.
- Geels and Kemp (2000; 2005) use a multilevel model to study transitions (which they defined as system innovations) from one socio-technical system to another. One reason to compare the multilevel model with the EIMS basic model is the fact that the multilevel model was largely used in studies on sustainability; a key concern in our research (Ehrenfeld, 2008). Geels and Kemp's multilevel model is particularly relevant for this research because it can summarise concepts of holism (Bortoft, 2010) as well as the idea of nested hierarchies as the structural organisation of social complex system (Alexander, 1977; Miller, 1978). Geels and Kemp's multilevel model inspired the methodology to operate the EIMS models.
- One challenge transition management studies faced when using the multilevel model is related to the fact that transitions are a very complex and non-linear process. Change does not happen necessarily as the sequence of the steps represented by the multilevel model. Change comes back and forward and it continuously shapes all different levels of the system. Another key challenge transition management studies faced when using Geels and

Kemp's multilevel model was the fact that it did not consider factors outside the system (The Macro System). In light of these two arguments Loorbach (2007) introduced the Multi Layer Perceptions model or the MPL model which is also based on nested hierarchies, yet is arguably more flexible and dynamic. The MPL model was of key importance to trigger the need to search for a model as a standard framework still adaptable to all context, needs and circumstances.

- The SCENE-model was used within transition management (Loorbach, 2007) to characterise the systems in analysis. The main relevance of this model is the fact that it gives space to characterise complex systems and sustainable development both from an objective and subjective perspective; both from qualitative and quantitative qualities of a system. Furthermore, the structure of SCENE model gives it flexibility to be applied in every context even if the representation of the model stays the same. This is relevant to compare and cross information. In addition, SCENE model can easily be used as a tool for participatory use.
- Hodgson (2011) used the The World System Model to frame a complex and holistic perspective of social systems in a simple and pragmatic way. As EIMS models The World System Model aim to be used by everyone who aims to explore whole complex systems. As with EIMS models it was used as a framework and the methodology in a relevant study named as The IFF World Game. The World System Model helped design and contextualise the heart and focus of the EIMS models.

4 The most significant studies for this research's theoretical background, research methods and methodology were:

- The neighbourhood project (Wilson, 2011), namely the Design Your Own Park Competition, which used evolutionary theory to link space which human adaptations. In this study a broad spectrum of people were asked to suggest designs for a neighbourhood park. The facilitation process and the selection criteria were inspired in Lin Ostrom's work (1990). This experiment was effective in providing the structure and the necessary ingredients for people to self-organise and manage their commons effectively. In addition, this study proved that when we change an environment we change human behaviour.
- The City Games is a case study based on complexity science's urban theory and was inspired on Portugali's City Game SIRN (Portugali, 1996). With this study, Tan (2012) aimed to find out when, how and what kind of different design orders and design rules emerge spontaneously from the interaction of a small group of people. The participants were asked to brainstorm for innovative strategies and interventions in the building environment around a 3D model of their city. The study aimed to test the applicability of the city-games as a design tool. We argue that the projects which emerge from the city games' workshops, due to their complex and emergent nature have probably more potential to serve adequately human life than one the ones which emerge from a single mind. Nevertheless, the basic problem remains; when such large scale projects are implemented as one single urban intervention there is a risk of posing problems for human adaptation.
- Hodgson's (2011) game is significant for this research in three ways.

a) It contributed for the contextualisation of EIMS models in the context of whole systems adapted for an everyday life use.
b) It confirmed the relevance of a shared vision to stimulate people to work towards a common good.
c) It encouraged the use of EIMS as a framework used in the research's methodology.

These issues are relevant for this research because they help justifying the research methodology and they echo the findings of the research's literature review. In addition, the model used in the studies was relevant for the design of the EIMS models.

- There is expansive literature on the relevance of whole systems theory to support design. The most relevant theories, principles and practices were magnificently synthesised in the work of Blizzard and Klotz (2012). This work took the form of a methodological review of the literature available on the subject and was synthesised in the shape of a framework. This framework is composed of 20 elements, categories and processes principles and methods. As the norms suggested by Elionor Ostrom (1990) on how to facilitate cooperative human behaviour, Blizzard and Klotz's syntheses of processes, principals and methods can facilitate sustainable designs to emerge.

Such a framework could be used to guide design process and conceptualisation towards the creations of meaningful and efficient top-down interventions; it might represent a way for humans to break through what Wilson (2009) call the rigid flexibility and help us imagine the imaginable.

The whole system's framework was relevant for this research because it informed the design of EIMS models as well as the methodology to use them. In addition, it helped identify general characteristics sustainable designs and therefore it helped defining sustainable interventions. Finally, it played a vital role defining the methodology used in study 3.

- Transition management (Loorbach, 2007) focused on nursing the transition of organisations and institution from the "old way of doing things" to a more innovative and sustainable way of thinking and performing. The research on Transition Management is based on case studies and it is continuously being tested and developed. Still it is an inspiring work which shares relevant common purposes with this research, such as:

  a) To address problems of complexity from their basis.

  b) To link theory with practice.

  c) To explore the connection between short-term action and long-term intentions.

  d) To explore the conceptualisation of a vision as a framework to select and design intervention.

  e) To explore the relation between long-term intentions or visions with notions of sustainable development.

  f) To explore the relevance of micro-interventions in the process of nudging dynamic change.

  The studies on transition management were relevant because they helped to position this thesis in a broader research context of management of change. Furthermore, transition management's findings reinforced key concepts and ideas that emerged from the literature review and from our pilot studies; namely the idea of manipulating change in complex systems by using small-scale interventions.

5 See analogy between Hodgson's model and EIMS in note 4.
6 See chapter 3 p. 93 for a notion of nested hierarchies from a perspective of social organisation. See chapter 4 p. 135 for a notion of nested hierarchies from a perspective of interventions.
7 The EIMS were designed to help defining cross levels and hierarchies of governance relevant to address a given problem (Termeer, Dewulf, et al., 2010).
8 See chapter 4 p.113 for a more in-depth description of interventions as actions and as reactions of the emergent nature of complex urban systems.
9 For a better understanding of the kind of management suggested by this research see chapter 3 p. 92- 110
10 Such as suggested by study's 3 findings.
11 As suggested by study 1's findings.

Chapter 6: Studies

1 For more information about the EIMS' models see chapter 5 p.160.
2 For more information about the *micro intervention system* (MIS) see chapter 6 p.192.
3 For an historical description of Aberdeen, from the perspective of Union Street and therefore from the perspective of interventions in the building environment, see: Morgan (2008).
See also:
http://www.andywightman.com/docs/UTG_AWreport_FINAL.pdf
http://mcjazz.f2s.com/RailwayHistory.htm

http://en.wikipedia.org/wiki/Aberdeen
http://www.aberdeencity.gov.uk/home/home.asp

4 Today, Union Terrace Gardens are a one-hectare public park which is open all year long; they are much smaller than when they were open in 1879. The gardens are situated half way along Union Street right in the heart of Aberdeen. Actually, we can say that the Union Terrace Gardens are the heart of Aberdeen. Normally the heart of a city is marked by a square, a church, or the civic building of the city. In contrast, Aberdeen's centre is not a place of encounter, a place to stop, a place to connect with the spirituality or with civic duties. The city centre of Aberdeen is *Union Street*[3]; a place to walk, to move. The buildings related to it are mostly retail and housing. Besides the graveyard of Saint Nicolas church, *Union Terrace Gardens* are the only place to "stay" or to stop related to *Union Street*.

Today the garden is surrounded by some of the most relevant architectonic buildings of Aberdeen city centre; His Majesty's Theatre, St Mark's Church and the Library on Rosemount Viaduct to the north, and the Triple Kirks to the east.

Union Terrace Garden is limited to the north by Rosemount Viaduct, to the south by Union Street, Aberdeen's main thoroughfare, to the east by the railway and Denburn Road, and to the west by Union Terrace.

On the west side the gardens are characterised by the arches situated under Union Terrace. The arches were design by James Matthews' with the intention to turn the park into a pleasure area. They were placed along the length of the gardens and are one of the special features that define the character of the whole site.

Contrary to popular belief, the north side of the garden is in fact not a natural the amphitheatre. It is the covered remains Denburn Terrace which was reduced to rubble when the Victorian Viaduct was built in 1888.

This slope is the elected place for people to sit. It has no trees blocking the sun and it is protected by the wind. Besides that it gives one a beautiful view over the length of the gardens.

The north side of the gardens are limited by the viaduct which substituted the pedestrian bridge which was part of the original design of the gardens. Denburn Viaduct (1867) became the Rosemount Viaduct in 1886 and it is the north end of the gardens today.

On the east side, as a background to the rail way, are the back facades of Belmont Street's buildings.

Figure 31: Image of Denburn Road taken from the Union Bridge.

The back sides of the houses of Belmont Street emerge from the ground. These constructions step down the slope of the Denburn; they connect the difference in level between the front and the back side of Belmont Street. In other words, the volumes are displaced and shaped in such a way that they stretch in height and relate both to where the railway was built and the bottom level of the gardens as well as to the much higher level of Belmont Street, which smoothly relates to Union Street through a gentle slope. These houses are reasonably small scale and picturesque constructions. They do not form a continuous and compact facade. They are, in fact, rather permeable and offer several narrow alleys that physically connect the back and the front sides of Belmont Street.

A key feature of the east "facade" of the gardens is The Triple Kirks which was a church designed by Archibald Simpson in 1843 to commemorate the conflict between church government and Spiritual independence. Today some of these constructions are abandoned and others are bars or restaurants mostly related to Belmont Street. This gives the east facade of the gardens a rather nostalgic and abandoned character.

The railway is still functioning but it is rather discreet when compared with the impact of the oversized Denburn Road.

The south side of Union Terrace Gardens is characterised by Union Street and Union Bridge (1801).

5 See http://www.friendsofutg.co.uk/

6 See the study made by RGU in 2006 entitled Urban Connections (Aberdeen City Growth)

7 See http://www.thecitygardenproject.co.uk/

8 See http://www.brisacgonzalez.com/projects/pva/pva01.html and http://www.peacockvisualarts.com/files/NEW%20BUILDING/InformationLeaflet.pdf

9 There are other topics of discussion, which emerged from crossing information gathered in study 1 and 2. In light of this, topics such as the relation between power and big scale interventions will be addressed further in the text, when the reader is familiar with study's 2 findings.

10 See the questionnaire used to collect data in appendix 3.

11 See the assignment used to collect data in appendix 4.

12 Acuto (2010) explains how Dubai was built on the basis of such objective.

13 Using the UTG to bring in people in the city contradicts political strategies such as the creation of out skirt business centres and new university campus.

14 See, chapter 3 for an evolutionary perspective on the subject.

15 Emile Durkheim (1984) refers to the fact that global icons are significant only when they are recognised as such by the symbolic meaning understood by as many people as possible; they should relate to what Gregory (1994) addresses as imaginative geographies. King (2004) explored common signs and functions related to global icons of modernity. Bourdieu (1991) explored the relation between Language & Symbolic Power.

16 See note 4 and 5 from chapter 5.

17 To see more about the relevance of architecture and design in urban development see:
http://livabilitylaw.com/archives/7887
http://www.metropolismag.com/pov/20111129/frontiers-of-design-science-biophilia
http://www.metropolismag.com/pov/20120330/science-for-designers-the-meaning-of-complexity

18 We have related the themes of focus of the students with the detailed description of the tutors' remarks given just before the final presentation (This report was used as the student's basis for the completion of the project). Based on this comparison we can suggest that tutors influence directly the students' priorities. Nevertheless, more research should be done to support this statement.

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Appendixes

Appendix 1

Categorisation of interventions according to their size.

Examples of interventions in the building environment according to their size.

Relating hierarchies of *Patterns of Space* with hierarchies of *social organization* and hierarchies of *interventions in the building environment*.

Hierarchy of organisational levels of urban and social systems. E.g. The research study's environment.	Level 1: World	Level 2 Continent E.g. Europe	Level 3 Country E.g. UK	Level 4 Region E.g. Scotland	Level 5 Province E.g. Aberdeenshire	Level 6 City E.g. Aberdeen	Level 7 Neighbourhood E.g. city centre	Level 8 A place E.g. UTG	Level 9: Object E.g. The arcade system	Level 10: The unit/ The element. E.g. The public benches
Patterns organised as intervention areas of focus. (IAF)	**Macro Systems of Interventions**					**Macro Interventions** Urban planning and urban design.			Architecture	**Micro Interventions** Design
IAF 1 - Access to water, food, energy, learning, health, a house, work and nature.	Interventions in the urban environment from the scale of the world, the continent, the country and even the region tend to be interventions of a lower level applied in a system. They can also be architectural icons such as the Eiffel Tower or the opera house in Sydney.				**IAF 1** - Access to: -Water: a dam - Food: farm for agriculture, cattle farming - Energy: a nuclear station, Wind farm, a dam. - Learning: centres of exchange of good and knowledge between the urban areas and the countryside. - Health: hospitals - A place to live: housing areas. - A place to work: office areas, factories, a harbour, land	**IAF 1** - Access to: - Water: a lack - Food: urban plantations -Energy: a power station. -Learning: cultural centres, university centres, research centres. -Health: hospitals. -A place to live: housing areas. -A place to work: office areas, factories, a harbour	**IAF 1** - Access to: - Water: a lack -Food: shopping areas -Energy: local sources of energy - Learning: museums, schools universities. -Health: hospitals. -A place to live: house. - A place to work: office buildings, a factory, shops	**AF 1** - Access to: -Water: a public swimming pool - Food: one shopping street -Energy: local sources of energy -Learning: one museum, one university - Health: one hospital -- a place to live: housing buildings -A place to work: the office buildings, shops	**AF 1** - Access to: -Water: a water tower - Food: one market, a supermarket - Energy: a wind mill, -Learning: a school. -Health: a health centre -A place to live: a house. -A place to work: an office	**AF 1** - Access to: - Water: a fountain - Food: one market tent. -Energy: a solar panel -Learning: one information board. - Health: one emergency office. - A place to live: a room, a bed - A place to work: a desk
IAF 2 - Relationship between nature and urban environment.					**IAF 2** - Access to: -Nature: natural reserves, preserved natural areas	**IAF 2** - Access to: -Nature: a city park	**IAF 2** - Access to: -Nature: a garden	**IAF 2** - Access to: - Nature: a garden; an urban open space	**IAF 2** - Access to: - Nature: an area in a garden	**IAF 2** - Access to: - Nature: a tree

IAF 3 - Relations within and between the same and different levels of social organization, in terms of trade, knowledge and culture.					**IAF 3, 4 and 5:** - A place to trade: local markets and "urban markets", shopping areas. - A place to meet and have fun: Sports complexes, entertainment areas - A place to pray: sacred areas. - A place for every age group: community centres	**IAF 3, 4 and 5:** - A place to trade: markets, shopping areas - A place to meet and have fun: sports complexes, entertainment areas - A place to pray: sacred areas. -A place for every age group: squares, community centres	**IAF 3, 4 and 5:** - A place to trade: markets, big supermarkets. - A place to meet and have fun: stadium, a public swimming-pool, café, restaurant, bar disco. - A place to pray: a church. - A place for every age group: squares, community centres	**IAF 3, 4 and 5:** - A place to trade: a market, a supermarket. - A place to meet and have fun: stadium, a public swimming-pool, - A place to pray: a church - A place for every age group: squares, community centres	**IAF 3, 4 and 5:** - A place to trade: a shop, market, a supermarket - A place to meet and have fun: a restaurant, a disco, a bar - A place to pray: a church. - A place for every age group: a square	**IAF 3, 4 and 5:** - A place to trade: market a stand. - A place to meet and have fun: a public bench, a door step, the pedestrian sidewalk - A place to pray: an alter in a church - A place for every age group: a playground, a table to play cards
IAF 4 - Distribution of wealth and kinds of goods; the balance between developed and undeveloped levels of social organisation (E.g. countries) within and across natural, political, economical or social boundaries (E.g. continents)										
IAF 5 - Distribution of cultures and religions within and across levels of social organisation.										
IAF 6 - Communication and transportation Networks within and across levels of social organisation.					**IAF 6 -** Access to: -Networks: roads, public transport	**IAF 6** - Access to**:** -Networks: roads, public transport	**IAF 6 -** Access to: -Networks: roads, public transport, bicycle paths	**IAF 6 -** Access to: - Networks: a street, bicycle paths	**IAF 6 -** Access to: - Networks: a street, bicycle paths	**IAF 6 -** Access to: - Networks: the street with comfortable pedestrian sidewalks
IAF 7 - The magic and the character of each place;	**IAF 7:** Relates to what is unique; to the unique way	Relates to the unique way people perceive and enjoy the	Relates to culture and tradition and to the way that is							

within each levels of social organisation.	people express themselves in relation to one another and the environment.	world around them	expressed in human actions of all levels and kinds.							
IAF 8 - Relationship between the place one lives and the place one works.	**IAF 8:** Relates to the global markets and the use of plains	Related to human quality of life and with ecological behaviour		**IAF 8:** Relates to the organisation of the overall urban structure.	Relates to the use of car and public transport	Relates to the place of one function in relation to the other as well as in relation to the whole.	**IAF 8**: Working within walking distance from one's home. Optimal distance	**IAF 8**: Working across the street from where one lives. Optimal distance	**IAF 8**: Living and working in the same building Optimal distance	N.A
Examples of patterns in: *A Pattern Language (Alexander 1977)*					Pattern 1 until Pattern 20 (p.10,p.112)	Pattern 3 until Pattern 74 (p.21,p.374)	Pattern 8 until Pattern 94 (p.41,p.466)	Pattern 21 until Pattern 94 (p.114,p.466)	Pattern 75 until Pattern 253 (p.114,p.466)	Pattern 75 until Pattern 253 (p.114,p.466)

Table 4: Categorisation of interventions according to their size. This categorisation is based on the theory of nested hierarchies and relates interventions with Alexander's patterns of space (Alexander 1977) and levels of social organisation.

Notes:

- Each pattern must be considered both in relation to one another within the same hierarchical level as well as across all hierarchical levels.
- Each of the examples given can be placed under different IAF's: a harbour can be either seen as a place to work or as a place of trade. Appropriate Interventions are contextual. The way we look at them has to reflect the unique needs and character of the place.

Bibliography

Alexander, C. (1977). A Pattern Language. New York, Oxford University.

Appendix 2

List of the interventions suggested by the *micro-interventions* system project for the *Union Terrace Gardens* in Aberdeen

Interventions	Problems to address			
	1) Urban connectivity		2) Bringing human life to the UTG	
Description	Establish continuity within the different urban levels	Connect the two urban levels.	Promote seasonal social activity	Promote everyday life activity
1- Open the gates: a) Open the existing gates on Belmont Street. b) Build a generous staircase connecting Schoohill with the lower areas of Denburn Road. Facilitate the public access to the back side of Belmont street.		*		*
2- Make the empty spaces liveable: Recover the empty areas facing the Denburn valley. Those areas have a wonderful view over the gardens, they have sun until late afternoon and they are protected from the winds. They are the perfect place for a drink after work. Even in winter.		*		*

These empty areas can be easily connected with the amenities of Belmont Street such as bars and shops. One option would be to stimulate the owners of Belmont Street to recover and use those areas. The terraces will themselves connect Belmont Street with Denburn Road.				
3- Use ground-floors to bring life to the street. The ground floors facing the Denburn Road should be used with public functions. If they are private property and their owners are not interested in exploring their use, they should be sold or made public. These ground-floors should be occupied with functions such as small scale shops, artist galleries and workshops, small cafés, small music schools, restaurants... They could be related with the functions on Belmont Street or not. In any case they would always relate to Denburn valley and the gardens.		*		*
4- Redraw the section of Denburn Road. Denburn Road is over dimensioned taking into consideration the traffic that uses it and the fact that this four-lane fast road ends in a round-about. Transforming these four lanes into two would allow the pedestrian sidewalk related to Denburn ground floors to be made wider. The pedestrian sidewalk should not only be made wider, but should also be populated with trees and public benches. This intervention would stimulate the pedestrian use of the lower city and would bring life to the abandoned and neglected "Old	*	*		*

Aberdeen".				
5- Make a bridge. Make a pedestrian bridge from one of these new small squares to the gardens. This intervention would help to connect higher and lower Aberdeen not only stimulating people to go to the gardens but also to the amenities placed there (Intervention 5). It would make the gardens an extension of the new squares facing Belmont valley. One could have lunch on a terrace watching their children playing on the other side of the bridge.		*		*
6- Support everyday life at the UTG: Populate the gardens with two or three small kiosks. One could sell newspapers and others could sell coffee, beer or ice cream. One could be the tourist and culture information centre of the city. This intervention connected with the bridge could invite people to populate the gardens as part of their everyday life. Furthermore, these kiosks could be used to support other kinds of seasonal events.		*	*	*
7- Use the arcades. The space under the arcades should be used to support life at the gardens. The use of this space could be a challenge due to the fact that it is relatively narrow to support a lot of functions, still there are plenty of things we can imagine happening under the arcades which would stimulate life at the		*	*	*

gardens. This would be an interesting assignment to give to architectural students which would generate several new suggestions. In any case this area could be used in connection with the functions situated in Union Terrace or independently. It could just be a nicer place to sit and have a coffee or read a book or it could be a place one could by a coffee or a souvenir or could even serve to exhibit art or goods...				
8- Break the walls. Segments of the wall which define the "natural amphitheatre" of the garden should be open. This intervention should be made together with intervention 9, and 10. Their main purpose would be to connect the library and the *His Majesty's Theatre* with the gardens.		*		*
9- Erase a road. Erase the small road which connects Union Terrace to the Rosemont Viaduct and School Hill and make it part of Union Terrace Gardens.		*	*	*
10- Reduce traffic. Slightly elevate Rosemont Road from the crossing of the library onwards. This would reduce the speed of the traffic and would give a much more human character to the city centre as a whole.		*	*	*

Furthermore, along with intervention 8 and 9 this would relate the library and the *His Majesty's Theatre* with the gardens. These strategies would make the garden the open space of these key buildings in Aberdeen city. People would use them while waiting for a concert or reading a book.				
11- Connect the green. Redesign the back side of the extension of the *His Majesty's Theatre* and connect it with the gate under Rosemont Viaduct and the UTG. Make it an extension of the green. This would help connecting the lower city and bring people from health care facilities such as the *Denburn* clinic and the *Woolmanhill* hospital to experience the healing effects of Nature.	*	*		*
12- Redesign the amphitheatre. This is the sunniest place of the gardens and it is related to an open field in front of it. Let people sit and enjoy the sun and the events happening in the valley. Build granite benches such as in the Greek amphitheatres. People would use them both as a place to sit as well as generous stairs inviting one to the valley. This intervention will reinforce interventions 8, 9 and 10		*	*	*
13- Make it ready for everything.				

Implement a discreet modular structure on the grass-field adjacent to the amphitheatre. Such a structure would be able to support light constructions which could be used to make a stage, a market, a covered open space for any kind of special event such as a concert or skating rink, a public gathering...		*	*	*
14- Recover the existing public toilets.			*	*
15- Make a lift. A lift on the crossing between Union Street and the Union Terraces would be of key relevance to connect all segregated parts of the city centre.		*	*	*
16- New bus stops. Create new bus stops on Dunburn Road. This would help populate the street and connect the two urban levels.		*		*

Table 10: Table of interventions suggested by the MIS project and the intentions behind them.

Appendix 3:

Questionnaire- Study 2

Two strategies for the Union Terrace Gardens in Aberdeen: *The micro-project system* (MIS) / *The city square* (CS):

Possible interventions:

a) (MIS) Several micro urban interventions.
b) (US) One big scale urban intervention.

General questions: Answers should be a), b) or "I don't know"

1- Which would be more expensive?
2- Which would be faster to implement?
3- Which would be more difficult to implement?
  - Regarding the management of private and public property.
  - Regarding building complexity.
4- Which would attract more people to the centre/gardens?
5- Which would give more character to the city?
6- Which would be easier to replace/modify in the event of failure?

Specific questions for a) and b): Write down the main points.

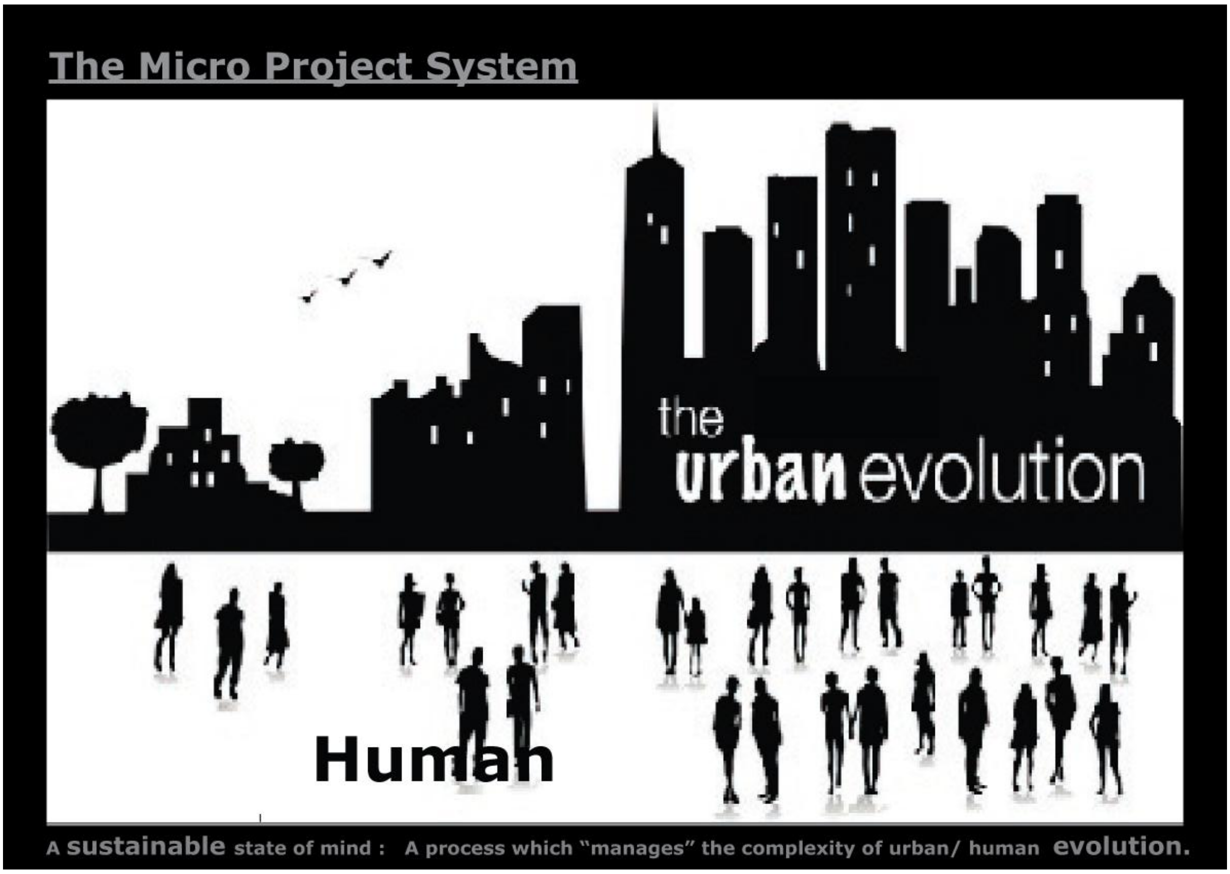
1- What are the possible consequences for society?

2- What are the possible consequences for the city?

Members of the group: Names, year and field of study, previous study.

Appendix 4:

Written assignment - Study 2



The Micro Project System

Micro versus Macro.
Activity

Do this on your own or, if you can, in discussion with another.

What are the implications of what you have learned in this exercise?

The Micro Project System

The micro project system defines "Urbanity" as an open system based on 4 interactive components:

a) The individual and the different groups of individuals. (Society)

b) Their environment. (Natural and Artificial)

c) The way individuals deal with each other and with the environment. (Politics, culture, religion, and economy/ /Architecture, urban planning and engineering)

d) The "tools" individuals use to deal with each other and with the environment. (Technology // Communication and transportation networks)

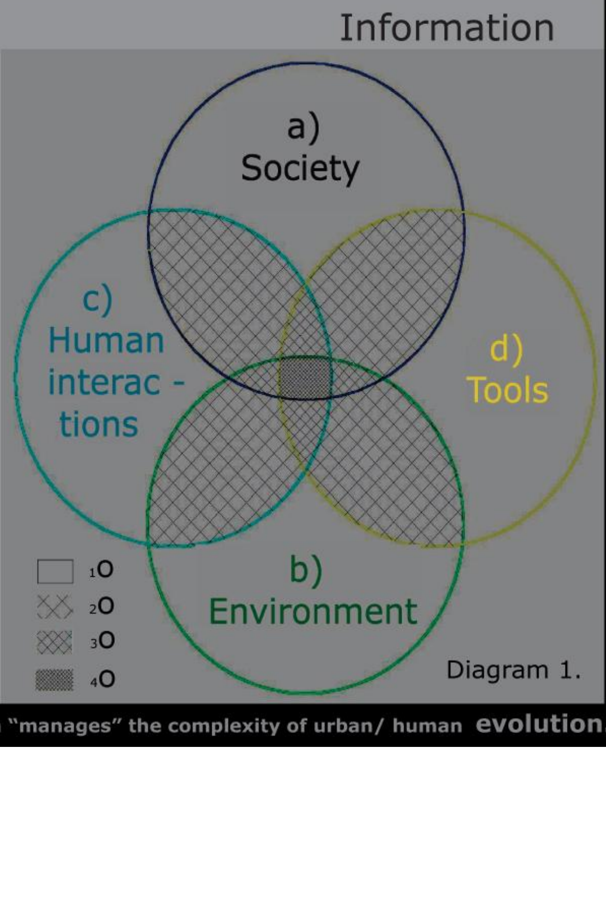


Diagram 1.

A **sustainable** state of mind : A process which "manages" the complexity of urban/ human **evolution.**

The Micro Project System

Activity – Part 1

Identify an intervention made in society or in the city:

Identify one small human action which had greater implications for a city or for a society after a certain period of time.
(The implications can be either positive or negative)

1- Describe the intervention as well as its social and urban context.

2- Place the intervention, with a red point, in diagram 1.

Example 1 : The act of planting a tree.
Example 2 : The act of creating a new television channel.
Example 3 : The act of changing the legislation regarding emigrants.
Example 4 : The act of creating an association for Muslim people.

NOTE: Choose an action related to your field of interest.

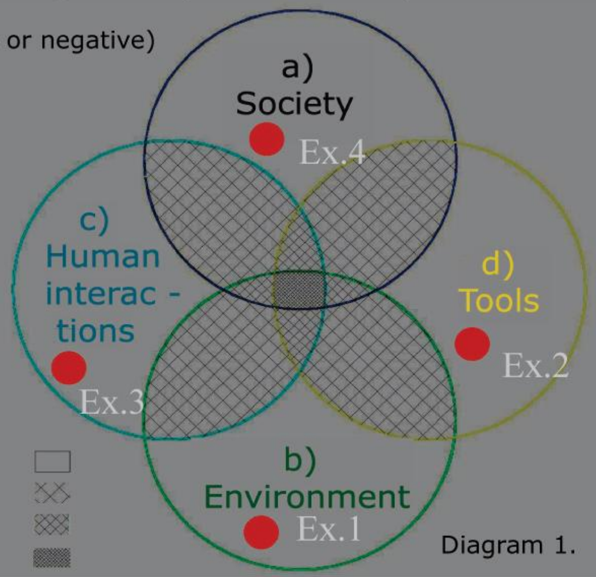


Diagram 1.

A **sustainable** state of mind : A process which "manages" the complexity of urban/ human **evolution.**

The Micro Project System

Activity – Part 2

1 - Describe the chain of events after the original intervention was made.
Mention the social and urban implication of each event.
2 – Place the events in a chronological sequence in diagram 2.
(You can eventually mention the dates of the events or how much time passed between them.)
3 – Write a small conclusion.

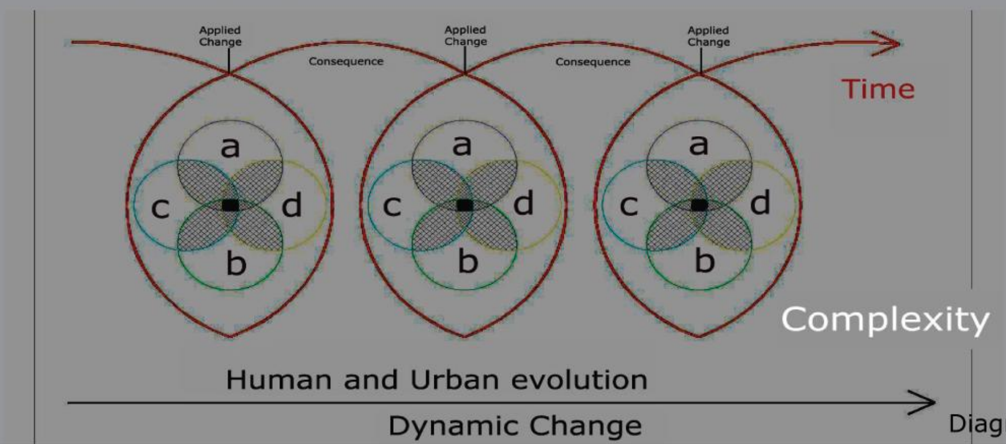


Diagram 2.

A **sustainable** state of mind : A process which "manages" the complexity of urban/ human **evolution.**

The Micro Project System

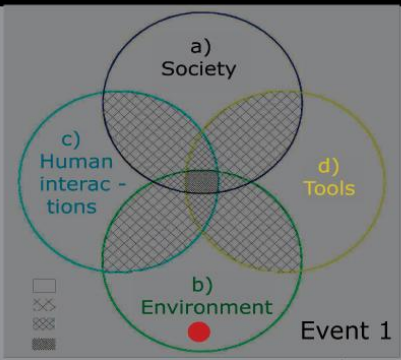
Example:

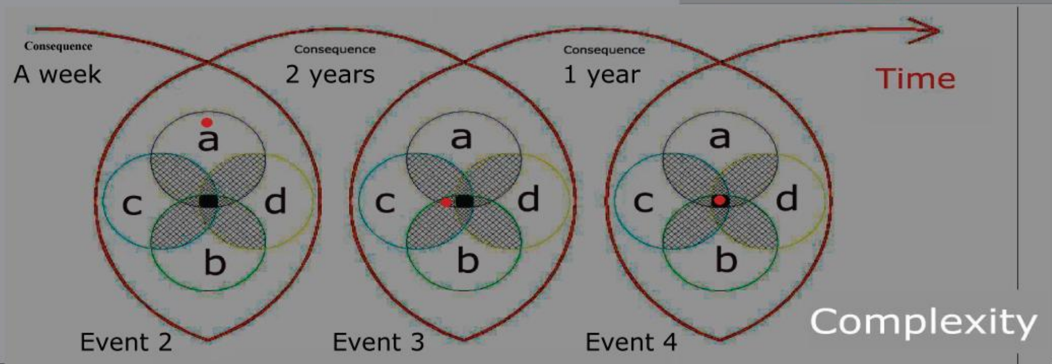
Event 1- The act of planting a tree.

Event 2- People start to gather under the tree.

Event 3- Economy and culture start to flourish.

Event 4- A new road was build.





A **sustainable** state of mind : A process which "manages" the complexity of urban/ human **evolution.**

The Micro Project System

Please note that there is no wright or wrong answer when placing the events in the diagrams.

We are testing this complex and dynamic system together!

Thank you and Good luck!

Above all... enjoy!!!!

Marta & Genevieve

A **sustainable** state of mind : A process which "manages" the complexity of urban/ human **evolution.**

Appendix 5:

Written coursework for Module 2
PgCert Research Methods

Contact Details Removed

Title of research:

The Micro Project System:
An exploratory system to support a sustainable urban management.

Aims and objectives:

The key driver for the research hypothesis is to learn from the adaptive character of human evolution and utilise the findings to manage the process of change in the city. It has as a framework the city as a complex, open system, and as an organic and self-organising structure.

This research aims to bring together different theories related to complexity and organic change to create a framework to support a philosophical consideration of the city compatible with human and urban evolution.

It aims to develop and test a conceptual urban management system which deals with the complexity of urban evolution in an active and sustainable way. That is to say; a system which supports the design and the management of cities and deals with urban change from a holistic perspective from both a micro and macro scale.

The research methodology aims to explore the potential of micro-interventions applied in the parts which constitute the whole of the city to steer urban change.

It embraces the idea that a new concept of urban management is necessary to address the needs of rapidly changing post-modern urban environments. Interventions made in the city should be part of a continuous process: a process which evolves with the city and its inhabitants. This framework will be used as a tool to assist a constant dialogue between the city, planners and the decision makers.

Appendix 6

Details of Feedback Comments Sheet Not Available