DESIGN AS THE EXPRESSION OF DOING THINGS TOGETHER

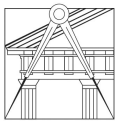
An ecological understanding

Thesis in fulfilment of the requirements for the degree of Doctor in Philosophy (PhD) — Final document

Author	Denis Hickel
Supervisor	Professor Seaton Baxter, OBE, Honorary Professor University of Dundee
Co-supervisor	Professor Doutor Rita Assoreira Almendra

Jury

President	Doutor João Carlos Vassalos dos Santos Cabral, Professor Associado, Faculdade de Arquitetura da Universidade de Lisboa.
Vogais	Professor Seaton Baxter, OBE, Honorary Professor University of Dundee
	Doutora Maria João Carvalho Durão dos Santos, Professora Auxiliar, Faculdade de Arquitetura da Universidade de Lisboa;
	Doutora Rita Assoreira Almendra, Professora Auxiliar, Faculdade de Arquitetura da Universidade de Lisboa;
	Doutor José Rui de Carvalho Mendes Marcelino, Professor Auxiliar, Faculdade de Arquitetura da Universidade de Lisboa;
	Doutor José Manuel Andrade Nunes Vicente, Professor Auxiliar, Faculdade de Arquitetura da Universidade de Lisboa;
	Doutor Paulo Jorge Sintra Almeida Partidário, Investigador Principal, Direção Geral de Energia e Geologia.



FACULDADE DE ARQUITETURA
UNIVERSIDADE DE LISBOA

DESIGN AS THE EXPRESSION OF DOING THINGS TOGETHER

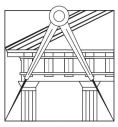
An ecological understanding

Thesis in fulfilment of the requirements for the degree of Doctor in Philosophy (PhD) — Final document

Author	Denis Hickel
Supervisor	Professor Seaton Baxter, OBE, Honorary Professor University of Dundee
Co-supervisor	Professor Doutor Rita Assoreira Almendra

Jury

President	Doutor João Carlos Vassalos dos Santos Cabral, Professor Associado, Faculdade de Arquitetura da Universidade de Lisboa.
Vogais	Professor Seaton Baxter, OBE, Honorary Professor University of Dundee
	Doutora Maria João Carvalho Durão dos Santos, Professora Auxiliar, Faculdade de Arquitetura da Universidade de Lisboa;
	Doutora Rita Assoreira Almendra, Professora Auxiliar, Faculdade de Arquitetura da Universidade de Lisboa;
	Doutor José Rui de Carvalho Mendes Marcelino, Professor Auxiliar, Faculdade de Arquitetura da Universidade de Lisboa;
	Doutor José Manuel Andrade Nunes Vicente, Professor Auxiliar, Faculdade de Arquitetura da Universidade de Lisboa;
	Doutor Paulo Jorge Sintra Almeida Partidário, Investigador Principal, Direção Geral de Energia e Geologia.



FACULDADE DE ARQUITETURA
UNIVERSIDADE DE LISBOA

Dedication

To Professor Seaton Baxter for the friendship and all the wisdom. To my wife Juliana and my son Martim, for the love and inspiration.

Acknowledgements

My recognition to the Faculty of Architecture of the University of Lisbon that hosted this PhD process and to the FCT (Foundation for Science and Technology) that has granted me with a scholarship to support great part of this work.

This work was made possible and enriched by the encounter with the Centre for the Study of Natural Design, which hosted this work as an integral part of it and, by the encounter with the people of the Municipal Library of Torres Novas, which made the work with their local schools possible. Thank you Seaton Baxter, Gonzalo Preece, Mona Nasseri, David Sanchez, Fiona Wood, Steve Brogan, Fraser Bruce, Felipe Dias, Jorge Simões, Margarida Teodora, Helena Caetano and also to the students and teachers that enthusiastically accepted to participate on the activity. My gratitude also to Rita Almendra that along these years has generously offered me her time and knowledge.

Abstract

This research is a situation of design within an essentially ecological perspective. This is supported by a theoretical framework and an ideation process designed to be held with some of the schools of the Municipality of Torres Novas, Portugal, where the students were invited to imagine their school in relation to a future scenario and certain ecological values and concepts to co-create what was called an *Ecological Imagination for the Schools of Torres Novas*. This lived experience made possible a reflection about a different domain of practice for designers within the proposed framework. This is about a design activism where the designer/researcher plays the role of social mediator activating, integrating and facilitating certain co-creative relational domains, which this work supports to be essential to further construct a culture of ecological sustainability.

This is a design led research that is exploratory and generative. It explores other domains of thought and practice to propose an ecological situation of design and also, a different context of action, skills and tools designers can develop to co-create alternatives to the emerging issues of this century. The experience with schools and the ideas generated in this practice were used to further support and validate the thesis' theoretical reflections and are suggested as valuable to further approaches to this subject matter by designers.

This document was organized according to the research hypothesis that to promote ecological sustainability, including in design practice, are necessary three steps: **1.** It is necessary to construct deep awareness about the causes and extent of our socio-ecological issues and widely share it, situating it within the scope of people's understandings. **2.** At the same time, it is also necessary to situate people, communities and human activity within an essentially ecological perspective able to co-creatively cope with the socio-ecological issues of this century. **3.** In this process,

designers together with other individuals in possession of different knowledge and abilities — from the mundane to the exoteric — will facilitate future thinking, or ecological imaginaries as a form of anticipation that can be followed by the craft, articulation and endeavour of viable habitats and ethos.

These are also possible skills to be introduced within designers' educational domains. Everything that is proposed in this thesis is an agenda adopted to connect with people and to create networks within the municipality of Torres Novas that are intended to improve or to create transitional structures with people co-creating, promoting awareness on the need for change, and gradually exerting bottom up influence over political decision-making. The process does not end here, as this case is essentially the report of an ongoing design experience and agenda.

Keywords
Participatory Design
Ecological Thinking
Future Thinking
Education
Generative Research

Resumo

Este é um trabalho de investigação que propõe um entendimento do design a partir de uma perspectiva ecológica. Para além da criação de um arcabouço teórico, o designer/pesquisador foi ao encontro da comunidade escolar de Torres Novas, Portugal, convidá-la a idear as suas escolas a partir de um cenário de futuro e de certos valores ecológicos para criar o que se convencionou chamar *um imaginário ecológico para as escolas de Torres Novas*. A experiência vivida possibilitou a reflexão sobre um domínio emergente da prática do design como forma de sustentar o entendimento teórico proposto. Trata-se portanto de um certo *ativismo através do design*, onde o designer cumpre o papel de mediador social ao ativar, integrar e facilitar determinados domínios de relacionamento cocriativo que, no entendimento deste trabalho, são essenciais para a construção de uma cultura de sustentabilidade ecológica.

Do ponto de vista metodológico, esta é uma investigação orientada pelo design, é exploratória e generativa. Busca em territórios além dos domínios teóricos do design referências para poder contextualizar e propor um entendimento ecológico para o design e também, um contexto diferente de prática, habilidades e ferramentas que os designers podem desenvolver para cocriar alternativas para as demandas emergentes deste Século. A experiência ativada com as escolas e as ideias geradas a partir desta foram utilizadas como suporte para reflexão e validação para o arcabouço teórico desta Tese e são sugeridas como valiosas para futuras inflexões dos designers nestes territórios de pratica.

Este documento foi organizado e estruturado de acordo com a sua hipótese de que para promover uma sustentabilidade ecológica, incluindo aí a prática do design, são necessários três passos: **1.** Construir um entendimento sobre as causas e extensão das questões sócio-ecológicas emergentes e situá-las dentro do escopo de entendimento das pessoas. **2.** Ao mesmo tempo, é necessário situar as pessoas, as comunidades e o fazer humano dentro de

uma perspectiva essencialmente ecológica que seja capaz de lidar com os desafios sócio-ecológicos deste século. **3.** Munidos de tal entendimento, os designers, juntamente com outros indivíduos detentores de conhecimento e habilidades diversas — do mundano ao exotérico — poderão cocriar imaginários ecológicos como forma de antecipação, seguida de engendramento, articulação e empreendimento de ethos e habitats viáveis e desejáveis.

A reflexão sobre os temas propostos por este trabalho e suas indicações são também habilidades passíveis de serem introduzidos nos domínios da educação dos designers. Tudo o que é proposto por esta tese é uma agenda adoptada para conectar com as pessoas e criar redes dentro do município de Torres Novas que têm a intenção de suportar estruturas de transição com as pessoas cocriando, conscientizando para a necessidade de mudança, e gradualmente, exercer influencia sobre as decisões políticas locais. Este processo não fica por aqui, pois essencialmente da a conhecer uma experiência em design e uma agenda em curso.

Palavras Chave
Design Participativo
Pensamento Ecológico
Planeamento por Cenários
Educação
Pesquisa Generativa

GENERAL INDEX

PROLOGUE 1

INTRODUCTION: REALIGNING THE PROBLEM-SITUATION AND QUESTIONING 8

PART 1. BUILDING DEEP AWARENESS ABOUT THE EXTENT OF OUR ECOLOGICAL ISSUES: PREPARING FOR THE LONG ENERGY-DESCENT FUTURE 15

1. Introduction 15

2. Design Thinking at the Worldview Level 17

3. Design and the Thinking of the Future 25

4. Patterns leading to an energy-descending scenario: A low-carbon economy emerging 31

4.1. Peak oil 35

4.2. CLIMATE CHANGE: MORE THEN WEATHER PATTERNS 39

4.3. Economy 43

5. Three possible scenarios as close as 2025 and a common energy-descending future: Collapse, Adaptation or Evolution? 50

6. PART 1 Conclusions 65

PART 2. THE PROCESS OF BUILDING DEEP UNDERSTANDING OF OUR ECOLOGICAL BEING 67

1. Introduction to An Ecosophy D.1 67

2. Building an ecological literacy: Departing from the Santiago Theory of Cognition 70

2.1. Introduction and part 2 overview 70

2.2. A conceptual shift 72

2.3. Living systems 73

2.4. The systemic constitution and conservation of human identity 76

2.5. Cognition: to live is to Know 76

2.6. Language and Self-Consciousness 78

3. The Biological Foundations of Culture and Design 81

3.1. Meaning and the Emergence of Culture 81

3.2. Design as the expression of doing things together 84

4. Overcoming default scenarios: Ecological Literacy and a triple step to seed ecological sustainability 87

4.1. Building ecological literacy 89

4.2. Getting inspiration from ecological lexicons 91

4.3. Engaging in ecological thinking 95

5. Ecologically literate Design 101

5.1. Ecological Design 101

5.2. Salutogenic Design: Designing for human and planetary health 103

5.3. Co-designing in love: towards the emergence and conservation of human sustainable communities 113

6. Co-creative design: setting relational domains for deep ecological sustainability 118

6.1. Introduction 118

6.2. Moving Towards the Fuzzy Front End 119

6.3. Evolution of Participatory Design Research 121

6.4. Changing roles 121

6.5. Uncovering Co-creativity 122

6.6. Generative Design Research 124

6.7. The Emergence of a Co-creative Design Domain 126

7. Part 2 conclusions: Design co-creative domains activating participation IN the public sphere 128

PART 3. THE BUILDING OF THE ECOLOGICAL IMAGINATION OF THE SCHOOLS OF TORRES NOVAS 132

1. Introduction 132

2. The exercise 134

2.1. The design and implementation of the activity 135

2.2. A review of the creative process, methods and methodologies 145

2.3. The workshop with the scholar community of Torres Novas — detailed description 161

2.4. Lessons and pictures emerging from the exercise with public schools 180

2.5. Complementary relevant activities 182

3. reflections on further iterations and final considerations on THE PROPOSED DESIGN 187

EPILOGUE: REVIEWINNG AN ECOSOPHY 195

1. The impact of monocultural approaches to education 199

1.1. The Technocratic Age 199

1.2. Disorders of technocracy 203

2. Imagining ecological alternatives 206

2.1. The Biological foundations of Education 206

2.2. Implications for design 208

2.3. A brief imagination for the school 213

2.4. Design and education — an open end to further explorations 215

REFERENCES 217

FIGURES INDEX

Figure 1 - The transmutation of design thinking 24
Figure 2 - Articulation of total views after Drengson (2008, p. 33) 68
Figure 3 – Holons and holarchies, from Hollick, 2006 p. 84-85 74
Figure 4 - Culture and design. After Fritjof Capra (2002) explanation 85
Figure 5 – the ecological lexicon departs from the situation of knowledge to the domains of one's living in a way it can be comprehended, manageable and meaningfulness. 94
Figure 6 - Under-load overload balance: under and over load are peaks that even positive, or negative can lead the individual to a situation of illness. A balanced situation is to reach a near equilibrium between ease/disease situations 107
Figure 7 - Thesis domain situation within design practice 120
Figure 8–The evolution of design research as defined by Sanders. Initially the social scientist was the interface, until the roles of designers and researchers blur and the user become a critical component of the process (Sanders, 2002 p. 02). 122
Figure 9 - Emerging Trends in Design Research: Changes over time in the landscape of design research where GDR is in a fully participatory and design led mindset. Available on Make Tools – online (Sanders and Chan, 2006) 125
Figure 10 — During the conversations with the students it was possible to draw on the flipchart to explain the concepts and to incite their reflection and participation. 136
Figure 11 - The leaflet with the scenario and enticing pictures to illustrate it and to enact positive visioning. 138
Figure 12 The leaflet of the ecological being. Banksy's graphic was used to illustrate the constitution of the ecological being both because it is very illustrative of the desired explanation and because of its appeal to youth. 140
Figure 13 -The ecological lexicon was a set of terms, concepts and words that the students were free to pick and to use along the exercise. 143
Figure 14 — Students sticking their ideas on the wall after the brainstorming session 144
Figure 15 — Left, the ideas arranged on the wall and right are the sketches produced during the discussion stage with the students. A flipchart turned out to be a simple and effective tool to draw and connect concepts with the students 145
Figure 16 — the card game 149
Figure 17 — Pictures from the workshop held in Tomar 160
Figure 18 - To some of the children this was the first time they had handled earth. . This picture is a good representation of the atmosphere and the dynamics centered around gardening 183

Figure 19 - An expression of the experience of doing: The child has represented her arm in the making of the activity. In the background is the watering can and the different layers composing the plant bed 184
Figure 20 - This pupil has carefully represented himself in the activity of watering and several other activities involving the planting bed 185
Figure 21 - Exploring the ecological being as a resilience factor 195
Figure 22 - The sketch above is a graphical scheme that may help to resume the understanding proposed by this brief explanation on the impacts of monocultural approaches to education and the technocratic age we are living — an emerging nuance of the industrial civilization that is surrounding us. 205
Figure 23 – The ecosophy D.1 reflected upon sense of coherence' basic components from salutogenese 211
Figure 24 – Design thinking entering educational domains 215

TABLES INDEX

Table 1 -Four possible scenarios from David Holmgren (2009) Future scenarios 52
Table 2– World's ecological status 62
Table 3 *generalized resistance resources* adapted from (Horsburgh, 2000 p. 179) 107
Table 4 - Comprehensibility, manageability, and meaningfulness, Adapted from Novak (1998) and Antonovsk (1996)..... 109
Table 5 - Final comments on Salutogenesis 112
Table 6 — "A snapshot in time of traditional and emerging design practices" from Sanders(Sanders and Stappers, 2008 p. 07) 121
Table 7 — Levels of creativity, adapted from (Sanders and Stappers, 2008)..... 123
Table 8 – Methods and methodologies explored..... 146
Table 9 – Review of the exercise objectives, generative tools and exercises 147
Table 10 — Details on the participants 162
Table 11 — Exercise final format..... 162
Table 12 - Explanatory conversation 164
Table 13 - Ideation Process 165
Table 14 — The final questionnaire 167
Table 15 — The pros and obstacles of possible ways to pursue this design 190
Table 16 — Aligning main outcomes according to proposed objectives**Error! Bookmark not defined.**
Table 17 — The stages of Change 192

LIST OF ACRONYMS AND ABBREVIATIONS

CSND | Centre for the Study of Natural Design

EB | Ecological Being

EL | Ecological Lexicon

EOD | Earth Overshooting Day

FFE | Fuzzy Front End

GDR | Generative Design Research

GRR | Generalised Resistance Resources

MLTN | Municipal Library of Torres Novas

A whisper about growth and development

Nowadays, the idea of growth consists of the expansion of the overall size of the economy and of the quantities of energy and material goods flowing through it to reach widespread development, which in accordance with the evidences that will be approached in this work and also all the evidences emerging around us became unrealistic.

When we fully understand our participation in the dynamics of ecological living systems, the core value of our economies will be stewardship, not extraction. Growth and development, in this new story, will mean soils, biodiversity and watersheds getting healthier, and communities more vibrant and resilient.

PROLOGUE

In the Portuguese-speaking world it is not usual to write a thesis in the first person. However, the nature of the subject that will be supported here is pretty much connected to the process lived by me, the designer/researcher. Also, the kind of theoretical framework and what is proposed in it requires the understanding that this Ph.D. thesis is the fruit of a lived experience. Throughout this whole process, I have explored unexpected pathways, met different people and come across different places and realities. This thesis was made from such encounters. So, in an intentional manner, I have opted to write up a prologue and epilogue where I could place both initial and final comments about this work in the first person.

This research departed from design domains to interweave with the subjects of ecology and the schools of the city of Torres Novas in Portugal. What I propose here is an ecological perspective for design and an exploration and reflection about one possible role for design and designers that have emerged from it. This transcends design domains and may reach a certain status of design activism in face of the broader ecological challenges of this century.

My initial concerns were what a sustainable school could be and how the users could be involved in the process of its creation to foster certain awareness on the issues of sustainability. However, as is usual in design domains, I was pretty much focused on the material aspects surrounding the subject of study. This, however, was a perception that has changed throughout this process to accommodate the awareness emerging from the research. It was during my initial research, when prospecting on the causes and the extent of our ecological issues and also in exploring emerging ecological perspectives that I came to realize that there was a gap of coherence between what I was coming to understand, what I was proposing and how I was living. In sum, I came to think that it was necessary to build coherence between an awareness of belonging to the dynamics of ecological living and on finding ways to living accordingly.

This process surrounding the issues of sustainability is one that most of us are living at different levels. I will support that what we are all about to live in this century will

necessarily require deeper levels of spiritual and conceptual transformations. However, that which I have experienced cannot be imposed on other people. On the other hand, I can invite them and you — the reader — to reflect on it and following this build your own transition to what I will support as *deep ecological sustainability* to differentiate from the regular sustainable development mindset and agenda.

The regular mindset behind designers when tackling the issues of our sustainability is very limited to the material aspects of it — the planning and materializing of Eco, sustainable, green and whatsoever buildings and objects. However I will support here that there is a lack of debate and reflection of the immaterial aspects underlying design practice. The so called green buildings and objects that come through design do emerge from within the same human-first value system, worldviews and processes that are contributing in first place to the issues of our sustainability.

As a result I have to rearrange the research course in order to understand design within an essentially ecological perspective and to only then look back to the subject of designers and schools. So this shift has led me to propose a whole situation of design within our ecological crisis and how our designs emerge along our broader socio-ecological relationships. Subsequently, I have proposed and experienced a new locus of design activity within the subject of schools. This was essential to support the whole theoretical understanding emerging.

For that reason what I will expose and explore in this thesis is that beyond all the formal, material and technological aspects that are usually approached by designers, school buildings — in example — are also designed and built with purpose, carrying meaning and reflecting the specific cultural aspects, circumstances and relationships within which they are created. They are a clear example of materialization of a certain culture, worldviews, aims and ambitions. The organization of buildings along with its physical and aesthetical aspects does inform its inhabitants about its function, divisions and hierarchical aspects of our broader social relationships. Also, as we know today, the built environment does affect the user's behaviour both physically and emotionally.

Therefore, what I will argue is that the material aspects of design practice can do a lot to improve the efficiency of how education is intended to happen in a top down and specialist manner. But if design remains limited to the material aspects of its practice it will remain limited on how to turn green the objects of the material consumerist culture. So, what are the purposes, or intentions of both education and design in face of the present ecological issues and emerging ecological understandings? And what can the possible locus of design activity be in a transition to a culture of deep ecological sustainability?

These are broader questions that make it necessary to look at the immaterial aspects of design practice and how it emerges in our ecological processes of our living and doing things together. It means to approach the worldview of value-systems and even spiritual values of the designer/researcher. So it made me question the broader cultural context where design does emerge and to prospect ways in which design can contribute to shift current worldviews. Hence, this work is the direct reflection of a situated epistemology: It comes through me and is the reflection of my worldview which is the consequence of my personal meeting and mating with the world and my place of living, which I will expose and support in this work.

Based on what I have briefly introduced, it is necessary to differentiate among the current sustainable development agenda and deeper ecological sustainability — the latter being the broader purpose to which this thesis is connected and that is the setting for a new reference system of values and beliefs able to promote the transmutation of human culture. The products resulting from design processes are not single entities with an autonomous existence. They are part of a whole system of beliefs, which in this case is the one of our industrial civilization and all its technological advancements, knowledge domains, values, cultural patterns of living and the firm belief in permanent and widespread material growth. This, as I will further argue in this thesis, is the system of beliefs that has led to all the ecological mess humanity is in. Also, design comes through people and as all of our doings, it is immersed in this network of systems of beliefs in which we participate with different levels of consciousness and where we are likely to continue reproducing certain practices and pathologies that are no longer sustainable.

The current sustainable development agenda is attached to the current imaginary of growth and development that — as I will support — has become physically impossible. At the present moment, it does correspond to a major accommodative response, which means a major attempt to sustain a status quo which does not question the underlying immaterial aspects of intentions, aspirations and the fundamental system of values referenced by humanness in itself as non participant of the planetary ecological dynamics within which we are all immersed.

If human constructions such as a building or any other material product for instance, emerge from a certain cultural context, then it is informing certain intentions, purposes and meanings, and it is indeed, a materialization of human endeavour. Hence, in what concerns the desirable emergence of a culture of deep sustainability, designers will necessarily need to shift their thinking and worldviews, to be able to reflect on the objectives of the processes they choose to be engaged in and that eventually will lead to certain materializations. For instance, such a thing as school for a certain sustainability can only exist as the result of broader and consciously intentional ecological relationships and with the clear purpose to set deeper ecological values. However, with that in mind and with the ecological values I will expose here, one may understand that we can eventually shift from the idea of schooling society to deliver universal education to the one of “deschooling society” where learning is not separated from the act of living of the individual, as proposed by philosopher Ivan Illich (1970) and also by the educator John Holt (2004).

What I am introducing here is a previous philosophical understanding supported by the work of the Chilean biologist and philosopher Humberto Maturana (1984) who proposed an essential connection of human living and doings to the dynamics of ecological systems. Since that, everything I do affects the living of others humans and non-human beings and the soundness of planetary ecosystems. It comes together with the understanding generated by the exploration of other causes and the extent of our ecological issues, mainly by going through a domain of studies called future thinking, or scenario thinking. So that, by the interweaving and framing of several subjects like peak-oil, climate change, globalization, economy, society and nature it became possible to understand that the accommodative path underlying the efforts towards sustainable development are not possible anymore. It is so because

industrial civilization is encountering physical limitations in keeping the current pace and the cultural imaginary of economic growth. As I will further expose and support in this thesis, humanity is entering a major period of scarcity of all natural resources and ecosystems supporting industrial civilization to the point we are witnessing a global ecological threshold and there is no more space for continuous material growth. This clear possibility of a material and energy-descending future became the broader context of this thesis.

The contemplation of this very possibility changes many things we take for granted about the future, including how and why we educate and design. On questioning how to construct ways out of it I have encountered in Professor David Orr's (2002) teachings a plausible starting point when he states that in face of the present situation we need to become *ecologically literate people, which basically means, to get to know the dynamics of ecological systems and living accordingly.* The simplicity and objectivity of such a statement is disconcerting. However, by personal experience, I soon came to realize that there is a huge gap among its theoretical understanding and the living accordingly step, especially regarding all our cultural patterns and standards of living as an industrial civilization coupled with the lack of awareness of the dimension of our participation in life supporting dynamics of Earth's ecosystems.

What follows herein is also an attempt to situate myself within such dynamics. I went to live on a farm with my wife and son and I have begun to cultivate part of my food, to deal with activities such as beekeeping and the maintenance of my property. Such experience has been outstanding for all its diversity of possibilities for learning from nature, from and with ordinary people and for its possibilities to thrive in different and meaningful ways. To fully approach such movement would entail a deviation from the original objectives. Even so, this has brought a new set of references to the scene. When one faces new activities and challenges one will inevitably encounter new words, terms, concepts, and will engender them with old ones to confer new sense of meanings to things, doings and living. These are what I have decided to call an ecological lexicon. A stock of terms, which have emerged along the way, were examined so as to build up the ecological literacy entailed in the thesis itself. So I state early on, that the reader may encounter unusual terms regarding design

domains. These however, I will clear and define as part of the explanatory process of this thesis.

Throughout this process and while researching such emerging literacy in the realm of this design thesis, I came to propose an empirical practice to deliver to the schools of the city of Torres Novas — now, my place of living. Basically, I summarised the emerging awareness and decided to invite the local scholar community to think on how their school would be in face of an unexpected energy-descending future and to ideate on a certain ecological perspective. The exercise therefore became a cut-off to support the emerging theoretical understanding. More than a set of ideas for certain scholarly ecological imaginary or the methodologies and tools I have framed and used, I realized that I was exploring two issues that I became to consider as the main contribution this thesis may offer:

One is an emerging role for designers as activators, facilitators and integrators of co-creative processes that are necessary to promote major cultural shifts and that will entail for designers to develop new capabilities and — in face of the proposed future — to review their references, values, intentions and aspirations behind design processes. Two, this is both within the growing idea of ecological design and design activism that is when design play a central role promoting and supporting social change, raising awareness about values and beliefs, or questioning the constraints that mass production and consumerism place on people's everyday life (Markussen, 2012 p. 38, Preece, 2011). As Markussen (2012) has previously reflected on the disruptive aesthetics of design activism, I would like to promote a perspective where the co-creative design process per se may be disruptive of certain pathological cultural practices and a platform for social change and the mindfulness craft of a culture of deep ecological sustainability.

Finally, the encounters with my thesis' tutor, professor, and my friend, Seaton Baxter were also essential to my going ahead with such an endeavour. His support and wisdom has made it possible not only to believe in different human relationships but it has also paved the way for contact with innovative and challenging visions of design in face of the same paradigm and emerging from the Centre for the Study of Natural Design. It has also given me the opportunity to establish contact and

converse with people like Dr Daniel Wahl and Dr Gonzalo S. Preece, two fellow researchers that became essential references to this thesis. In fact the theoretical understanding emerging is complementary to their work. Finally, in this thesis both design and education are to be ecologically situated to define and support it as *co-creative relational domains*. This work is a reflection of my desire to participate in constructing a possible way forward in dealing with the issues of the twenty-first century.

INTRODUCTION: REALIGNING THE PROBLEM-SITUATION AND QUESTIONING

> *Although some of the statements in the prologue may be repeated here, this is where the references that have helped to create this theoretical framework come to the scene. Also the repetition of some terms, concepts, or even phrases and paragraphs will be necessary throughout the thesis to promote major connections and key-concepts. In this sense, the whole text follows a sort of spiral approach. It means they may be subject of some repetition in order to connect and deepen the necessary explanations. Also It was opted not to condensate the reflections about design in one single chapter but to split it along the different parts of the thesis aiming at promoting major connections with each context.*

Design is at a worldview level but it is essentially human-centred and informed by the same objectivist mindset that has led to the ecological issues we are living — To tackle such issues it is necessary to resituate it within an essentially ecological perspective. Actually, the general problem regarding our ecological issues is one of *worldview* – that means how we see and relate with the world. This general mindset behind our current worldviews is commonly regarded as objectivist, dualistic or reductionist presupposing the experience of human existence separated from things and events, including the dynamics of natural ecosystems (Bohm, 1980, Bateson, 2000a, Capra, 2002, Orr, 2002, Naess, 2008). As the philosopher Charles Eisenstein has stated:

> "The converging crises of our time all arise from a common root that we might call Separation. Taking many forms — the human/nature split, the disintegration of community, the division of reality into material and spiritual realms — separation is woven into every aspect of our civilization" (Eisenstein, 2011)

Despite the fact that there is an emerging body of knowledge (Bohm, 1980, Capra, 2002, Hollick, 2006, Meadows, 2009) advocating that contemporary scientific findings are in fact already supporting interconnectedness and multidisciplinary

systems thinking, which are connecting our living and doings to the complexity and unpredictability of living systems; the objectivist mindset still has great impact on the current culturally dominant worldviews informing our value and knowledge systems (Ferry, 2010, Ferry, 2011a). Hence, in a general manner, our way of thought and action in the world ignores the fundamental interweaving aspects of the domains of our *social and ecological relationships,* which, in ultimate instance, is leading to all sort of social, economic and environmental crisis we are living in.

As has already been stated in the prologue, the current debate on *sustainable development,* which is pervading design domains, has in fact been held under this same general objectivist mindset. Now, more than 40 years since the energy crises that first brought attention to the fact that there are limits for growth in a finite planet, and which has triggered the current debate on sustainability, nothing has effectively changed in the essence of industrial civilization (Greer, 2008, Greer, 2009, Hulme, 2009, Foster, 2001, Heinberg, 2011). On the contrary, as the ongoing review of United Nations' Millennium Development Goals stresses, since the challenge of *sustainable development* was initially posed there is a drastically higher human impact on the physical Earth (SDSN, 2013). Therefore, there is a general *lack of coherence* between the current discourse on *sustainable development*, its logics and values, with the awareness of our intrinsic participation on the dynamics of ecological living systems.

Sustainable development is a humans-first value system[1] *and is tied to the prevailing assumption that human wellbeing is attached to economic development and material growth* (Heinberg, 2011, Jackson, 2009). However and as will be supported in Part 1 of this thesis, there are clear warnings that this is not likely to keep its current pace. When interweaved together subjects like climate change, peak-oil, resources

[1]The anthropocentrism of sustainability is more evident for instance, in the policies of developed and in development nations, where there is support for a mix of shallow policies with some lip service to deeper values such as biodiversity. Some examples are the reduction of the restrictions for deforestations and constant pressure over natural reserves to gain agricultural monocultural land or mining fields, or yet the overwhelming scientific evidence that the cocktail of chemicals used in modern agriculture is harmful to biodiversity and is cumulative both on people and the environment. One serious global consequence of the combination of facts is the decline of pollinator insects. See for instance the global debate on the lost of bees (Apis Mellifera) especially in United States and that is also becoming a major European concern. Pollinator insects are responsible for about 70% of human food through pollination.

depletion, loss of biodiversity, demographics and so on; bring the understanding that we are about to enter an *energy-descending period, which means the depletion and scarcity of much of the ecological conditions sustaining industrial civilization and that may shift everything we culturally take for granted about the future of industrial civilization* (Kunstler, 2006, Greer, 2008, Greer, 2009, Hulme, 2009, Jackson, 2009, Heinberg, 2011, Gratton, 2011).

Hence the debate on *sustainable development* has not the necessary strength to leverage major shift of worldview, or to make deeper questions on how we, when living and doing things together, make sense, attribute value, and share meaning on the making of human culture. On the contrary, it is configuring a wide accommodative pace of the general status quo. Accordingly, this work will support that in face of the present issues, whatever the knowledge domain, the first attempt is to question the present status quo of industrial civilization in order to promote *a major shift and to resituate the debate from the current discourse on sustainable development to a whole and coherent ecological thinking and practice able to build a different relationship with the whole community of life.* Hence this is a thesis about *deep ecological sustainability.*

This term, which will be used in this thesis, is fully inspired by Arne Naess's definition of "deep ecology" (Naess, 2008 p. 27), where deep ecology and subsequently deep ecological sustainability, specifically emphasizes respect for the intrinsic worth of all beings and treasures all forms of biological and cultural diversity. Henceforward, *deep ecological sustainability is the attempt to find ways of living accordingly with the dynamics of ecological systems*. It reflects an attempt to understand, restore and tune human purposes according to the life supporting dynamics of ecological systems.

As an essentially human intersubjective activity, design practice and thinking has been naturally emerging as an integrative discipline able to introduce and facilitate the flow of information from and among different knowledge domains for a diversity of purposes and solutions. However, in that which regards sustainability, if played under the same general mindset of humans-first value-system, such role will be limited on how to turn `green´ the objects of the current industrial and consumerist

human culture. On the other hand this thesis supports that the situating of design within an essentially ecological perspective can cause the emergence of new understandings, meanings, and broader *co-creative relational domains* that may offer alternatives to the culturally dominant worldviews. It is a shift from a predominantly object-oriented mindset to a more process-oriented mindset, where the materialization of products may become secondary to the facilitation of processes to foster and sustain deep ecological sustainability, where inclusiveness, co-creativity and systemic health are the norm.

REALIGNING THE QUESTIONING

As previously mentioned, the research conducive to this thesis started within a typical object-oriented mindset aiming at looking at the scholar built environments to identify patterns leading to 'sustainable schools'. However, schools are also immersed (nested) in broader systems of value priorities and as such, in the present circumstances, are subject of full top down and hierarchical design processes that are also according to certain immaterial aspects of worldviews and values systems, political priorities, aims, purposes, carrying meaning and ambitions.

Stepping back to understand such immateriality behind the design process became the purpose of the research and only then to get back to the school to understand how design can contribute to foster deep ecological sustainability within educational domains. However, our major concern and the main question underlying this study is ***what is the possible understanding of design when situated within an essentially ecological perspective?***

Also, the research over the causes and the extent of our ecological issues has led to understand that the human impact on the planet is already threatening the conditions of human subsistence, material development and modern ways of living. ***It has led to question of how to cope with such prognostics?*** Subsequently, Professor David Orr's (2002) proposition that in face of the present issues it is necessary for people to become ecologically literate, became the starting point that has led to using this thesis as an attempt to build a certain ecological literacy.

So situated within an energy-descending scenario and attempting to construct an ecological literacy this thesis went back to the school to understand the implications of the emerging philosophical framework by questioning the scholarly community ***how their school would be faced with such a prognosis?*** This has led to the reflection, not only of the discrepancies among the current scholar status and the ecological imaginary that became apparent through the activities carried out with the schools but also to reflect on and deepen the role of the designer within and the understanding of design from that major ecological perspective.

REALIGNING THE HYPOTHESIS

Finally, the emerging hypothesis is that it is necessary to construct deep awareness about the extent and causes of our socio-ecological issues and widely share it, situating it within the scope of people's understandings. At the same time, it is also necessary to situate people, communities and human activity within an essentially ecological perspective able to co-creatively cope with the emerging scenario. In this process, designers together with other individuals in possession of different knowledge and abilities will facilitate future thinking, or ecological imaginaries as a form of anticipation that can be followed by the craft, articulation and endeavour of viable habitats and ethos.

THESIS STRUCTURE

The thesis structure follows the hypothesis and is organized in 3 different Parts that also correspond to the major research phases.

Part 1 is the situation of design and this thesis within a broader context and amidst the flux of events that are configuring *an energy-descending scenario*. It reviews the theoretical background supporting that design needs to become situated in an essentially ecological perspective and following this characterizes the context of the research as a whole— which also supports that this will be the norm in the century ahead.

The work with scenarios introduces the field of *future thinking*— or *scenario planning*. This is an emerging subject that can become part of the culture of a wide range of design practices, both as a major source of information as well as a visioning

tool for understanding the systemic implications of design practice. Subsequently, it exposes and interweaves together the patterns influencing our common future and constituting our general ecological status at the present moment. It opens the way to examine and discuss three possible scenarios to work with. Despite the range of possibilities, they all head to an energy-descending future. All these elements provide the context in which to situate design within and to support the resituating of it within an essentially ecological perspective in Part 2. The elements exposed in Part 1 were also the reference for much of the information and the scenario shared with the scholarly community of Torres Novas in order for them to ideate about their schools as is approached in Part 3.

Part 2 is the main theoretical framework. It constitutes the core of what ecologist Arne Naess (2008) has called an ecosophy. It represents the building up of the designer/research ecological literacy and worldview, where design is situated accordingly. It departs from the biological understandings of our living from the living systems perspective proposed by Humberto Maturana, to connect with insights from Fritjof Capra in the biological foundations of culture to connect design within. Revealed here is a triple step that has emerged from the research process. This is the suggestion of a possible way to overcome the emerging scenarios by exploring and deepening the subjects of ecological literacy, ecological lexicons and ecological thinking that form a sequential understanding of our ecological participation. Following this, three sequential understandings of design are examined; Ecological Design according to Professor David Orr, Salutogenic Design according to Doctor Daniel Wahl, which also led to expose the whole concept of salutogenesis as a reference to support the need to adjust human systems according to ecological systems; and finally Doctor Gonzalo Salazar-Preece with the emotions of love and homing sustaining ecological forms of design.

The framework of Part 2 is complemented by the study of the work of Doctor Elizabeth Sanders who has been researching the aspects of participatory design to propose a field of research that is *generative design research*, which came to support much of the empirical practice that was conducted with the schools of Torres Novas. Following, her explanations are connected with the sociological understandings of Doctor Sandra Jovchelovitch about participation, which are also connected to the

ecological ideas of Maturana and Preece, to support the emerging idea of design as a co-creative relational domain that may constitute the very possibility of democratic public spheres of participation that are essential for fostering and maintaining democratic ecological ways of living.

Part 3 is the full description of the exercise carried out with the public schools of the city of Torres Novas in Portugal. It is fully based on the previous Parts 1 and 2. It reveals how it was constructed, the methods, methodologies and tools developed. It also describe the specially designed generative tools to explain concepts and enact the participants' creativity, a Pilot practice held at the Polytechnic of Tomar, the outcomes and subsequent review that led to the final rearrangement of the practice. Finally, it exposes other activities conducted that are relevant to the thesis — such as a brief workshop undertaken with the children of a private schools also in Torres Novas, a reflection of the overall outcome of the practice and possibilities for future steps with this specific community.

The Epilogue of the thesis is a theoretical reflection on the entire study. Design, education, learning and schools are aligned according to the emerging ecological understanding and the implications for design are exposed to create an imaginary for public schools and to outline further contributions design can bring to educational settings when informed by emerging ecological thinking. The epilogue exposes both the final conclusions and the array of possibilities emerging for future research and action. The thesis parts must be seen as a whole where — back and forward — every part was reviewed along the process. So the reader will find sequential conclusions and explanations along the text.

PART 1. BUILDING DEEP AWARENESS ABOUT THE EXTENT OF OUR ECOLOGICAL ISSUES: PREPARING FOR THE LONG ENERGY-DESCENT FUTURE

1. INTRODUCTION

This Part 1 is a broader situation of design within the issues of our sustainability. First, a view of design is introduced as universal in scope and in the worldview of technological culture, which promotes it as an integrative discipline. This is the link to propose that it has to be situated within an essentially ecological perspective and to introduce other emerging eco-centric frameworks. Secondly, the whole area of studies named scenario thinking is approached as way to understand and expose the causes and extent of our ecological issues. Part 1 has contributed to the thesis in three different manners:

- This situates the thesis and aims to situate design within a broader context and amidst the flux of the events that are configuring *an energy-descending scenario* like globalization, peak-oil, resources and biodiversity depletion, climate change and several other issues of our contemporary geopolitics
- It introduces the field of scenario planning — or future thinking — an emerging subject that can become part of the culture of project in a wide range of design practices, both as a major source of information as well as a visioning tool to understand the systemic relationships of practice
- This was the basis for constructing a scenario for working with the schools of Torres Novas. First, it offered some elements for discussion and was productive in situating the students in a way they could understand that an energy-descending future is not a mere creative invention but a foreseeable and plausible situation. Second, and facilitated by the designer/researcher, it became a tool to project the school in the future thus enabling them to create their own vision — this is a topic that will be fully exposed in Part 3.

An *energy-descending scenario* means that much of the Natural resources and ecosystems feeding and fuelling the current expression of industrial culture are

becoming damaged, depleted and rare at such a rate and extent that the industrial civilization has entered a major era of transmutation. John Greer has referred to it as "the long descent of the industrial society" (2008) that will entail deeper structural changes in lifestyles, working and commuting, in food production and several other organizational and cultural aspects of the economy and society. This, as a matter of fact, may also change the roles, scope and boundaries of design activity within society. At this moment, inaction and deluded action are already charging long-term consequences (Kunstler, 2006, Greer, 2008, Greer, 2009).

This brief introduction and everything else that will be exposed in this section may sound catastrophic. However, according to the first hypothetical point of this thesis, it is precisely the awareness over the causes and the extent of the present crisis that may help people and their communities to get situated, to shift mindsets, to confer new meanings for living, to plan and act to cope with it; and eventually, to smooth and redirect this energy-descending transition towards more desirable pathways. Still, although many different narratives about the future may be possible, they are likely to be framed within a context where less energy will be available, a wide range of natural resources will be exhausted, spoiled by pollution or overused, and different climatic conditions compromising food security in several regions of the globe will be the norm (Foster, 2001, Kunstler, 2006, Greer, 2008, Greer, 2009, Hopkins, 2008, Hopkins, 2011, Holmgren, 2009a, Hulme, 2009). In this first Part therefore, the field of scenario planning will be presented. Following this, and based on the overview of several future visions, from different authors, the trends, facts and patterns that led this thesis to be situated within an energy-descending scenario will be presented and discussed.

2. DESIGN THINKING AT THE WORLDVIEW LEVEL

Design is inherent to all human activities; it has therefore great importance on the processes that both sustain industrial civilization and culture in its current unsustainable expressions and also on playing an active social role to change it. Design facilitates and integrates the encounter of different knowledge domains to create objects, environment and processes. And as is argued by Victor Margolin, "designers occupy a dialectical space between the world that is and the world that could be" (Margolin, 2007 p. 04) and therefore necessarily have a say about the ecological challenges ahead.

However, the design activity is mostly informed by the anthropocentric expression of human culture that is both responsible for unsustainability and is now endeavouring a major accommodative pace through the sustainable development debate. To be able to communicate the complex aspects of this necessary shift in worldview and culture, not only will it be necessary for major reflexive thought about the scope and boundaries of design, but also coherent and holistic philosophical frameworks to guide designers´ thinking and practice will be needed, which, this thesis does suggest, as the situation of design within an essentially ecological perspective.

As will be further developed in Part 2, it is through design — any planned act toward the future — that we materialize our inner worlds of values, beliefs and intentions: All the material structures that emerge from the network of human interactions and relationships constantly shaping the web of culture come through design in a process of mutual influence: symbolic and visual communications; material objects; activities and organizing services; complex systems and environments for human activities that make up the social world – all created for a purpose according to some design and carrying meaning (Buchanan, 1995, Margolin, 2007, Capra, 2002, Orr, 2002, Wahl and Baxter, 2008).

Design activity has grown and expanded as far as its context[2]. This, according to Buchanan, is the expanding of its "meanings and connections, revealing unexpected dimensions in practice as well as in understanding" to become the "new liberal art of technological culture" (Buchanan, 1995 p. 03); a discipline experiencing revolutionary transformation, widening the scope of its activity to beyond the discourse about visual form and mechanical function (Buchanan, 1995, Margolin, 2007, Markussen, 2012). Participants of design contexts now come from diverse knowledge domains, professions and academic disciplines drawing together because of a shared mutual interest in "the conception and planning of the artificial" (Buchanan, 1995 p. 12) which give a clear understanding of design as an integrative discipline.

The importance of design as an *integrative discipline* has also been acknowledged by different authors in different periods referring to it as the "bridge" among compartmentalized and specialized sciences and technologies (Papanek, 1985, Owen, 2006); as being well positioned to enable a more integrative, holistic approach (Best, 2009, Wood, 2008b, Wood, 2008a); as "designing in between" (Giaccardi and Fischer, 2008); as a major "agent of change" (Banerjee, 2008) and finally according to Wahl and Baxter:

> "At the nexus of values, attitudes, needs, and actions, designers have the potential to act as transdisciplinary integrators and facilitators [...] to integrate multiple perspectives and diverse knowledgebase of different disciplines, value systems, and stakeholders" (Wahl and Baxter, 2008 p. 72)

By acting as an integrative discipline it can facilitate other thoughts entering design domains, which might help to understand the different complex natures of various systems domains and some of their general characteristics – knowledge, rules, norms, practices, and structures. And, at same time it will contextualize the contributions of diverse perspectives in a context of creativity, systemic understanding, and ability to envision; therefore co-participating, integrating and facilitating a more inclusive decision-making process.

[2] As Richard Buchanan (1995 p. 15) has stated, "design has no special subject matter of its own apart from what a designer conceives it to be. The subject matter of design is potentially universal in scope, because design thinking can be applied to any area of human experience."

However, in that which regards the issues of sustainability, according to Baxter (2005) this is only one dimension that will create designers' new fields of action. If played within the same humans-first values system and the fragmentary worldview of the political, economic, and institutional structures that have legitimated ecological degradation, it will be kept working within the same narrow market forces of the continuous growth and green consumerism instead of transforming it (Orr, 2002, Wahl, 2006a). In this sense it is suggested that, to properly cope with the issues of our sustainability, design might be situated in an essentially ecological perspective.

This is not about situating design in some specific knowledge domains as previously proposed by Snodgrass and Coyne (Snodgrass and Coyne, 1997) and other authors, as was identified and approached by Buchanan (1995). Any effort to situate design thinking within fine arts, natural, or social sciences would tend to contribute to a scenario of further fragmentation – despite their contribution to knowledge, they are limited to human-centric approaches and would limit design in scope or reduce it from its complexity. Hence, this is essentially about the constitution of frameworks capable to be transversal to all its subject thinking and action. It departs from Buchanan's idea that

> [...] "the significance of seeking a scientific basis for design does not lie in the likelihood of reducing design to one or another of the sciences [...] Rather, it lies in a concern to connect and integrate useful knowledge from the arts and sciences alike, but in ways that are suited to the problems and purposes of the present" (Buchanan, 1995 p. 04)

Following this path, different knowledge basis from which to inform design has been proposed. Terence Love has suggested that *ethnology*, taken together with evolutionary analysis, new understandings emerging from neurosciences, and systems perspectives as a combination able to create a major "unifying basis for design theory and practice" (Love, 2005 p. 06). Complementarily, Professor Seaton Baxter has advanced to suggest that it is necessary to surpass anthropocentric perspectives by the creation of new perspectives, fostering, for instance, references as zoocentrism and biomimicry to surpass it and to facilitate the integration of different creative perspectives in design education and practice and, by the

incorporation of it, to eventually adopting "a full ecocentric approach"[3] (Baxter, 2007b p. 88).

Doctor Daniel Wahl (2006) has suggested Salutogenese as a conceptual framework for design. Salutogenese, literally "health generating", was coined by medical sociologist Aaron Antonovsk (1996) that, on the light of the living systems theory, have suggested that the health of individuals is fully dependent on the totality of its interaction organism and medium of existence. By analogy, Wahl has coined the term salutogenic design, where the fundamental intention of human design is to positively contribute to the creation of systemic health across temporal and systemic scale. Doctor Gonzalo Salazar Preece (2011) departing from the work of Chilean Biologist Humberto Maturana has proposed that the emotion of love and homing are fundamental aspects of design in building and sustaining human sustainable communities. According to him, *love* is the essence for cultivating relationships of nearness and intimacy that are essential to ecological living. *Homing* is the explanation of embodied process through which we generate our built environments that are constituted by objects, buildings, landscapes, complex systems, etcetera, all of which are parcel of our natural, ecological existence.

Baxter, Wahl and Preece came up with their propositions within the realm of The Centre for the Study of Natural Design (CSND) at the school of Design of the University of Dundee. CSND was created in 2002 with the underlying philosophy to contribute for a fully ecocentric perspective able to challenge existing design perspectives, motivations and practices (Baxter, 2005, Baxter, 2007b, Baxter, 2007a, Wahl, 2009, Preece, 2011, Brogan, 2011, Wood et al., 2009). Yet and with the same underlying intention, Professor David Orr (2002) has proposed an all-inclusive term in design domains, which is *ecological literacy* to suggest that in face of the emerging ecological issues designers are to become ecologically literate persons in first instance.

[3] Zoocentrism and biomimicry are nature-inspired approaches to design that give priority to the intrinsic value of animals and ecological systems by emulating nature's patterns and strategies as source of inspiration. These are subject of different research fields and will not be deepen in this work. It is not the aim of this thesis to expose a range of different design approaches searching for ecological sustainability but to propose a theoretical reflection that can be transversal to it. The work of Daniel Christian Wahl (see the references) offers a more complete overview on the different niches of design practice looking for sustainability.

Parallel to this sequence of major attempts to create holistic and ecocentric frameworks to inform design practice, Professor Victor Margolin (2007) has suggested that "designers have to think more profoundly about the future and their role in making it into the present" (Ibidem p. 14) and scenarios thinking would constitute a "warning system" to inform designers and to situate what they design. According to him, designers "have a unique ability to give form to plans and propositions" (Ibidem p. 10), and thus have a role to play in the construction of the future.

Despite their ability and the fact that design is implicated in all human activities, there is little in the typical design curriculum that prepares students to interplay with such scenarios, with broad and coherent visions about geopolitics, economics, the various spheres of activity that constitute the social world, and of course their own communities and spheres of knowledge and interest (Margolin 2007). The same is valid to content and activities that could support deep ecological awareness, as for instance ecological thinkers and frameworks like the one provided by Permaculture (Holmgren, 2009b) that still remain marginal in academic settings.

Permaculture Design (Holmgren, 2009a, Legan, 2009, Hopkins, 2008, Hopkins, 2011) is a holistic approach to planning and maintaining systems of human scale, according to ecological principles and patterns, socially equitable and diverse, economic situated and viable and energetically and technologically appropriated. It was proposed by the Australian ecologists Bill Mollison and David Holmgren (2009) in the 1970s and literally means permanent culture and emphasizes the awareness over the immutable aspect that human living is intrinsic to the dynamics of ecological systems. Permaculture emphasizes the creative application of the basic principles and patterns of Nature, integrating plants, animals, buildings and people in productive, harmonious and healthy systems. It is a synthesis of traditional farming practices with innovative ideas, uniting indigenous wisdom to the discoveries of modern science in a systemic way of thinking and advancing design principles that can be used to create, maintain and improve the efforts made by individuals, households and communities towards ecological living (Holmgren, 2009a).

An example of application of the patterns proposed by Permaculture is the Transition Network and the Emerging Transition Culture (Hopkins, 2008, Hopkins, 2011, Pinkerton and Hopkins, 2009, Heinberg, 2011). The Transition Movements are groups of people, households and community initiatives in response to peak-oil and climate change, where local enterprises and economy are valued and nurtured.

Lower energy use, creativity, the building of resilience, sharing, gift, time bank, non interest based schemes, cooperatives, etcetera are the pillars of this economy (Eisenstein, 2011, Heinberg, 2011, Hopkins, 2011). Since the founder of the initiative, Hob Hopkins, launched it in the city of Totness in the United Kingdom in 2008 it became viral across Europe with hundreds of transition initiatives, including Portugal (Network, 2013). Beyond the Transition Movement, many of the well established eco-villages and communities from Findhorn in Scotland to Tamera in Portugal are imagined, crafted and maintained under the principles of *Permacultural Design* (Gibsone and Buckingham, 2013, Tamera, 2014, GEN, 2014).

These are examples of emerging frameworks of ecological thinking questioning and challenging traditional productive structures and its underlying intentions and the design imaginary constructed within the *sustainable development* agenda of the perpetual economic and material growth. Finally, design community as a whole has not debated enough on the meaning we attribute to sustainability and what we are supposed to sustain in first instance and is far from adopting ecological thinking as a core ethos. To understand the depth of our ecological crisis and to discover ways of live accordingly the dynamics of ecological systems are major subjects in design thinking and practice that need to be further developed to reinforce designers ability to cope with the issues of our time, to have a say about them and to produce arguments about the changes one would like to see in the world.

Furthermore —as will be exposed in the following sections of Part 1 —faced with the growing complexity and also the volatility of the environment within which design is produced, proper intellectual tools will be required in order to reflect on the meaning of these trends and their ethical implications. This is mainly represented by the possibility of transition from the carbon intensive industrial society in which we live today to a post-carbon existence, which we have yet to figure out. In face of such

awareness, the intersections of general sustainability, humanity's cultural aspects and ecological thinking are still to be clearly defined on the realm of design practice. As in Margolin's words,

> "[t]o position one's self among these and other oppositional forces require an intensive reflection on one's own values, goals and social concerns" (Margolin, 2007 p. 12).

Hence, from this thesis' perspective, designers will be entailed upon to build consistent worldviews with a comprehensive conception of the biosphere and of humanity's relation to it. An *ecological perspective* is meant as a fundamental situation of human social representations within an intersubjective domain that recognizes different worldviews, the existence and richness of the diversity of situated epistemologies and intersubjective domains of human relationships, as well as a new dimension of human and Nature dynamic relationships. It is in being ecologically situated that designers can engage with the proposed future in a more direct way.

The figure on the next page resumes what this overview of design thinking means and the need to situate it in an essentially ecological perspective. On the vertical axis, as design moves to reach a wider participation in the human social world, it enters new domains by finding new fields of application to design thinking and practice. Still, it facilitates and integrates the entrance of different perspectives from science and arts alike characterizing a human-centric design, where human soundness is the underlying purpose. However, any attempt to solve the issues of our sustainability within the human-centred mindset is fated to remain limited by failing to recognise and to live our essential participation in the dynamics of ecological systems and may tend to assume an accommodative pace of the status quo.

On the horizontal axis, ecological thinking enters design domains. It also facilitates the entrance and integration of other knowledge domains, but differently, it is characterized by an attempt to situate design towards deep ecological understanding and participation where systemic ecological soundness is the underlying principle. Ecological sustainability and ecological expressions of design are on the worldview level of the encounter of the diversity of human knowledge domains, broader design

practice with deeper awareness of our participation within the dynamics of ecological living systems. As a matter of identification, such encounter is named *natural design*, which necessarily entails major transmutation of thinking, a rupture with accommodative adaptation and to the status quo and to also confer new sense of meaning to design within our human living and doings. All the subsequent sections and parts of this thesis were constructed to promote this idea.

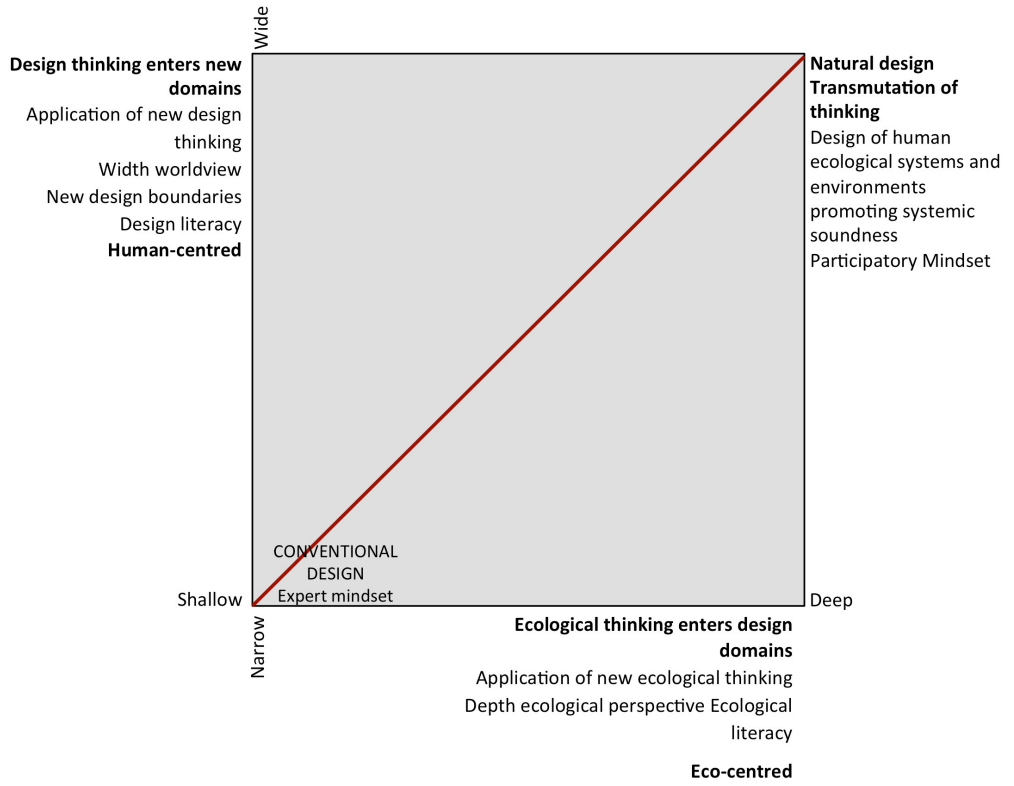


Figure 1 – A possible path to the transmutation of design thinking

3. DESIGN AND THE THINKING OF THE FUTURE

To plan effectively in the present and to cope with the pace and unpredictability of the ongoing global changes, requires a prospective vision of what the future may be. Also, if someone, either from a certain community or a knowledge domain were to produce their own arguments about what kinds of changes they would like to see and also have a say in shaping them, it would also be necessary to engage in long-term thinking about the future (Margolin, 2007, Gallopin et al., 1997). Designers, trained in many disciplines and by their intrinsic participation in shaping culture, may have an effective role to play within.

Scenario planning is a field of study that emerged after the Second World War as an attempt to apply sophisticated modelling techniques to the creation of scenarios to orient action within a wide range of subjects like geopolitics, technology and policy-making (Margolin, 2007 p. 06). Today it is an important and strategic area of study for governments, the business world, and is also becoming an important tool to help communities and social enterprises to improve public participation in local and informed decision-making processes (Gallopin et al., 1997, Hopkins, 2008, Holmgren, 2009a; Gratton, 2011).

Scenarios are not predictions or forecasts. Rather, they are stories about the future with a logical plot and narrative exploring the manner in which events unfold in a way that people, organizations and communities may explore the complexity, the intersections, and possible framings of certain issues, themes and trends (Gallopin et al., 1997, Hopkins, 2008, Holmgren, 2009a, Wiek et al., 2006, Sondeijker et al., 2006). As was proposed by Margolin (2007 p. 05), they can be generally exemplified as "predictive" and "prescriptive", where the first is what could happen and the second is how it should be. Whatever the terms proposed by Margolin and to keep the idea that the future cannot be fully predicted nor controlled, the terms informative and prospective will be used instead. Notwithstanding, this general idea, a prospective scenario can be turned into a plan of action with certain prescriptions to reach certain objectives. According to the words of Victor Margolin,

> "A predictive [informative] scenario is based on what could happen. Its methodologies involve gathering data and organizing it into patterns that

> make reflection on future possibilities more plausible. Creators of predictive scenarios recognize that the events activities they study are too complex to control by fiat. In contrast, prescriptive [prospective] scenarios embody strongly articulated visions of what should happen. […] Predictive scenarios tend to be pragmatic, while prescriptive ones are idealistic (Margolin, 2007 p. 05-06).

In what concerns our ecological issues and the imminence of an energy-descending scenario, it was in 1972 that the Club of Rome published the *Limits to Growth*, a study based on MIT computer models that simulated the future relations between the earth's resources and the human population to argue, at that time, that the continued consumption of resources at that current rate was unsustainable (Margolin, 2007, Greer, 2008, Hulme 2009, Heinberg, 2011). The call for new sustainable environmental policies and practices was followed by subsequent reports — The Bruntland Commission, the Agenda 21 and also several other individual authors and organizations that began to produce scenarios calling for sound environmental policies, deeper questioning over the status quo, the current expressions of capitalism, the belief in permanent growth and the environment as a subset of the economy (Gallopin et al., 1997, Foster, 2001, Margolin, 2007, Hopkins, 2008, Holmgren, 2009a, Kunstler, 2006, Greer, 2008, Greer, 2009).

Within the field of design, only a few authors have articulated future visions as a subject of reference for their speculations. Among them are Victor Papanek (1985) and Buckminster Fuller (1981); also, as remarked by Victor Margolin (2007 p. 11) are Gui Bonsepe, and Tomás Maldonado, and more recently, adopting a "liberal, global agenda and emphasizing a more positive side of capitalism", there is Bruce Mau's Massive Change [BMMC]. Together Michael Braungart's "Cradle to Cradle (Braungart and McDonough, 2009).

Mau and Braungart's propositions are clearly fitted within the mindset underlying the sustainable development agenda that do not delve deep enough to question the structures of economic growth, its prevailing ethics and its pervasive consumer culture over human cultural diversity and the sensibility of people and places. It goes against several values presented in their discourses. This duality is clear in Braungart and McDonough statements:

> "Cradle to Cradle goes beyond the environmental chorus saying that growth is wrong and that it is virtuous to prune the pleasures we take in things like cars or shoes until there is no pleasure left.
>
> When you talk about "save the planet" you turn it into an ethical[4] question, and I think you won´t solve the problems if they are seen as ethical" (Braungart and McDonough, 2009p. 11).

Also, by not questioning the current structures of economic growth and development, these propositions do not question the fact described by Heinberg (2011 p. 01) that growth consists "of the expansion of the overall size of the economy […] and of the quantities of energy and material goods flowing through it", which in accordance with all the evidences that will be approached in the subsequent sections of this Part 1, and as is sustained by Foster (2001), Kunstler (2006), Heinberg (2011) and Eisenstein (2011) is unrealistic. Also the human ecological condition might not be solved by a fragmented problem-solving mindset (Greer, 2011, p.23-34).

Similar contradictions are also present in propositions to connect certain economic logics with ecosystems services to support the idea of "competitive advantage" to companies. The pervasive idea of *competition* for instance, is a projection of our own present-day cultural view of biology "as consisting of myriad discrete, separate competing selves" (Eisenstein, 2011 p.16), while in ecological terms it would be more appropriated to construct an imaginary where cooperation and symbiosis[5] are the norm[6]. In addition, by applying financial value to natural resources under the current worldview along with the imaginary of commoditization of all things is a risk as it does tend to run over the privatization of life-sustaining ecosystems (Alier, 2004, Eisenstein, 2011). This is the case for global emerging issues with water, genetically

[4]Ethics belongs to the domain of value systems and worldviews where design emerges, which this thesis supports to be a subject left aside the current debate on sustainability. This will be discussed in depth in part 2.

[5]Symbiosis is close and often long-term interaction between two or more different biological species. From the Ancient Greek it is literally "living together" — see on Wikipedia and also the propositions made in Part 2.

[6] To counterpoint the idea of Natural Capitalism, please see Charles Eisenstein, Sacred Economics: Money, Gift e Society in the Age of Transition, 2011; namely Chapters 1 and 7. In Chapter 1, p. 16 he suggests that "there are other ways of understanding nature that, while not ignoring its obvious competition, give primacy to cooperation, symbiosis, and the merging of organisms into larger wholes. This new understanding is actually quite ancient, echoing the indigenous understandings of nature as a web of gift."

modified seeds, and general indiscriminate use and appropriation of biodiversity[7]. Margolin refers to aspects present in Bruce Mau's Massive Change, which can also be extended to the expressions to turn green certain aspects of Capitalism, that

> "[…] fails to confront the many ways that designers are implicated in producing a world that runs counter to the values the exhibition espouses, nor does it suggest the kinds of political changes that must occur in order for designers to undertake the good work it advocates" (Margolin, 2007 p.12)

These are also clear examples of the above-presented, where despite the attempts towards sustainability, these propositions are essentially framed by the existent cultural structures of the human-first value system in relation to Nature, consumerism and economic growth that aim to live entirely on the fundamental aspects of industrial culture. From this perspective many of our ecological issues have been essentially framed and limited to the engineering of Nature via complex, expensive and equally harmful technologies. Furthermore, it does disregard any possibility of facing the fact that such cultural structures are themselves undermining the conditions in which to maintain industrial activity, leading to the retraction of the global economy to which much of design activity is strictly related (Foster 2001, Kunstler, 2006, Greer 2008, Greer 2009).

These are all features that can be addressed by exploring scenarios. However, broader and coherent scenarios are only a subject, or aspect that can guide designers through the complex intersections of the emerging changes. They are not able to

[7] This is comparable to the "tragedy of the commons" from a systems perspective explained by Meadows (2009, book appendix, p. 191): "When there is a commonly shared resource, every user benefits directly from its use, but shares the costs of its abuse with everyone else. Therefore [when] there is very weak feedback from the condition of the resource to the decisions of the resource users, the consequence is overuse of the resource, eroding it until it becomes unavailable to anyone". Furthermore as is supported and developed by Charles Eisenstein (2011) when one uses natural and common resources in private ownership we will find someone else making profit over its abuse and sharing the costs of its depletion with the whole of society. This is to say that the costs of the depletion of aquifers, for example, are not internalized in the economic costs and are external to the producer's balance sheet. In fact, all natural commonwealth that are used as the basis for credit creation today are privatized and the costs of its depletion are passed on to the public or to future generations. It also will connect to the other proposal of this thesis that in a global economy and consumerist culture, there is no feedback from the natural condition of the resources. Production and consumption are in different domains and what, when and how something is produced is outside of the scope of the consumer's understanding. The way out of it also belongs to the debate about resource usage: Education/sensitization, regulation or privatization? See also the section on economy in this Part 1

single-handedly shift things. Scenarios can address and expose the complex relationships among things, politics, geography, demography, economics and ecology; but they cannot tell us what to do in that which regards our intentions and overall ethical values towards others and Nature. These are the issues only broader discussions of our cultural value-systems can provide.

Yet, it is necessary to consider viable and desirable futures. In this case, scenarios may offer a way to consider long-range possibilities, by building coping strategies and to advance the possible consequences of our actions when planning further steps as well as on resituating designers within this major transition. It is about a different future, and so does entail the reconciliation of long-term thinking:

> "While the future is open and cannot be predicted, scenarios offer a powerful means for examining the forces shaping our world, the uncertainties that lie before us and the implications for tomorrow of our actions today. A scenario is a story […] concerning the manner in which future events could unfold and offering lessons on how to direct the flow of events towards desirable pathways and away from undesirable ones" (Gallopin et al., 1997).

Furthermore, according to Lynda Gratton,

> "Knowing something about the future helps us to prepare for our future, it influences the advices we give to others, and could have a fundamental impact on the choices that we, our family and friends, our community and our company decide to make; about the competencies we decide to develop, the communities and networks on which to focus our attention […] (Gratton, 2011 p. 13).

Whichever the type of scenario, they are complementary. When they are aimed to foresee certain patterns, they are informative and can help people to situate themselves amidst the flux of the unfolding events. When they are aimed at ideating a certain path or plan of action, they are prospective, a co-creative tool through which to co-create both a desirable and viable future. Ideation and collective dreaming can depart from data to support informed decision-making. These, for instance, were explored during the thesis' empirical practice to help people to

experiment holistic thinking and to understand the causes, extent, and their intrinsic participation in the ongoing ecological crises as well as to ideate about a common future. Hence the scenarios were explored and associated as a participative design tool to project, or foresee an object, or a product of human co-creative action and its possibilities, in this case, a possible common picture for public schools, amidst an energy-descending scenario — see Part 3.

This is so, as we are dealing with a major transition towards different biophysical circumstances that require different worldviews and cultural arrangements, hence “involves a mobilizing vision of the future”(Wright and Spers, 2006 p. 13); and as was suggested by Hopkins, "[…] we can only move towards something if we can imagine what it will be like when we get there" (Hopkins, 2008 p.141) and this type of collective creativity, this thesis will support, is design thinking in its essence.

With the backing of the subsequent sections and Parts of this thesis, the intention herein is to situate scenario thinking within the realm of design practice in form of broader ecological imaginaries. This thesis will support that it is by activating, facilitating and integrating different people and knowledge to co-create ecological imaginaries that designers can come to play an important social role by helping communities to situate themselves within a certain background and thus providing awareness, margins and guidance to allow major shifts in worldviews and cultural structures that the suggested post-carbon economy will demand.

4. PATTERNS LEADING TO AN ENERGY-DESCENDING SCENARIO: A LOW-CARBON ECONOMY EMERGING

> "If a factory is torn down but the rationality which produced it is left standing, then that rationality will simply produce another factory. If a revolution destroys a government but the systematic patterns of thought that produced that government is left intact, then those patterns will repeat themselves." Robert Pirsig, Zen and the Art of Motorcycle Maintenance cited in Meadows, 2009.

Having situated the subject of future thinking within design, it is necessary to set the patterns[8] that support the idea and context of an energy-descending scenario. It is now forty years since the 1970's oil crisis that led to the first global advice about the urgent need to shift the patterns of human development and which was supported by the pioneer study *Limits do Grow* released by the Club of Rome (Greer, 2008, Greer, 2009, Heinberg, 2011). Since then and despite of the continuous advice from a growing number of reports, the human impact over the biosphere has only increased to the point we are now overshooting[9] it (GFN, 2013, IPCC, 2014). That is to say humanness is not only consuming more than the biosphere can provide but it is also threatening the condition of ecosystems in an irreversible manner, which is a clear reflex of a general lack of awareness about the severity of the situation for at least four decades (Greer, 2008, Greer, 2009, Foster, 2001).

This delay and also the controversy underlying the debate around such issues emerge from an essential epistemological separation from the dynamics of living systems and

[8] Patterns are regular features, behavioural characteristics and relationships we can identify in complex systems to attempt to predict unfolding events. As was explained by the Environmental Scientist Donella Meadow (2009 p. 87), despite the complex human mental models we cannot represent the world fully. We can only keep track of few variables at one time. We will be always subject of unpredictability and surprise in face of complex systems; however, via systems thinking one can attempt to understand and relate with it and even to predict or influence certain movements but never to control it. "We know a tremendous amount about how the world works, but not nearly enough. Our knowledge is amazing; our ignorance even more so" (Ibidem. p.87)

[9] Every year, since 2003 the Global Footprint Network releases the Earth Overshooting Day (EOD). It indicates the day of the year when humanness production and consumption crosses the limits the physical biosphere can provide — for us and our future generations and other species alike. In 2013 the EOD was on August 20, marking the date when humanity exhausted nature's budget for the year.

the meanings we attribute to it (Schumacher, 1973, Bohm, 1980, Capra, 2002, Jackson, 2009, Hulme, 2009, Preece, 2011). Subsequently, it is reflected in many of the things we culturally take for granted as for instance, the belief in endless economic growth (Jackson, 2009, Heinberg, 2011, Alier, 2004). As in the words of John Michael Greer,

> […]"the roots of today's crisis reach down into a disastrous mismatch between today's human societies and the world of living nature on which human life depends" (Greer, 2009 p. 03)

In Hulme's argument, human perception over these issues may vary widely among different political and cultural backgrounds as

> "[w]hat is taken for granted among one group of people is 'uncomfortable knowledge' that is hard for another to accept because of its implications for ideas and resource commitments that they hold dear" (Hulme, 2009p. xxiii).

And therefore the recognition of our ecological issues as a threat to the ways of life to which we are accustomed and which we value depends on our views of Nature and on

> "[…] our judgments about scientific analysis, our perceptions of risk, and our ideas about what is at stake — economic growth, national sovereign, species extinction, or the lives of poor people in marginal environments of developing countries — whether it is ethically, politically, or economically justifiable to make-trade-offs between these" (Ibidem, xxiii).

At the same time, the constitution of contemporary everyday life does not make it easy to recognize the scale of the impacts of our personal and collective acts over the health of ecosystems as well as to understand our intrinsic dependence from such delicate dynamics. First, human-beings have crafted an autonomous existence from Nature; a subject approached by authors like David Bohn (1980), Humberto Maturana (1984), Arne Naess (2008), Luc Ferry (2010, 2011a), among others. Secondly, the constant improvement of our energetic resources, generation after generation, has contributed for outstanding scientific, material and technological improvements and prosperity. But at the same time, it has contributed in dissimulating the future of energy and all the diversity of social and ecological issues

generated by these facts (Foster, 2001, Alier, 2004, Holmgren, 2009a, Greer, 2008, Greer, 2009).

The economics of globalization humanity is living today is also the result of constant energetic and technological improvements together with the needs of most economies to expand market and trade frontiers and to ensure the necessary flow of resources that maintain material and economic growth, by trading-off expertise, technology and raw resources like rare metals, minerals, biodiversity, forests, coal, gas, oil, and so on (Appadurai, 2001, Alier, 2004). But this is a twofold way as long as globalization is not all about material flows. It also involves diverse immaterial cultural aspects, imaginaries of wellbeing, and knowledge production that has been mostly emerging as a widespread global economic monoculture with the same patterns of development, based on material growth, technology, consumerist life-style and financial speculation (Appadurai, 2001 p.06, Code, 2006, Eisenstein, 2011 p. xvii).

This has come to a point that the globalized economy is the domain of cultural, material and financial flows where the priority is growth, where nature is continuously regarded as a subset of the economy or even disregarded altogether (Appadurai, 2001, Alier, 2004, Heinberg, 2011, Jackson, 2009). Such flows do disregard the local cultural and ecological sensibilities of people and places when imposing an imaginary of material wellbeing that disregard cultural diversity and is the source of inequalities and both global and localized social and environmental conflicts (Appadurai, 2001; Allier, 2004). The critics over globalization are necessary for understanding its intricacies. As is approached by Appadurai (2001), there is still a lag between the pace of globalization and our efforts to contain it conceptually. If on the one hand, Globalization associated to the imaginary of economic growth has been producing staggering ecological and social impacts, on the other hand, as media flows across national boundaries, it has also contributed for wider discussions on human rights, ideas about gender equality and so on. Furthermore, in countries that are pressured by emerging markets, it sometimes forces oppressive governments or cultural barriers and ideologies to release pressure over minorities and others to attend global demand. It also

> "[…] allows people to consider migration, resist state of violence, seek social redress and design new forms of civic association and collaboration, often across national boundaries." [Therefore, it is also on the realm of globalization that forces the emergence of] "collective patterns of dissent and new designs for collective life" (Appadurai, 2001 p. 06).

Therefore, although it has certain negative aspects, it also has positive ones which can even include counteracting the politics of the purely economic globalization via a wider discussion on the possible different arrangements of ecological living according to the particularities of different places.

Yet, as essentially consumer individuals and participants of global dynamics we are not able to see or to understand the full impacts of our daily choices in things that are outside of the scope of understanding. It is so to the point that one may not even imagine, neither fully understand — to the point of denial — all the social, ecological, and energetic impacts, wars, deforestations, pollution, contamination, oppression and exploration of people and places, hidden political agendas, corruption and intentions that may be contained in a single and apparently trivial product (Alier, 2004, Kenner, 2008, Robin, 2010).

It is implicit in the logics of how we obtain or participate in the dynamics of the economy and is hidden behind a great portion of basic goods. For example, to buy water instead of get it for free, to buy food instead of grow it, to buy a meal instead of preparing it, to spend money in order to reach the workplace, to buy seeds instead of producing and keeping them in one's own field, to make use of commercial medicine instead of using homemade remedies or adopting a salutogenic attitude or to spend money to solve ecological issues (Allier, 2004). This applies to all aspects of our living, from housing, working, commuting and general consumption of products and services to all the global problems such as peak-oil and climate change and the meanings we attribute to it.

So, despite the increasing ecological problems, at this moment, the global economy is exclusively organized around logics of production and consumption to attend a spiral of economic growth that aim to continue the expansion of the overall size of the economy and of the quantities of energy and material goods flowing through it

(Jackson, 2009, Heinberg, 2011). It is followed by an increasing demand for more and more resources to support it and, at same time, more and more resources are being depleted to a point of no return (Foster, 2001, Greer, 2008, Greer, 2009). Hence — given the global scale of our living and the character of our epistemological relationship with the world we inhabit — the full consequences of our action are out of the scope of our understanding. As will be dealt with more in depth in Part 2, any attempt to establish some form of ecological sustainable living may involve the reconstitution of our everyday life within the limits of what we can grasp as a whole, where there can be comprehensibility, manageability and meaningfulness (Antonovsk, 1996). As was stated by Gratton, "little is expected to change until it becomes part of people's everyday decision making" (Gratton, 2011 p. 43).

This introduces a general overview of our situation. Still it is necessary to look more in depth at three major subjects that may threaten industrial society as we know it: peak oil, climate change and the economy which are all transversal to our living as individuals and society.

4.1. PEAK OIL

To understand the possible consequences of peak oil is to understand that recent history of humanity has been marked by development based on the availability of increasingly cheap, accessible and concentrated sources of energy — from steam to coal and from coal to oil. A trend that is not likely to continue throughout this 21st century.

Peak-oil does not mean the end of it. It means that we have reached a peak in its availability, which happened in the first decade of this century when the discovery of new oil wells began to decrease. It means that we are now descending not only the availability, but also the quality and accessibility of this oil. From now on, the pace of such decline is heading in the opposite direction to the increasing global demand for energy. The same issue does affect several other fossil fuels and raw resources supporting industrial civilization (Greer, 2008, Hopkins, 2008, Heinberg, 2011, Kunstler, 2006); which is stressed by Kunstler:

> "This is the point at which we have extracted half of all the oil that has ever existed in the world — the half that was easiest to get, the half that was

> most economically obtained, the half that was the highest quality and cheapest to refine" (Kunstler, 2006 p. 24)

Oil is our primary energetic source, it is essential to the modern world and shall not be replaced in its totality by any other source of energy (ISEOF, 2012, PCI, 2010, ODAC, 2011, NEF, 2012, Holmgren, 2009a, Hopkins, 2008, Cleveland, 2008, Greer, 2008, Greer, 2009, Heinberg, 2011). It can be partially explained by its *net energy return*, that is the ratio of the amount of usable energy acquired from a particular energy resource to the amount of energy expended to obtain it and which is known as *energy returned on energy invested* — EROEI (Cleveland, 2008, Holmgren, 2009a). Oil for instance had a 100:1 ratio on energy return to energy invested early in the last century. When the USA oil peaked in the early 1970's this proportion was about 30:1. In 2006 at a global scale it was 18:1 (Holmgren, 2009a p. 38-50, Hopkins, 2008, ISEOF, 2012). At the same time, all the alternative technology for substituting oil, it is only possible to reach a 10:1 ratio in the most optimistic of predictions (Heinberg, 2011 p. 119).

But oil alone has such a wide range of different applications at all levels of industrial society and is so intrinsically related to our lifestyles that the net energy return factor cannot be looked at alone:

> "Oil is nearly the perfect energy source. There was originally a huge amount of it, it contains a huge amount of energy per unit of volume, it can be extracted from the ground very cheaply, it is just as easy to transport and store, it is even easier to use, and it is fungible — that is, it can be easily put to work in many different ways; you can burn it to produce heat, power motors, fuel cars, or planes, generate electricity, or anything else you want. Oil provides 40% of all energy used by human beings on Earth, and it powers nearly all transportation in the industrial world. It is also the most important raw material for plastics, agricultural and industrial chemicals, lubricants, and asphalt roads" (Greer, 2008 p. 11).

It means that the shift to other energy sources would entail whole new productive industrial, economic and human infrastructures with high level of investments and time, followed by economic, social, and environmental implications. The most obvious substitute fuels at hand, that together with oil are already providing most of

the world's energy — are coal, natural gas and uranium. These are already being exploited at an out breaking pace, plus with all the associated social and ecological impacts in its extraction, manufacturing and use (Heinberg, 2011 p. 14). Yet, nuclear power comes together with staggering risks to global security, be it for ecological reasons or its ethical implications as armament for political power. At the time this thesis was being written, for instance, the Fukushima Daiichi atomic power plant in Japan was releasing tons of water contaminated with radiation into the Pacific Ocean for 22 months, from the 2011 nuclear disaster. Since then, it has been compromising biodiversity, fishery stocks, local and global economies and imposing long-term risks to human health, to residents of the Pacific Ocean and worldwide consumers via the food chain. An agenda of denial and misinformation has prevailed since then (Perrow, 2011b, Perrow, 2011a, Perrow, 2013, Corbett, 2013).

At the same time, renewable resources such as solar power, wind, and bio fuels are essentially dependent on oil subsidy. That is to say, the extraction of raw materials is necessary for manufacturing, distribution and the use of these renewable resources. Given the scale of the necessary shift in infrastructure, these can only substitute a fraction of fossil fuels:

> "Making a solar cell, for instance, requires large infusions of diesel fuel first to mine the raw materials and then to ship them to the factory. Even larger doses of natural gas or coal are needed to generate electricity that powers the complex process of turning the raw materials into a cell that will make electricity out of sunlight. The complexity of the process makes net energy calculations challenging, but estimates range from a very optimistic 10:1 yield to more pessimistic, and arguably more realistic, 1:1 net energy yield" (Greer, 2008 p. 18)
>
> "The same, as it turns out, is true of every other alternative resource" (Ibid. p.19)

The production of biofuels, for instance, is proportionally more energy intensive then to extract oil and it would enter in direct competition with agricultural land available for food production. It would also bring together all the problems deriving from extensive monocultures. Large-scale agriculture relying on technology, fertilizers, pesticides, energy, all deriving from oil and other extractive resources and heavy

industrial processes, plus large amounts of water and, as a consequence, increasing deforestation, generalized pollution, loss of biodiversity, and the raising of food prices (Benenson and Rosow, 2012, Schumacher, 1973, Greer, 2008, Hopkins, 2008, Holmgren, 2009a, Heinberg, 2011, Pinkerton and Hopkins, 2009).

Fossil fuels are the natural result of millenary natural processes resulting in a huge amount of concentrated energy. Concentrated energy is different from diffused energy as that from solar energy, for instance, and industrial economies need concentrated and controllable energy that can be used directly and do useful work (Heinberg, 2011 p. 107). An example of this is that recently, two researchers from California have set out a full plan for substituting fossil fuels with wind, water and solar power (Deluchi and Jacobson, 2011), a Plan that according to the US former vice-president Al Gore is totally possible (Jacobson and Delucchi, 2009). However, it can only be possible if seen from an exclusively engineering and technological expertise perspective.

On the contrary, if seen from a broader holistic perspective, given the information exposed here and considering the systemic nature of energy production this would be impossible (Meadows, 2009). The large scale global burning of fossil fuels is one of the root causes of climate change. That plan would entail accelerating the burning of fossil fuels to dangerous levels as well as accelerating its depletion and to cause generalised pollution in the process of extraction and manufacturing. Furthermore, non proven reserves and the shortage of some materials together with the lack of political will and the corporative lobbies would loom over the proposed initiative (Jacobson and Delucchi, 2009).

Again, this is an example of the type of attempt to engineer Nature from an exclusively technological imaginary that is underlying the sustainable development debate. It means an enormous effort to keep the status quo that is comparable to a war effort and as such, it would deviate financial and natural resources from other activities such as food production, education, healthcare, and etcetera with clear social and ecological consequences. The other issue is that it would entail the existence of sovereign states to guarantee legal and military resources to nationalize reserves and mobilize the technical and managerial capability held mostly by

corporations. According to Holmgren, it would aggravate toward a scenario of aggressive national policies and actions to prevail that would move governments towards fascism, or corporatism by merging state and corporate power (Holmgren, 2009a p. 61). It would also put countries under belligerent disputes as the resources for such enterprise are in part spread throughout the world and controlled by few — only China, for instance, controls more than 90 percent of the global market of the metallic elements that are critical to a number of advanced technological systems, mobile devices and emerging green technologies (CSIS, 2010, Scott, 2010).

The energetic crisis is thus a much wider and more complex issue then an engineering problem. It also brings together an array of associated ecological and social implications ranging from climate change, unequal access and distribution of strategic resources, appropriation of genetic and biological resources, the vanishing of traditional agroecology and of the biodiversity, and pressure over water resources; all for the sake of the economy (Allier, 2004 p. 35). Altogether, the peak of natural resources and climate alteration are threatening the vital purpose of modern industrial civilization: economic growth and technological expansion. According to Allier, even though some of the developed nation may count on technological and financial means to correct some environmental damage, they are too late to be considered “green” (Ibidem p. 35).

4.2. CLIMATE CHANGE: MORE THEN WEATHER PATTERNS

Climate is a globally functioning holistic system that is the totality of the atmosphere, hydrosphere, biosphere and geosphere, and its ecosystems together with their interactions. As such, the change in climate is subject to systemic complexity and unpredictability. Anthropogenic climate change is a culmination of all the alterations in the climate as a result of an array of direct or indirect human actions that are accelerating the natural patterns of transformations of the climate at a global level (Hulme, 2009).

The general debate over this subject has been held under a mindset where climate is seen as something objective, with clear and measurable physical attributes. It fosters the general idea that it is an objective problem that can be predicted and controlled, or reverted by scientific, technological, financial and political resources.

Consequently, the knowledge to cope with climate change is mostly regarded as the domain of the scientific community. It does tend to disregard all the aspects that are out of the scientific scope, which are the immaterial aspects implicit to the meanings we attribute to climate change and which are not present in the ongoing debate (Hulme, 2009 p. 72-107).

As is explored by Professor Mike Hulme (2009) in "Why we disagree about climate change", when the term climate is used, it is important to remark that it has both physical and cultural connotations that are reflecting our relationship with it in time and place. Therefore, according to him, climate may change because its physical attributes change or because it's cultural symbolism changes, or both, reflecting differences in epistemologies and values systems, and providing a great deal of room for disagreement (Hulme, 2009 p. 33).

The climate, for instance, may denote different interpretations and relationships to a Brazilian-Indigenous in the South-American rainforest, to someone living in a mega-city region, in Europe, America, or yet anywhere in the countryside around the world and hence, shifting according to different cultural backgrounds. It is given different connotations according to worldviews, political and material interests, aims and objectives of different groups of people, or nations, and whether one sees it as a cluster of resources or part of the intrinsic web of life.

Physical climate is not static and the alterations in climate can be triggered by a multiplicity of natural factors that can make changes in different time-scales, but since 1824 there is also a growing scientific understanding on what is regarded as *anthropogenic climate change* (Hulme, 2009 p. 42). It means that the

> […] "physical functions of global climate and, consequently, the parameters of local weather are changing (largely) under the influence of the changing composition of the atmosphere caused by an array of human activities" (Hulme, 2009 p. xxxiii).

This array of activities includes the different geographical situations of human settlements, their sustaining and cultural management of landscape and of available natural resources in different times and scales of human history. In our recent history

— especially the second half of the last century until now — has been marked by the continuous adoption of the same patterns of development worldwide, with intensive industrialization and technological advancements supported by the intensive burning of fossil fuels and use of diverse natural resources. It is also followed by the impact of the exponential growth of human population and its needs, from water and food, to transport, urbanisation, material goods, and technology; all resulting in the sub product of an industrial society: large scale pollution and widespread ecological impact.

From a physically scientific understanding of the climate, we have obtained the awareness of the threats posed by human contributions to alterations in climate, ranging from issues such as accelerating global warming, glacier meltdown, changes in oceans levels, temperatures and maritime streams. This provokes alterations to general weather patterns like the seasons, wind, rain, and severity of floods, droughts, and storms that are already provoking damages, climate refugees, taking lives and affecting settlements. It also might provoke unexpected changes on the local characteristics of climate, threatening wildlife and biodiversity that may deeply affect local ecosystems (Foster, 2001, Kunstler, 2006, Holmgren, 2009a, Hulme, 2009, Nash, 2010). With rising temperatures and transformations in local weather patterns becoming an ongoing reality and beyond this, more frequent extreme weather events, we will also see a rise in plagues of pests and disease which are some characteristics from tropical regions to temperate ones (Kunstler, 2006). These will in turn, affect ecosystem services[10] like pollination and threaten local food security which will then inflict cultural changes in what and how people cultivate food (Holmgren, 2009a, Crawford, 2010).

As in the case of peak oil, it is not easy to contemplate the consequences of the above-exposed subjects for many of the same reasons: they are out of the scope of most people's understanding and are subject to the meanings people attribute to them. According to the work of John Greer (2008), and also from the work of Hulme

[10] Ecosystems services are the benefits that people derive from the ecosystems. These might include the production of goods i.e., food, fibber, water, fuel, genetic resources, pharmaceuticals, etc.; natural regeneration processes i.e., purification of air and water, seed dispersal and pollination; stabilizing processes i.e., erosion control, moderation of weather extremes; life-fulfilling functions of aesthetic beauty and cultural value (RESALLIANCE. 2004a).

(2009) the history of humanity is marked not only by the aspects of human affairs and geopolitics, but also by an evolution of cultural relationships with nature and natural resources. From precious natural resources, civilizations have flourished, expanded territories, built empires, made wars, and in the end many of such ancient civilizations have also gone by failing — among other cultural subjects — to succeed within the limits of ecosystems. Seen under these terms, our civilization — the industrial civilization — has been building its own paradigm: the development of a culture with principles of moral and ethics, and values-systems referenced on man — the humanism (Ferry, 2010, Ferry, 2011a).

From the work of the French philosopher Luc Ferry (2010) it is possible to understand that humanism was born out of an array of human social, cultural and also environmental relationships. All the circumstances that triggered a cultural revolution that came to support modern European civilization, western civilization and included in these, science and the industrial revolution, were also accompanied by the will to superpose the limits imposed by nature — which include an array of human physical constrains, susceptibility to diseases, famine, life and death and the climate. These are the roots of our contemporary worldview to nature (Ferry, 2010, Ferry 2011a).

The importance of this short explanation was to comment that it was in this shift of worldview that a negation of nature took place, with human autonomy transcending the natural world and its dynamics, setting humanness in a superior level where its moral and ethics, and consequently its social and cultural dynamics, are all referenced by the human in itself (Ferry, 2010, Ferry, 2011a, Preece, 2011).

At same time, even under this dualistic mindset, it is Nature in all its aspects — including the climate — the driver of biological evolution and human ingenious, innovation, from tools, to the cultivation of food, and more recently, technologies to build its habitats and to face and superpose certain natural conditionings. And throughout this whole process, climate has also offered

> "[…] material benefits for all human cultures: the rain, wind, sun and warmth that waters, powers and feeds our lands and machines. [As well as] resources for our aesthetic and spiritual imaginations: the clouds and sunsets which

> inspire our poetry, the seasonality around which we develop rituals" (Hulme, 2009p. 02).

It turned to be that the industrial civilization, born within humanism, has been endeavouring a technological revolution that was only made possible by constant energetic improvements. If on the one hand, this has all allegedly brought about both increasingly material and immaterial development, on the other hand it has also contributed to build up our perception of nature as a source of endless resources and climate as something that is stable and predictable most of the time. Today, even in face of major ecological collapses, the worldview of command and control over nature is still reflected in our lifestyles and mainly in our economy that — by principle — is how we manage our resources. What humanness is doing with climate is fully born from the meanings we attribute to it. And as is approached by Hulme (2009), this is the point we are missing about the current debate on sustainability.

4.3. ECONOMY

In the realm of economics, there is a prevailing response to prosperity and wellbeing attached to economic terms which, subsequently, call for more and more economic growth (Jackson, 2009 p. 03). To Heinberg (2011), this presents a fundamental conceptual mistake that is the belief that economics can and should perpetually grow, which is reflected in the 2008 economic crises and the global economy's delay in taking-off since then:

> "The economic crisis, that began in 2007-2008, was both foreseeable and inevitable, and it marks a permanent, fundamental break from the past decade — a period during which most economists adopted the unrealistic view that perpetual economic growth is necessary and also possible to achieve. There are now fundamental barriers to ongoing economic expansion and the world is colliding with those barriers" (Heinberg, 2011 p. 01-02)

This belief in perpetual economic growth, according to him, is because to most of the economists, Nature is merely a subset of human economy, and by consequence an endless pile of resources to be transformed into wealth. It also contributes to widespread the idea that natural resources can be endlessly substituted with some other form of capital like money or technology. However,

> "The reality, of course, is that the human economy exists within and entirely depends upon nature, and many natural resources have no realistic substitutes. This fundamental logical and philosophical mistake, embedded at the very core of modern mainstream economic philosophies, set society directly on a course toward the current era of climate change and resource depletion, and its persistence makes conventional economic theories — of both Keynesian and neoliberal varieties — utterly incapable of dealing with the economic and environmental survival threats to civilization in the 21st century" (Heinberg, 2011, 40).

Joan Martinez Alier (2004) also supports this view and explains that much of the ecological conflicts, be it within or outside of the market, local or global, happen because economic growth does entail continuous enhancing of the use of natural resources. The future human generations shall experience environmental impacts, as well as other species which are already fully experiencing it. Indeed, according to him, some impacts are already disproportionally happening over certain human groups and they would be noticed even that economic growth ceases as the current level of economic activity is already exhausting several resources and carbon sinks (Alier, 2004 p. 09)"

For the sake of the economy, wherever ecological problems came to emerge during the past decades, the more often attempts were made to "control" the problem and to reduce the risk to human beings and nature to acceptable levels while leaving the structure of production and profit-making intact (Foster, 2001 p. 129). This same mindset is reflected in the sustainable development agenda as was remarked by Hulme:

> "There is a paradox at the heart of all economic analyses about climate. It is embedded in the Stern Review and in the economic scenarios used by IPCC. It is the presumption of continued economic growth as measured by conventional GDP" (Hulme, 2009 p. 139).

According to his explanations, If we kept the Stern Review and IPCC scenarios on economic growth for this century, ranging from 1.3 to 2.3, or even 3.6 per cent/year — depending on the adopted scenario — it would mean that by 2050 the world economy would be 70 to 600 per cent larger and richer (Ibidem p. 140) which given

the pace of the ecological crisis unfolding and the fact that we have already exceeded planetary limits posing risks to both present and future generations it sounds incoherent.

It is recognized in Heinberg (2011) observations on the report of the European Environment Agency released in November 2010, where it reads that the growing global demand for resources and its limits, driven by the need to satisfy rising global consumption, is threatening the economy of the European Union (EU). It remarked that there are no quick fixes, it has also called on efficiency of resource usage, and that, despite the substantial improvements in EU environmental policy, major challenges remain, and "which will have significant consequences for Europe if left unaddressed"; according to him, the report,

> […] "does not present any warnings of environmental collapses. However, it does note that some local and global thresholds are being crossed, and that negative environmental trends could lead to dramatic and irreversible damage to some of the ecosystems and services that we take for granted" (Cited in Heinberg, 2011 p.151).

If we take three interrelated factors like demography, longevity — people living longer and consequently more people disputing a place on the market or overcharging social security systems —and the need for economic growth within the context of globalization: as the populations grows and more and more countries are adopting the same cultural patterns of economic development it necessarily entails a continuous growing demand on technology, urban growth, consumption and consequently on growing pressure over natural resources, thus pushing its limits, affecting ecosystems biodiversity, water quality, minerals, fishery stocks, farmland and so on.

The understanding of the rapid expansion of ecological issues is also stressed in the ongoing United Nations review of its "Millennium Development Goals (MDG)", recognizing that since the challenge of sustainable development was posed and later, when the MDG was first stated in the year of 2000:

> "The world has changed profoundly [since then] when the Millennium Declaration and the MDGs were adopted. Four critical shifts will make the

> coming fifteen-year period, 2015-2030, different from the MDG period through to 2015: (i) a drastically higher human impact on the physical Earth; (ii) rapid technological change; (iii) increasing inequality; and (iv) a growing diffusion and complexity of governance" (SDSN, 2013 p. 02).

Hence, the recognition that the global competition for resources and ongoing depletion has become mainstream and the rising costs of the impacts themselves and from the efforts to avert them indeed constitute major barriers for further economic growth. According to Heinberg this comes together with

> "[…] the financial disruptions due to the inability of our existing monetary, banking, and investment systems to adjust to both resource scarcity and soaring environmental costs — and their inability (in the context of a shrinking economy) to service the enormous piles of government and private debt that have being generated over the past couple of decades" (Heinberg, 2011 p. 02-03)

To Heinberg, an era of economic growth is coming to an end, and should come as no surprise (Ibidem p. 01). And as long as, at this moment, the growth-oriented mindset carries considerable weight on today's political, governmental and individual decision-making, and that we do not witness any sign of shift in it, we can thus expect to face continuous economic downturns. As under the current world order growth is necessary to maintain economic and social stability, as the "sole index of national well-being" (Heinberg, p. 06), the natural resources shortage is likely to be accompanied by escalating social inequalities and all the array of associated issues before things start to really change (Greer, 2008, Greer, 2009, Jackson, 2009, Gratton, 2011, Heinberg, 2011). As in the words of Charles Eisenstein:

> "Here is a certainty: the linear conversion of resources into waste is unsustainable on a finite planet. More unsustainable still is exponential growth, whether of resource use, money, or population (Eisenstein, 2011 p. 173)

Yet, there are two other unsustainable issues posed to the economics framework. One is the issue of externalized costs, which are the costs that someone else pays. This is what guarantees competitive advantage to enterprises and the endless number of cheap stuff, from food to goods on the market shelves. This is so because

much of the producers of cheap products that flows from one region to another — in much of the cases smashing local, or ecologically conceived practices and products — are not liable to pay the current and future costs of i.e. aquifer depletion, pesticide poisoning, soil salinization and other general social and ecological issues that are kept external to the price of goods. According to Eisenstein, "externalized costs render economical things that are actually uneconomical, such as deep-sea oil drilling and nuclear power (Eisenstein, 2011 p. 173-183)

The other issue also derives from the externalized costs and is on how to measure and or confer economic value to immaterial aspects of Nature and on the ecosystems services, including its aesthetical values and on existing local environmental knowledge (Hulme, 2008, Heinberg, 2011, Jackson, 2009). Furthermore — as mentioned before — by risking to value nature under the same humans-first value system, growth-mindset and commoditization of all things, we run the risk of ending up privatizing common assets like water, seeds and soil, and enhancing unequal access to it especially by poor people. This is indeed an ongoing reality with different levels of severity all throughout the world, where the intentions behind also lead to corruption, lack of accountability and responsibility, tyranny, loss of local agency and the weakening of general standards of quality (Alier, 2004).

In face of what this thesis considers staggering evidence, it seems we are approaching a *threshold, or an ecological turning point*[11], which no one can predict when or to what extent it will happen. In fact, it seems to be already happening all around us and it may constitute what Greer (2008, 2009), Heinberg (2011), Kunstler (2006), Holmgren (2009a), Hopkins (2008) and Eisenstein (2011) consider as the end of an entire era, and the beginning of the long descent of industrial civilization (Greer 2008).

[11]A threshold is defined here as a point between alternate regimes in ecological or social-ecological systems alike. When a threshold along a certain variable in a system is passed, the nature and extent of feedbacks change, such that there is a change in the direction in which the system moves. A shift occurs when internal processes of the system (rates of birth, mortality, growth, consumption, decomposition, leaching, etc.) have changed such that the variables that define the state of the system begin to change in a different direction, towards a different attractor. In some cases, crossing the threshold brings about a sudden, large and dramatic change in the responding variables, whilst in other cases the response in the state variables is continuous and more gradual (RESALLIANCE. 2004b).

There is fracturing between science and economics in respect to the course of action. On one hand, even in the face of the scientific limits to deal with complexity and unpredictability to expose the fully impacts of climate change, scientists have been warning that it is for real and is rapidly becoming at dangerous levels. On the other hand, the economics of growth can no longer explain, predict or protect human development. It is not the duty of science to say what to do; hence it belongs to the realm of the meanings we attribute to it. This, as stressed by Hulme, is another of the reasons on why we disagree about our ecological issues, as individuals and societies ascribe different values to activities, assets, constructs, and resources in many different ways (Hulme, 2009 p. 111).

Meanwhile, the myriad of complex and interweaving events unfolding behind this short explanation on the patterns leading to a common future are already exerting pressure over industrial civilization in such a way that the 21st century may be marked by major crises and collapses (Kunstler, 2006, Hopkins, 2008, Greer, 2008, Greer, 2009, Heinberg, 2011 p. 01). It all means that transition to an alternative culture may happen in a forcible manner, with or without a planned and creative response, in a chaotic manner and amidst major economic, energetic and food crises (Foster, 2001, Kunstler, 2006, Greer, 2008, Greer, 2009, Holmgren, 2009a, Hopkins, 2008, Hopkins, 2011, Gratton, 2011). Simply consider that

> "[a]s the population increases and economic growth unfolds, the world has to provide ever greater supplies of food, water, energy, and raw materials for industry. The earth, though, only has so much oil, so much coal, so much topsoil, and so on through the sprawling list of resources used by industrial society, and it can only absorb so much pollution before the natural systems that support the economy beginning to break down. Since these systems includes the weather patterns, nutrients cycles, and ecological interaction that produce food for people to eat, wood and other raw materials for them to use, and even the oxygen they breath, this is not a small matter" (Greer, p.05).

Given the three interconnected issues — peak-oil, climate change and the economy — it is necessary to understand that despite all human genius and technology there are clear physical limits for the current patterns of human development and living,

and all these limits have already been crossed. The totality of *ecological impacts of human living, burning of fossil fuels, extracting of raw resources, depletion of soils, deforestation, patterns of production that do compromise ecosystems and provoke generalized pollution, included in vital elements like water, air, our food, which has been causing massive loss of the biodiversity that sustain ecosystems soundness, has been growing at an accelerated pace.* From those three-exposed issues, the subsequent section addresses and proposes three possible scenarios for the near future.

5. THREE POSSIBLE SCENARIOS AS CLOSE AS 2025 AND A COMMON ENERGY-DESCENDING FUTURE: COLLAPSE, ADAPTATION OR EVOLUTION?

Following the patterns conducing to the proposed energy-descending future, there are three general scenarios that can be presented and discussed within the scope of this thesis. By adding insights from the work of Rob Hopkins (2008, 2011), David Holmgren (2009a, 2009b), John Greer (2008, 2009), James Howard Kunstler (2005) and also from the interweaving of the "five forces" — technology; globalization; demography and longevity; society; and natural resources — as proposed in the work of Lynda Gratton (Gratton, 2011 p. 14); these are the scenarios of *Adaptation, Collapse, and Evolution*. These scenarios are named according to the work of Rob Hopkins (2008) who has studied several other authors and resumed to these three general possibilities. However, they were also interweaved with all the above-presented patterns and authors to frame and deliver speculative scenarios that were explored to expose their possible consequences:

- The emerging threat of a *scenario of collapse* of the industrial civilization that we may face if we keep the current pace of exponential growth, pollution and depletion of natural resources and ecosystems.
- The *adaptation scenario* within which, to avoid collapse and to keep economic growth is one where we may try to orient ourselves towards major technological efforts and resource efficiency. It is characterized by shallow behaviour change and by the attempt to head us out of the threat without deviating sharply from the current status quo. Indeed this is the general mindset underlying the debate on sustainable development. This, in face of the current pace of human physical action over the biosphere (resources depletion, pollution and ecosystems health), is not a reliable option.
- In a third scenario, it is suggested that we can try to deeply understand the root causes and the extent of our ecological issues to consciously shift to a culture of deep ecological sustainability. Even though, this path will require a major shift in mindsets and the whole structural rearrangement on human patterns of living. It is also suggested that it will entail a major shift from

> anthropocentric worldviews, which are characterizing the debate on sustainable development, towards ecocentric worldviews where we do have a lot to learn from the dynamics of natural ecological systems to living accordingly. This is similar to the scenario that Hopkins (2008) has regarded as *Evolution* and Greer (2009) has named as the Ecotechnic Future.

They help to understand and to recognize the challenges ahead, to evaluate the possibilities, and to emphasize that an energy-descending scenario, and everything else involved in it, is not only an issue but is also rapidly becoming a major predicament which we need to cope with. The awareness of these general scenarios was also used during the empirical work in order to invite the participants to do the same reflection and to situate themselves amongst the circumstances that will be detailed on Part 3. In this Part 2, the scenarios will not be framed separately; instead they will be interweaved and discussed together. This is so because we cannot simply choose one of them and avoid the others. Due to the severity of the issues presented beforehand, we are likely to witness a sort of combination of the three (Hopkins, 2008, Holmgren, 2009).

Rob Hopkins departs from the interweaving aspects of peak oil and climate change to build scenarios within the context of what he has co-founded and named the Transition Movement. By assuming the energy-descent as a premise he became part of a movement of people working on the resituating of the living and of the economy from global to local settings where house-hold and communities are brought together to creatively participate in local decision-making to support the building of a low-carbon culture by exploring principles of permaculture, ecology and setting supportive networks for local business, food production, communal living, housing, and energy production. The Transition Network, as it became renowned, is a worldwide bottom up initiative to foster local low-carbon economies under collective envisioning (Hopkins, 2008, Hopkins, 2011, Pinkerton and Hopkins, 2009, Network, 2013).

David Holmgren is co-author of the term Permaculture and explores future scenarios as a way to demonstrate how communities can use them to adapt to climate change and peak oil. Like Hopkins, Holmgren explores the interweaving aspects of peak oil

and climate change to construct 4 possible energy-descent scenarios from a combination of either fast or slow decline of oil and either mild or severe climate change over the next 30 years. These are the *brown-tech and the green-tech scenarios, earth steward and lifeboats* (Holmgren, 2009a p. 88). The first two scenarios together are quite similar to Hopkins "adaptation scenario". The table below contains a summary from Holmgren scenarios that are useful to compare and enrich possible narratives with the three others that are about to be discussed.

Table 1 -Four possible scenarios from David Holmgren (2009) Future scenarios

SCENARIO	Energy and agriculture	Settlement, Form and Mobility	Economy and Money	Politics	Gender	Culture and Spirituality
Brown-Tech: Top down Constriction	Centralized power, high-tech efficiency. Nonconventional oil, gas, coal, nuclear, Bio-shelter agriculture	High-density cities, electric private transportation, hinterland abandonment, mass migration	National banks and currencies	Nationalism/fascist, Class structure and rights, price rationing, population control	Male dominated and blended	Super rationalist and fundamentalist dichotomy
Green-tech, distributed power-down	Distributed network, conservation, gas, wind, solar, forest, organic agriculture	Compact tows and small cities, electric public transportation, telecommuting	Regional currencies and food	City state e hinterland, Markets/Rationing, Democracy	Balanced and blended	Humanist/eco-rationalist
Earth Steward: bottom-up rebuild	Distributed local hydro, methane, industrial salvage, forest, organic and garden agriculture	Ruralisation of suburbia, rural resettlement, minimal mobility	Local currency, barter	Town and bioregion, participatory democracy? Neo feudalism	Female dominated and gendered	Earth spirituality
Lifeboats: Civilization Triage	Distributed local, forest, rangeland, industrial salvage, oasis agriculture	Hamlet and gated communities, nomads	Household e barter, precious metals	Feudal system, patriarchal authority	Male dominated and gendered	Warrior cult

John Michael Greer is author of several books and various articles on the subject of peak-oil and the future of industrial society. Two were the books used in this thesis to complement the present scenarios. On the "The Long Descent" (2008) he exposes a study on the patterns followed rise and fall of past human civilizations to identify the common ones with industrial civilization. Also, by interweaving together several aspects of our modern civilization, Greer does support that we are heading to what he has named "The Long Descent of Industrial Civilization"; and explores possible ways on this major path of transition. In his book 'The Ecotechnic Future' (2009) Greer deepens the possible paths and possible scenarios in his proposed transition, exploring a range of alternative scenarios on how life could be through the "long

descent". Greer supports that with insights from ecology, people could manage to adapt to the challenges in what he has proposed as the Ecotechnic future.

Professor Lynda Gratton explores how the *five forces of Technology, Globalization, Society, Demography and Energy* are driving our future and especially the future of work (Gratton, 2011). Gratton's work is based on the London School of Economics and involves a research consortium of 200 people, members of 45 different companies from around the world that aim at creating a picture of the future of work. By making use of interviews and 2025 day-in-a-life stories she has managed to assemble several different versions on how the future of the work would be. In her research the *Five Forces* driving the future of work are interweaved according to the needs of a low carbon economy, rapid advancements in technology, an increased globalization, profound changes in longevity and demography, and important societal changes that together will fundamentally change much of what we take for granted about work.

Richard Heinberg is the author of several books on the economics of transition throughout this energy-descending scenario. By relating it to fundamental aspects of peak-oil and climate change and by examining conceptual aspects of the economy, Heinberg came to support that we are living what he has named the *End of Growth* (2011). He proposes the rebuilding of the economy in the context of the culture of transition as proposed by Hopkins. Similarly to Heinberg, Professor Tim Jackson's *Prosperity Without Growth* (2009) analyzes the economy to also support that the faith in economic growth is not possible anymore and that it is necessary to discuss and to prospect possibilities of fostering prosperity without material growth. Both are supportive of the idea that traditional economics are failing by regarding Nature as a subset of economy.

James Howard Kunstler's *Long Emergency* (2006) departs from the same premises of peak oil and climate change but is by far the most negativistic. While all the other authors come up with possibilities to explore the descent or to overcome the negativistic scenarios, Kunstler builds a broader scenario where he supports that there will be a catastrophic time gap among the consequences of peak oil and climate change and the emergence of a new culture, which will take to the drastic

draw-back of human presence on earth. Indeed, Kunstler's work analyzes the collapse of the industrial civilization and raises the possibility of a new dark age.

The scenarios of Adaptation, Collapse, or Evolution are therefore three speculative ones within the context of an energy-descending future. Despite using Hopkins designations, they were written as a way of gathering insight from all the above-authors. These are to be used as thought starters to debate possibilities about a future with less energy within design domains. The year 2025 was used as a reference as it is expected to be in this decade, according to some of the scenarios approached by Gratton (2011) that the issues of peak-oil and climate change are to become part of the day-to-day of European citizens. This may mean soaring energy prices that will affect the whole economy, the productive system, extreme weather events like fierce storms, floods and harsh winters and summers that will do the same. The denoting of 2025 brings with it a necessary sense of urgency and the idea that the future is already here. From this we can take the first steps towards discussing what comes after growth: Collapse, Adaptation, or evolution?

Adaptation, that is also described by Holmgren (2009) as *Technological Explosion* and/or *Technological Stability*— that are the equivalent of the first two scenarios in table 1 —are characterized by a prevalent anthropocentric mindset within which we assume we can somehow draw ourselves out of trouble by relying on technology. This is described by Hopkins (2009), and referred to in the Club of Rome Report *Limits to Grow* (Hulme, 2009, Greer, 2008, Heinberg, 2011), as a major *business as usual* approach in which we assume we will not deviate sharply from the present pro-growth mindset. Also, as was exposed before, the pro-growth mindset is present even in the most pessimistic reports of the IPCC and permeates the imaginary behind the sustainable development debate.

The general assumption in these cases is that adaptation of peak oil and climate change will happen in a slower but steady pace in which there will be no need to move from our current comfort zone, nor shift the status quo and that the only change in behavior required is sustainable development and resource efficiency followed by a gradual shift in the type ofenergy sources fueling the system. The adaptation scenario therefore does not question ethics, value systems, nor does it

question the underlying belief in endless economic growth (Jackson, 2009, Heinberg, 2011, Alier, 2004).

On the other hand, as was stated by David Holmgren and supported by all the above-mentioned authors and as previously stated in the item on peak-oil, contrary to the energy transitions since the industrial revolution:

> "There is a huge body of evidence that the next energy transition will not follow the pattern of recent centuries to more concentrated and powerful sources" (Holmgren, 2009a p. 12)

Therefore, as long as the prevailing mindset is set to adapt to finding ways of keeping society organized around economic growth, a transition towards what has been termed *sustainable development* is not likely to be the smooth or steady course of action expected. Deeper degrees of adaptation will be necessary in any sort of scenario with less energy available. However, it is important to explain that the term *Adaptation,* as is used here to refer to the shallow move towards *sustainable development.* This means *an adaptation to keep the status quo while for all the above-exposed reasons, it is the thought of this thesis that more than just a certain degree of adaptation but a whole transmutation of human thought will be necessary to cope with the unfolding events.*

To John Michael Greer (2008) this confidence in technology is rooted in the western worldview that still behaves by framing the whole situation as a "problem" to be solved. To Greer, it has reached a *no returning point* and is in fact a "predicament" with which we have to live. As he remarks, a problem calls for a solution and once it is found the problem is solved.

> "A predicament, by contrast, has no solution. Faced with a predicament, people come up with responses. Those responses may succeed, they may fail, or they may fall somewhere in between, but none of them "solve" the predicament, in the sense that none of them makes it go away" (Greer, 2008 p. 22).

The predicament — or the *condition* — of human living is due to the ecological limits set by the biosphere and the one of human participation on such life-maintaining

dynamics. Both of these are delaying in becoming epistemologically recognized. However, according to Greer (2011), it is therefore relevant to this debate to understand that in the last three hundred years, we have witnessed a shift in the way some basic factors of human life have been conceptualized. Complementary to the explanations from philosopher Luc Ferry which have been introduced above, it is since the beginning of the industrial revolution that the *human condition* has been reframed as a set of problems to be solved:

> "Our culture's mythology of progress envisions the goal of civilization as a utopian state in which poverty, illness, death, and every other aspect of the human predicament has been converted into a problem to be solved by technology" (Greer, 2008 p. 23).

> "The irony of the current crises is that a civilization that tried to turn all its predicaments into problems has ended up confronted with problems that, after being ignored too long, turned into predicaments" (Ibidem p. 34).

It is illustrated in Hulme's explanation and example:

> "Climate change is not a problem that can be solved in the sense that, for example, technical and political resources were mobilized to 'solve' the problem of stratospheric ozone depletion. We need to approach the idea of climate change from different vantage point. We need to reveal the creative psychological, spiritual and ethical work that climate change can do and is doing for us. By understanding the ways in which climate change connects with these foundational human attributes we open up a way of resituating culture and the human spirit at the heart of our understanding of climate. Human beings are more than material objects, and climate is more than a physical entity. Rather than catalyzing disagreements about how, when and where to tackle climate change, the idea of climate change is an imaginative resource around which our collective and personal identities and projects can and should, take shape" (Hulme, 2009 p. xxxviii).

These come to contrast with *cradle-to-cradle* and *natural capitalism* propositions, or the general debate on sustainable development that seems to not recognize or to accept that the issues of our sustainability are fully born out of a whole cultural context. Even though, the majority of the debate has been limited to its material and

technological aspects, all the issues exposed so far in Part 1 are not a novelty. However, many of its key aspects, such as globalization, economic growth and consumerism, extravagant lifestyles, unequal access and distribution to common wealth and resources, and so on, still show no signs of change. Considering all the above, at this moment, the possibility of a scenario of *adaptation* supported mainly by the belief in high technology is not at all possible. Not at least without soaring social inequalities and a high ecological price to pay that can exert a rebound effect (Gottron, 2001). The war effort necessary to promote a whole technological shift can bring devastating economic, social, geo-political and ecological consequences that can condemn millions of people to extreme poverty, wars and to make human living unviable, at least in a great part of the planet.

Arguably, it all may lead to general visions of *Collapse*, or "*default futures"* as the term used by Gratton (2011) to express the inaction in face of the present situation. A collapse means that in a certain moment of this century, all the systems supporting the current industrial society fails at a fast pace and without alternative plans, thus setting ourselves amidst generalized resource shortage, social unrest, martial law, civil wars, famine and so on (Kunstler, 2006; Hopkins, 2008; Holmgren, 2009a). Collapse is the kind of scenario that is likely to happen because of human inaction or the excess over ecosystems. Collapse may also become imminent as long as humanness keeps attempting to run many aspects of the *business as usual* approach for as long as possible. Within which, nations and/or regions may exert major efforts to retain as many strategic resources as possible (such as oil, minerals, land), which may lead to belligerent disputes. No one wants to live such a scenario. But they are plausible and one cannot ensure that at least in part that they will not happen. Furthermore, several aspects of collapse scenarios are already erupting everywhere/all over the planet such as the wars promoted for oil and other energy sources, climate and ecological disasters (Kunstler, 2006, Foster, 2001, Alier, 2004). However, in that which concerns the attempt to bring people together, there is a great deal of negative psychological consequence and denial when trying to engage people purely from that perspective (Hopkins, 2008).

Even when one considers an *Evolution* scenario, the situation is also not as linear as it seems. According to John Michael Greer (2008), at this moment,

> "our civilization is in the early stages of the same curve of decline and fall that so many others have followed before it, and the crises of the present — peak oil, global warming and the like — are the current versions of the historical patterns of ecological dysfunction (Ibidem p. 31)"

And in regards to possible scenario developments,

> "[a] controlled, creative transition to sustainability might have been possible if the promising beginnings of the 1970s had been followed up in the 1980s and 1990s. That didn´t happen and now we have to live with the consequences" (Ibidem p. 24).

> "At this point it's almost certainly too late to manage a transition to sustainability on a global or national scale, even if the political will to attempt it existed — which it clearly does not. It is not too late though, for individuals, groups, and communities to make that transition themselves, and to do what they can to preserve essential cultural and practical knowledge for the future" (Ibidem p.30).

> "The more sustainable, stable and effective these transitional structures are, the more people, technology, knowledge, and culture will make it through the couple of centuries that this whole process will take" (Ibidem p. 34).

Therefore, while an adaptation scenario does not consider that we are already heading towards a context where major structural shifts will take place, the *evolution scenario* departs from that recognition to discuss and promote a transition to a post carbon economy where the restructuring of living and the resituating of the economy within local scales are the norm.

Rob Hopkins advocates the hypothesis that it is still possible to create "national concerted action plans" to break away from the dependence from fossil fuels to prepare to what he has named "*evolution scenario"* (Hopkins, 2008 p. 45). He departs from his work on the proposition of a *transition culture* that emerges from the grassroots *Transition Movement.* Despite advocating for national scale plans, the fact is that the Transition Movement has been successfully making it at the scale of the "transitional structures" as above suggested by Greer (2008) that is the one of the

family household, citizens' initiatives in neighborhoods or small scaled cities and other intentional ecological communities.

Evolution scenarios are essentially different from the adaptation ones. While in the context of *adaptation scenarios* the approach to the ecological issues is top down, relying on political will, government authority, global protocols, policy–making, and situating the debate mainly at global and/or institutional level; within *evolution scenarios*, the approach is to be bottom-up and participative. The suggested scale is thus the one of the individual or small groups of people where the norm in general is to situate the global ecological issues at a local level, hence in the context of people's understanding. It is a major move from the larger complex system to the manageability of local and less complex systems.

Within an energy-descending scenario this makes sense to the extent urban conglomerates such as bigger cities, or mega-city regions for instance, are complex systems, largely dependent on external resources and relying on an outbreak energy consumption to be sustained. The bigger and more complex they are, the harder it is to attain a picture of the whole system within the scope of one's understandings, and the harder it is to deal with traditional centralized networks of political, institutional, and economic power (Meadows, 2009).

Even if the *evolution scenario* takes advantage by planning ahead, the situation remains complex and hard to accept as it does entail dissolution of much of what we take for granted about the economy, wealth, well-being, development, ecology and so on. An evolution scenario means that we have to review our concepts and worldviews — which does entail a whole transmutation in human thinking. It goes beyond the material and technological transitions to assuming the need for inner spiritual transitions of the self. And scenarios like this are therefore about to constitute self-supporting communities able to empower people for both the dimensions of thought and action. Therefore, as in Hopkins words, an evolution scenario

> "[…] require a degree of collective evolution, a change of mindset, but which assume that society, albeit in a low-energy, more localized form, will retain its coherence" (Hopkins, 2008 p. 45).

Yet, whatever the scenario, most of the above-authors emphasize that, given the pace and extent of the events, it may always be accompanied by a major structural collapses of the existing economic and industrial system. Even if much of the economic activity ended, we would still suffer major ecological and social consequences. This is pretty much a feature of a living system: The whole of Planet Earth.

According to Meadows (2009) a living system, when suffering some sort of external or internal pressure, has a variable lag in responding to certain behavior according to its structure, feedbacks, and the magnitude of the pressure — See also Part 2. Therefore, even when the force/event exerting pressure ceases to act, it still keeps behaving in a certain way or direction. The direction the system may assume has to do with its own structure and cannot be predicted— e.g. the rise in temperature average because of climate change is not a prediction, it is the recognition of an event already happening due to past causes. Climate change predictions are forecasts generated by computer models and are limited. However, anthropocentric climate change is already happening — see also David Hulme (2009) for this discussion. However, in that which regards what has been exposed so far, there are four important things about systems delays to bear in mind (Meadows, 2009 p. 104):

- The delay in retooling a production stream — Industrial civilization has its entire structure of production based on fossil fuels.
- The delay between pollution emission and the diffusion or percolation or concentration of the pollutant in the ecosystem to the point where it does harm. It means today's effects are the result of past events. Today's events will result in future and unpredictable effects
- The delay in changing social norms' range is of generations — living systems are naturally conservative
- Overshoots, oscillations, and collapses are always caused by delays.

The impacts of industrial civilization over the whole biosphere are delays that are decades long — human fossil fuel emissions have already introduced changes in climate that will not be fully revealed for a generation or two. This is why every new scientific assessment over the climate comes up with worse predictions than the

previous ones. This is why we will not remain below the safety average temperatures agreed on intergovernmental panels. Hence we are already living climate change and we may experience shifts in weather patterns that will seriously affect and provoke changes on the earth's bioregions[12].

Despite the scientific community having realized this and that global efforts are being negotiated to reduce emissions and other forms of pollutions, the fact is that emerging regulation has been paying a lip service to ecosystems and both causes and consequences of global issues are still rising (IPCC, 2007).

In the worst cases scenarios and in face of major energy shortages, governments all around the world shall drastically cut and control the individual use of energy and other natural resources such as water and minerals. It will reduce people's capability of commuting, for instance, which may be accompanied by the decreasing of industrial activity, drastic reduction of consumption, economic downturn, disruption of public transportation and food systems and in the end, the urgent need to decrease the complexity in human systems and turn the attention towards more localized ways of life in a forcible manner(Hopkins, 2008, Hopkins, 2011, Holmgren, 2009b, Holmgren, 2009a, Gratton, 2011, Greer, 2008, Greer, 2009).Therefore, the transition to sustainability would happen in a disordered manner with side collapses that would make it difficult. According to Greer, whatever the case is,

> "[an] entire world of infrastructure and technology would have to be replaced in a hurry, and the components for a new low-energy society are not simply sitting on a shelf somewhere waiting to be used. Meanwhile, industrial civilization goes on consuming irreplaceable resources at alarming rates and any slowdown in consumption leads governments and business interests alike to cry for immediate remedies to speed the economy back up. It is hard to think of a better recipe for a different future" (Greer, 2009 p. 15)

It all tends to aggravate with the globalization of a technological monoculture that has been superposing local cultural and agricultural practices. In face all that has

[12] Bioregion is an area constituting a natural ecological community with intrinsic characteristics, bounded by natural borders. Bioregion connects with the idea of bioregionalism, which considers that a certain bioregion can determine, or be determined by cultural phenomenon to emphasize the sensibilities of place like the local wisdom and its synergies with the environment.

been presented so far, the thesis does support that we are heading to a future where considerably less energy, biological diversity and natural resources will be available. It all will represent deep structural changes in our general patterns of living at different levels and scales according to countries and regions general capability to cope. It will lead us all from our comfort zones and the difference between a conscious or traumatic transition may rely on the pace we recognize and assume the seriousness of the situation.

All the above has been resumed to express a short world status scenario, which is the context to be considered in the subsequent chapters:

Table 2– World's ecological status

The current predominant cultural worldview is a humans-first value system that does not recognize the intrinsic worth of all beings neither our intrinsic participation in the dynamics of living system. It separates individuals from the collective and humanness from Nature. This mode of thinking, seeing and relating with the world is the root cause of our sustainable issues. As a circumstance, local and worldwide-globalized living has been unfolding based on an imaginary of economic material growth that is detached from the dynamics and the limits of ecological systems. It considers nature as a subset of the economy when it is precisely the contrary — we, human beings, are in nature first and foremost and it is the setting of all our social relationships. Hence, the economy is a subset of our ecological relationships. The widespread understanding of the economy and our structures of production have been limited to a matter of financial issues and adjustments. In light of the awareness of our essential participation in the dynamics of ecological systems, such a single mindset can no longer explain, predict or protect human prosperity. Beyond a way of thinking, our current cultural way of life is fruit of a constant improvement of the energetic resources fuelling the system, from wood to steam, to coal and to oil. This has led to continuous material and technological improvement in people's lifestyles, generation after generation. However it has also contributed in dissimulating the future of energy, climate change and other ecological issues to the point they are now becoming globally perceptible and threatening the environmental conditions that support industrial civilization. It challenges the current structures of production and profit that do support consumerist culture.

As the world population grows and more and more countries are adopting the same developmental patterns with the demand for technology and material growth, pressure on natural resources has been growing toward unprecedented levels to the point that we are witnessing the “peak of everything”. It means we are peaking all the natural resources supporting the ever-increasing globalized economic/cultural system.

As many of the natural resources feeding and fuelling it are non-renewable and already exploited way beyond their biologically regenerative capacity —such as the fossil fuels (oil, coal, gas) and other minerals, the fishery stocks, potable water, agricultural soils, and ecosystems, plus, all sorts of contamination and pollution; on to of this the access to them is exploitative, unequal and not guaranteed for all. For these reasons, we may not be able to substitute the structure that supports our current patterns of living at the same pace as current demands are growing.

Oil, for instance, does support all the modern human economic/productive systems ranging from the entire food system, the extraction, production and transportation of goods, technology, energy, public transportation, and settlements. The oil-based economy is what has made possible many other cultural aspects such as formal learning and training settings, and services.

Oil is not likely to be replaced by any other existent source of energy to the same extent it permeates and supports the current expression of the industrial/materialistic/technological culture. The existing technology able to transform diffuse sources of energy like wind and sun are dependent on oil and other fast depleting resources.

The ascent of values like individualism, acquisitiveness, competitiveness, great specialization, monocultural globalization to the detriment of local wisdom, personal abilities, social, moral, aesthetical, ecological and even spiritual values, and immaterial well-being — weaved together with all sorts of environmental degradation — are increasing all sorts of illnesses and disorders of mind and body and extinguishing valuable cultural practices that can help people to, for instance, rebuild connections with land and root based agricultural practices.

At the same time, social institutions, as well as educational systems and schooling are organized under the same worldview that does support economic growth as the barometer of prosperity and wellbeing. Therefore, it pervades and retro feeds the social system´s organizational and structural aspects. As a system runs itself on feedback loops, the cultural

aspects, social systems of values, beliefs, ideas and practices are likely to be organized to respond to the current systemic structural organization in such a way that deep structural changes that are necessary for a culture of deep ecological sustainability are likely to take a long time to happen.

Indeed all the above-stated is already an ongoing reality all around the world as humanness is already using natural resources way beyond ecosystems' carrying capacity.

These altogether increasing human impacts on ecosystems dynamics and health, and the belief and discourse on endless economic growth is no longer possible and the current organizational and structural aspects of materialistic and technological culture may abruptly change in the next few decades causing and deepening continuous economic crises, disruptions, and all sorts of social disintegration, inequalities, climate refugees, famine, violence, and belligerent disputes for resources — these are ongoing realities in African, Asian and South American continents that may well spread all-over the northern hemisphere alike.

Both the current general socio-political imaginaries and the discourse on sustainable development rely upon an imminent technological future that will lead us out of trouble. For all the above reasons (the peaking of everything, plus population growth, growing consumption and the growing demand on technology and consequently on natural resources) this is not likely to happen. Not at least without great social inequality and a high ecological price to pay. This is already being charged.

Even recognizing that these are general evolving patterns and with the awareness that a specific future cannot be predicted at all, these are major ongoing evidences that when related together lead to support the idea that we are positioning ourselves in the imminence of an unexpected energy-descending future. Also, that the current debate on sustainability has remained a shallow one, held under the same fragmentary mindset that created it in the first place. We are putting aside all the immaterial cultural aspects of our concepts, beliefs, value systems, intentions, aspirations and even emotions, permeating human living. We are not questioning established social structures, power relationships, and cultural practices like consumption values and knowledge production systems that does nothing more than support industrial culture

6. PART 1 CONCLUSIONS

All the economic growth experienced after the first oil crises since the decade of the 1970s until the present have come to hide and postpone the energy issues humanity was awakening to. New oil wells, fast pace industrialization of developing countries, vertiginous technological advancements, neo-liberalism and globalization have obfuscated the ecological impacts of industrial civilization so far: Climate change, energetic issues and the peaking of natural resources, generalized pollution, contamination of water, air and soils. In addition to an accelerated process of mass extinction, where of the earth's estimated 10 million species, more than 300,000 have vanished in the past fifty years and it is estimated that in one hundred years between one-third and two-thirds of all birds, animals, plants and other species will be lost (Kunstler, p. 08).

Under a humans-first value system such statements may be meaningless. On the other hand, if a deep ecological perspective is cultivated and our intrinsic belonging to the web of life is observed, then, we will understand that under our arrogant patterns of relating with Nature we are indeed threatening the very possibility of a soundness existence.

Soundness human living does require soundness ecosystems that are way beyond a managerial and objectivist problem-solving agenda. Rather than a discussion about the limits natural ecosystems can handle and attempts at engineering them, it is much more about valuing what is left, to observe, interact and rise up to promote broad systemic health.

Yet, if on the one hand, these pragmatic predictive scenarios pose limits to human material growth and place us in front of a void by dissolving much of what we take for granted about wellbeing until now, or what and why we design. On the other hand, it is still possible, within the emerging ecological awareness — that is as scientific as it is empirical, mundane and exoteric — to co-create scenarios that are both viable and desirable. There is a lot to be done and despite the imminence of collapse that the theme exposed so far may pose to the reader, there are a vast

amount of imaginaries to inspire us, as the one proposed by the philosopher Charles Eisenstein (2011). In Sacred Economics he explores that predominant duality of human thought to expose new possibilities from which is initially explained as a crisis of separation. However, he explains, this is not an ultimate reality, but a human projection, an ideology, a story. Since that a new world relies on a gentle shift of mindset:

> "The present convergence of crises — in money, energy, education, health, water soil, climate, politics, the environment, and more — is a birth crisis, expelling us from the old world into the new. Unavoidably, these crises invade our personal lives, our world falls apart, and we too are born into a new world, a new identity. This is why so many people sense a spiritual dimension to the planetary crisis, even to the economic crisis. We sense that "normal" isn´t coming back, that we are being born into a new normal: a new kind of society, a new relationship to the Earth, a new experience of being human."(Ibidem, p. xx)

> "In a world without weapons, without McMansions in sprawling suburbs, without mountains of unnecessary packaging, without giant mechanized monofarms, without energy-hogging big-box stores, without electronic billboards, without endless piles of throwaway junk, without overconsumption of consumer goods no one really needs an impoverished world. I disagree with those environmentalists who say we are going to make do with less. In fact, we are going to make do with more: more beauty, more community, more fulfillment, more art, more music, and material objects that are fewer in number but superior in utility and aesthetics" (Ibidem, p.27-28)

What follows in the subsequent Parts of this thesis is an attempt to get to know the dynamics of living systems and of our intrinsic participation in them, to approach and situate design within this inner world of thought, senses, aims and ambitions behind this major transition.

PART 2. THE PROCESS OF BUILDING DEEP UNDERSTANDING OF OUR ECOLOGICAL BEING

1. INTRODUCTION TO AN ECOSOPHY D.1

Once introduced an energy-descending scenario as the thesis' broader situation, Part 2 aims to build a theoretical understanding of individual's general participation within the dynamics of ecological systems and to then extend it to design domains. Hence, this is a theoretical situation of design within an ecological perspective that — using the term proposed by Arne Naess (2008) — constitutes an *ecosophy*. This is basically an attempt to compose a holistic framework that can help people, especially designers, to overcome the dualist act of thinking of reality in which things, objects and events are regarded as being separate and self-existent and to be able to situate their designs differently.

It is not the intention of this thesis to constitute a unifying basis for design or even a holistic explanation of things as absolute knowledge to be followed. On the contrary it is a single contribution for further discussion to propose the adoption of ecological principles as the necessary core ethos of design practice in face of the issues presented in Part 1. In other words, the intention is to support designers to reflect and constitute their personal frameworks in face of what is proposed here. Also, as will be developed in this Part 2 and on the subsequent Parts, it shall entail to surpass the limits of theoretical understanding to consciously participate on the dynamics underlying our individual existence.

A possible way to explain the effort contained in this Part can be encountered in the term *ecosophy* coined by the ecologist Arne Naess (2008) which means a philosophy of living, or rather, ecological harmony, a total view where it would be possible to have a sense of belonging. This is not a definitive knowledge but an ever-evolving worldview made out of one's life experiences and that is always subject to feedback, questioning and evolution along one's life recurrent interactions. Ecosophy, according to Naess' explanation is "Earth's Household", a philosophical worldview "inspired by the conditions of life in the ecosphere" (cited in Drengson, 2008 p. 32)

that is therefore desired to be fluid and open to ongoing transformation, curiosity and to the novel and the unexpected.

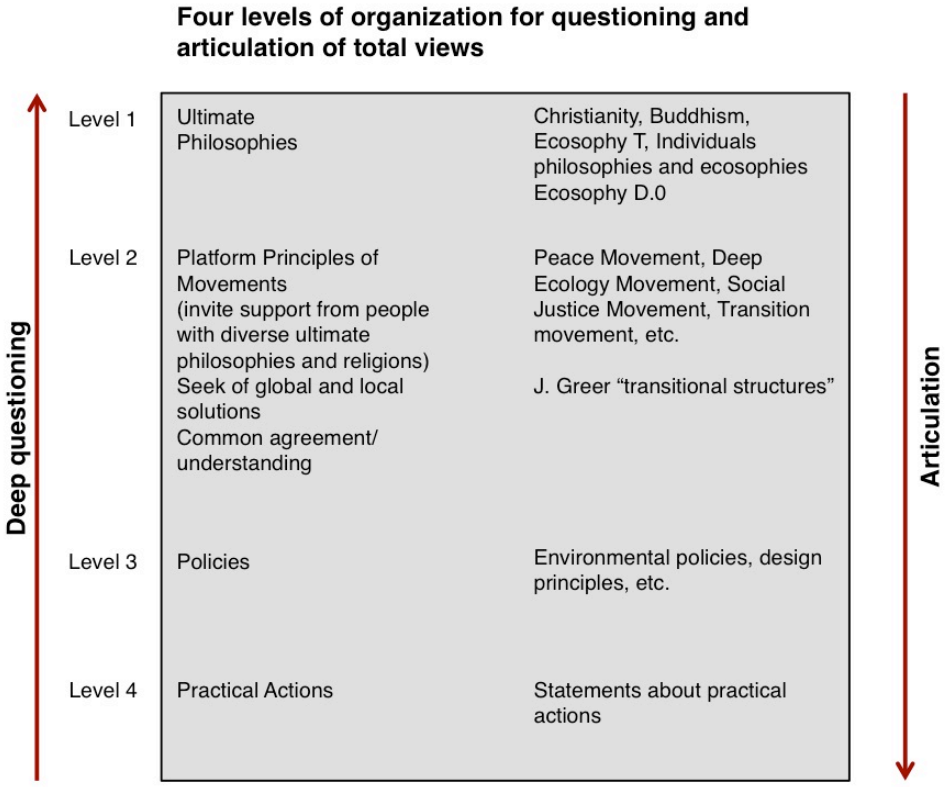


Figure 2 - Articulation of total views after Drengson (2008, p. 33)

As has been explained by Drengson (2008), it is the philosophical grounding for acceptance of platforms of principles. These platforms are domains that unite diverse people with different worldviews to build certain cultural settings, ethics and belief systems, in certain places according to certain principles (Drengson, 2008 p. 32). The above diagram was adapted from Drengson and represents some possible articulations of an individual's total views, possible questionings and practical actions. In which level 1 is the people's ultimate worldviews, and no matter how ultimate they may be, they are still subject to deeper questioning. At the same time, they are the underlying principles for further articulations in different levels of one's social/ecological participation. Level 2 is the platform for social participation and the building of networks of mutual trust – the more diverse they are, the greater and richer they become. As will be supported in the subsequent sections Designers are especially important at this level for their capacity to become activators, facilitators and integrators of people and their total views, in order to build the platforms for ecological living. Level 3 and 4 are those of practical articulation, application and

review of underlying principles like policymaking and ecological principles for design, which function as a guide for practical actions.

The proposition of an ecosophy does connect to Professor Tomás Maldonado's ideas that have been exposed by Victor Margolin (Margolin, 2007 p. 04-05), in which he does support that designers are required to set their own agendas so as to play a major role in the processes of social change. This is further corroborated in Drengson's explanation of ecosophies:

> "We do not have to wait for the experts and mainstream organizations in order to act on our own. We each can do something of long-term importance on a regular basis, starting today. Many people and groups are developing their personal ecosophy as their way to live richly in harmony with others and the natural world. There is a diversity of ecosophies that reflects the individual and ecological diversity of the self-organizing creative powers found in people and other beings everywhere. We are more effective when we have a sense of wholeness through an integrated total view" (Drengson, 2008 p. 39).

To constitute an ecosophy is a dynamic way to see and relate with the world, to question and to explore alternatives to scientific influential rationalism and the human-first value system that conceptualize certain world, its existing discourses and cultural artefacts. This idea is deeply connected and further supported later in Part 2 with Antonovsk's concept of Salutogenese, as a possible basis to understand that the cultivation of a total view is the domain to nurture a "sense of coherence" (Antonovsk, 1996 p. 15). In fact, this thesis' entire emerging philosophical framework is the designer/researcher's ecosophy: This is the Ecosophy D.1.

2. BUILDING AN ECOLOGICAL LITERACY: DEPARTING FROM THE SANTIAGO THEORY OF COGNITION

2.1. INTRODUCTION AND PART 2 OVERVIEW

The work of the Chilean biologists Humberto Maturana and Francisco Varela, "*The Three of Knowledge, the biological roots of human understanding*" (1984), also known as the *Santiago Theory of Cognition*, constitutes a systemic understanding of life that situates human living within the ecological dynamics of living systems. A living system is a self-generative network and its identity is built and conserved in the totality of its systemic relationships, that is, among the organism and the medium of its existence (Maturana, 1988, Maturana, 1997, Maturana, 2002, Maturana and Varela, 1984, Maturana and Verden-Zoller, 1996).

In short, the idea implicit here is that as long as we are biological beings, we are also biophysically interdependent with the medium of our existence. It involves other people, cultures and their objects, other living beings and physical elements such as air, water, soil and plants, hence the whole community of life on Planet Earth. Human social and cultural world is interdependent with the planetary biosphere. It is in living and doing things together that we are learning and reasoning through language, emotions and senses and bringing forth a world.

The Santiago theory presents the idea that the process of knowing is inherent to the process of life and this is common to all living system: A living systems will always know how to live in any set of circumstances where it finds itself in (Maturana and Varela, 1984). Other Biologist, Gregory Bateson (2000a), has developed similar ideas in a series of essays that were arranged together as the *Steps to an Ecology of Mind,* originally published in 1972, where he improved the criteria of mental processes providing explanations that the human mind is also fruit of broader ecological relationships intrinsic to the living of the individual. However, as both the title of his book and the foreword of the edition published in 2000 made clear, he has remained focused on the dynamics of human mind, never extending or promoting a unifying theory of living (Bateson, 2000a, Bateson, 2000b).

Initially, Maturana's original purpose was to generate a mechanism to explain the ecology of life encompassing mind, matter and the living to provide an explanation that was aimed to clarify the understanding that the domain of human existence is Nature as a whole. For this reason, the attention has been focused on the Santiago theory and on the later explanations of Maturana in the "Ontology of Observing" (1988) and the "Biology of Love" with Gerda Verden-Zoller (1996). Complementarily, it also received support in the work that the physicist Fritjof Capra (2002) has developed to promote further understandings of Maturana's explanation on the relationship of the biological, cognitive and social dimensions of life and the importance of such awareness to undertake the issues of our time. These are complemented by insights from Donella Meadows (2009) on living systems, and by the Physicist David Bohn (Bohm, 1980) and Dr Malcolm Hollick (2006) on the subjects of living systems and holism.

The thesis departs from such ecological understanding to situate design within. Beginning with the proposition of the idea of design as the expression of doing things together in section 3 of Part 2: The Biological Foundations of Culture and Design. What follows is the exploration and deepening of such an ecological idea of design following a hypothesized three steps framework for designers to become ecologically literate and to overcome the energy-descending scenarios: The building of ecological literacy, getting inspiration from ecological lexicons, and engaging in ecological thinking. It is further explored on subsequent sections by reviewing other explanations and ecological perspectives for design. It derives from the Work of Professor David Orr, the emerging work from the realm of the Centre for the Study of Natural Design (CSND), mainly with the works of Dr Daniel Wahl (2006) and Dr Gonzalo Salazar Preece (2011). Finally, inspired on the work of Dr Elizabeth Sanders and Dr Sandra Jovchelovitch, a connection of the theoretical understanding of design is promoted as a co-creative relational domain able to foster deep ecological sustainability. Such understanding was fully explored and reviewed with a series of workshops with the schools of the Municipality of Torres Novas to be approached in Part 3.

Yet, before going on, it is important to state why such importance and exposure has been given to Maturana's ideas in such depth in this design thesis. This is so because

it promotes a conceptual understanding of our intrinsic participation in the dynamics of ecological systems. It may introduce designers to a sort of initial understanding of living systems and, above all, it allows promoting fundamental connections to situate design within and also to reflect on how design emerges along human living and doing things together.

2.2. A CONCEPTUAL SHIFT

The central insight of Maturana, as is remarked by Capra, is that "cognition is not a representation of an external world, but rather a bringing forth of the world through the process of living itself" (Capra, 2002 p.37). Cognition, that is the process of knowing, is therefore an embodied ongoing phenomena which happens in recursive interactions in living and doing things together in the domain of one's existence (Maturana, 1988, Maturana, 1997, Maturana, 2002, Maturana and Varela, 1984, Maturana and Verden-Zoller, 1996).

In 1965 when studying the colour vision of pigeons, Maturana (2002) proposed an ontological and epistemological shift from the essence of what is observed to "how do I do what I do as an observer in observing?" — According to him to make this change meant to change the question from "the being" to the question that asks about "the doing" and to *abandon the notion that there was an external independent world to be known by the observer*. Since that his central theme of concern

> [...]"became the explanation of the experience of cognition rather than reality, because reality is an explanatory notion invented to explain the experience of cognition" (Maturana, 2002p. 05).

Such a conceptual shift has entailed to explain cognition as a biological embodied experience and to understand how these processes are rooted in the totality of the living being and its interactions (Maturana and Varela, 1984, Maturana, 1988, Maturana, 2002). Moreover, when studying human actions emerging from knowing, his claim was that every cognitive experience includes a subject who knows and their biological structure: The one who knows is "blind" to other individuals knowing, which is only surpassed in living and doing things together in the world we bring forth in the intersubjective domains of social living (Maturana and Varela, 1984 p.

22). Therefore, cognition — the mental process of knowing — is an embodied phenomenon.

2.3. LIVING SYSTEMS

To understand cognition as an embodied phenomenon requires an understanding of the constitution and operation of living systems, which was adopted by Maturana as the scientific mechanism to support his explanations: *Living systems are self-generative and structured determined systems constituted by a dynamic network of processes in closed networks of interactions, recursively reproducing itself in a continuous network of relationships with the environment, time after time, specifying its extension and boundaries that separate it as an autonomous operational entity* (Maturana and Varela, 1984, Maturana 1988, Maturana 2002).

Living systems are organized in a *network* fashion, which constitutes their pattern of organization. The *structure* of a living system is defined as the physical embodiment of the organization of a particular system or, the components plus their specific relations – their *organization* – that actually constitute the system as a particular case of a particular class; and every change in a system is structural change. By saying that living systems are *structure-determined* means that *all the process that they live, they do in reference to themselves*. Hence, there is a fundamental relationship between the systems structure and how it behaves and, very importantly, there is no guiding-principle, as such, the living system cannot be directed by any external force.

This means that all that an external force can do is to trigger responses, that are determined by the system's own structure, which is answered by certain behaviour according to its own structure at the time of happening. Also, a system will conserve its class identity and stay the same while the structure changes, but only as long as its organization is conserved through those structural changes (Maturana, 2002, Capra, 2002, Maturana and Varela, 1984). Hence, every change in a system is a structural change, and the conservation of organization of a system is their fundamental condition of existence. Still, the structure changes both as a result of its internal structural dynamics and as a result of its interactions with the medium of existence.

Living systems have two *non-intersecting* levels of existence. [1] As a unit that operates in the domain in which it arises as a whole: A living being in its medium, or niche of existence and within its ecological relationships. [2] As a composite entity in the domain of the operation of its components; and in this sense the whole is not simply the collection of its parts but the manner of their composition as long as they participate in it and in relation of contiguity (Maturana, 2002).

Hollick (2006) explains it through the terms coined by Arthur Koestler *holon and holarchy*. It entails to imagine the universe divided in systems and subsystems, where every entity is both a whole and a part. An entity is a complete system in its own — a holon — and simultaneously a subsystem within a larger whole. A Holarchy describes the relationship between holons at different levels of organization, such as between atoms and molecules or cells and organisms (Hollick, 2006 p. 84-85) — See image below.

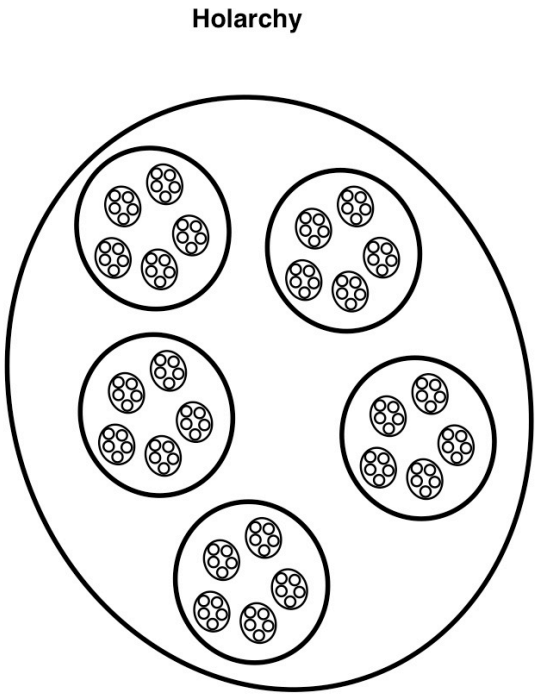


Figure 3 – Holons and holarchies, from Hollick, 2006 p. 84-85

Donella Meadows (2009) describes a system and its systemic relations as an interconnected set of elements coherently organized in a way it achieves something. And it must consist of three kinds of things: elements, interconnections, and a function or a purpose. And systems can be embedded in systems, which are embedded in yet other systems. As she exemplifies:

> "A school is a system. So is a city, and a factory, and a corporation, and a national economy. An animal is a system. A tree is a system, and a forest is a larger system that encompasses subsystems of trees and animals. The earth is a system. So is the solar system; so is the galaxy" (Meadows, 2009 p. 12).

So it goes to say that a living system is an autonomous entity that maintains itself by reproducing the same network of conditions that produced it and its boundaries, functioning as an autonomous totality in a certain medium with which it is constantly interchanging. A living system will arise and be conserved in any part of the cosmos where the conditions that make it possible take place, it will remain as long as it attends the organizational conditions that allowed it to emerge (Maturana, 2002).

As the system is open to the changes with the medium it is not a steady state. On the contrary, in its relationships both the system and medium can change and evolve together. This spontaneous organization, emergence and maintenance of the systems in closed networks of interactions Maturana and Varela have defined as *autopoiesis* — literally self-making:

> "Autopoiesis therefore describes the organization of living; in which things, systems, relations, and entities arise into existence in the instant in which the conditions of their constitution takes place" (Maturana and Varela, 1984 p. 52).

In addition, according to Donella Meadows, there is integrity, or a wholeness regarding a system and an active set of mechanisms to maintain that integrity. They are self-organizing, resilient, can change, and can adapt, or simply extinguish. Many of them are evolutionary, and out of one system another completely different system can arise (Meadows, 2009 p. 12). But, as she remarks, the elements of a system are not necessarily physical or tangible things (Ibidem p. 12): The interconnections and the relationships that hold the elements together can range from physical flows, chemical reactions, or, in human social systems, a great deal of informational flows, beliefs, value systems and emotions, in a myriad of feedback processes that will become a part of *the systems' complex behaviour*. As remarked by Hollick (2006 p. 83), we naturally tend to perceive systems as material structures which we can see, hear and/or touch. However, information and processes

determine the structure of the system. This is especially important when transferring the awareness in living systems towards human social domains.

2.4. THE SYSTEMIC CONSTITUTION AND CONSERVATION OF HUMAN IDENTITY

As explained by Maturana, that which we as *observers* distinguish as behaviour is not intrinsic to a living system nor an emergent property or a feature but it arises in the relational dynamic involving both the organism and medium in which it exists in its totality. This relationship is called "*structural coupling"* that means a living system operates in structural congruence with the medium of existence (Maturana, 1988 p. 14). Hence, in the process of living, on the path of recurrent interactions, the organism and medium will coherently adapt (keeping their structural congruence) and evolve together in mutual correspondence.

Hence, the structure of a system is determined in its *continuous evolutionary process of adapting, learning, and developing with the medium of existence.* And when we think of humans as

> "[...] living systems means that we are structure determined systems; that we operate at every moment according to our structure at that moment, and nothing external to us can specify what happens in us as a result of our interactions with the medium. [...] In fact, all that happens in us, necessarily has taken place and must have taken place through our operation as structure determined systems" (Maturana and Verden-Zoller, 1996 p.01)

We, human beings — structure determined systems— and the medium of our existences are continually and congruently evolving according to their structures, mutually adapting and influencing each other. *Revealing, therefore, a mutual dependency among a living system and its medium. As living systems, human beings do operate on the same basis. Regarding the issues of sustainability, the long-term soundness of human living does depend on the soundness of the medium of existence.*

2.5. COGNITION: TO LIVE IS TO KNOW

What we as observers distinguish as adequate behaviour in a living system is a constant ongoing process of adaptation that conserves the system in the ever changing and continuous flow of structural changes in structural congruence with the

medium in its process of living. Hence, a living system "is always engaged in adequate action" and it "always knows how to live in the circumstances in which it lives":

> "In any particular circumstance of distinction of a living system, conservation of living (conservation of autopoiesis and of adaptation) constitutes adequate action in those circumstances, and, hence, knowledge: living systems are cognitive systems, and to live is to know" (Maturana, 1988 p. 18).

Complementary to the above Capra's explanation comes as follows:

> "[...] Cognition is the activity involved in the self-generation and self-perpetuation of living networks. In other words, cognition is the very process of life." [...] "The interactions of a living organism, plant, animal or human – with its environment are cognitive interactions." [...] "Cognition involves the entire process of life – including perception, emotion and behavior" (Capra, 2002 p.)

Therefore the capacity of operating in dynamic structural congruence with the medium – structural coupling – entails cognition in its realization. And it permeates all levels of organizing activities of a living system. Whatever the living system, there is intrinsic knowledge in it. Take a bee for instance; it is a living system with intrinsic knowledge resulting from the evolutionary dynamics of structural congruence, adapting and evolving with its medium of existence. Basically, a bee knows how to be a bee.

What happens to us when we observe a bee, or any other living system? The bee is not simply waiting there to be observed. What we see, hear and eventually smell or feel like a bee is a reflection of the intrinsic nature of our nervous systems; sensory nerves all over the body that continually send impulses to various parts of one's brain. Malcolm Hollick explains the following manner:

> "Most scientists agree that the brain does this by creating a mental map, or model of reality which it can compare with incoming data. This model develops throughout our lives, as our brains integrate our life experience and knowledge.

> […] there are no facts waiting to be observed independently of our mental models. In practice, fact and model are inextricably interwoven, and interpretation of observation is inevitably grounded in our personal worldviews" (Hollick, 2006 p. 23).

Hence, perception is not a passive reception of given facts but an active process in which we participate in shaping the result, where we cannot separate what we see from the process of seeing and the meanings we attribute to it (Ibidem p. 24). *In this sense, cognition is not a representation of an independently existing world but rather a continuous bringing forth of a world implicit to the process of our living in an ongoing relationship with our medium of existence*. And finally, as Maturana explains, "our human living is biological living" (2002 p.34) an understanding that does connect us to what Capra has called the intricate "web of life":

> "As we understand how the roots of life reach deep into basic physics and chemistry, how the unfolding of complexity began long before the formation of first living cells, and how life has evolved for billions of years by using again and again the same basic patterns and processes, we realize how tightly we are connected with the entire fabric of life.
>
> And since our mind, too, is embodied, our concepts and metaphors are embedded in the web of life together with bodies and brains. We belong to the universe, we are at home in it, and this experience of belonging can make our lives profoundly meaningful" (Capra, 2002 p. 59).

2.6. LANGUAGE AND SELF-CONSCIOUSNESS

Following that explanation, everything that follows in human living takes place in the biological domain of our existence; it is the same for *language and self-consciousness.* Language is a biological cognitive phenomenon that took place "in the living and through the living of the organism" and that arises as a manner of coexistence (Maturana, 2002 p. 27-34). Language is our manner of living together as human beings, and what follows is that we do exist in the domain of objects and the world we bring forth through language.

As Maturana and Verden-Zoller explain, the conservation of living in language, and particularly in oral language, began to be systematically conserved generation after

generation in our ancestors and through the learning of children as a manner of living, through a whole process of change that has shaped the body as a whole — our nervous system, face, larynx and manner of relation with others and the human world (Maturana and Verden-Zoller, 1996 p. 02). It is also in this process that language takes place as our instrument for analysis and explanation. It enables us to share our thoughts, to form the basic frameworks of concepts and provides knowledge for building our worldviews (Hollick, 2006 p. 26). In Maturana's words:

> "We human beings exist as observers in language as we operate in the domain of structural coupling to which we belong. That is, we human beings exist in structural coupling with other living and not living entities that compose the biosphere in the dimensions in which we are components of the biosphere, and we operate in language as our manner of being as we live in the present, in the flow of our interactions, in our domains of structural coupling. Living in language, doing all the things that we do in language, however abstract they may seem, does not violate our structural determinism in general, nor our condition as structure determined systems.
>
> [...] language is a manner of living together in flow of coordinations of coordinations of consensual behaviors or doings that arises in a history of living in the collaboration of doing things together" (Maturana, 2002, p.27).

Self-consciousness arises with language in the interpersonal process of our relations in the domain of distinctions; as explained by Maturana:

> "Self-consciousness arises in language in the linguistic recursion that brings forth the distinction of the self as an entity in the explanation of the operation of the observer in the distinction of the self from other entities in a consensual domain of distinctions. As a result, reality arises with self-consciousness in language as an explanation of the distinction between self and non-self in the praxis of living of the observer. Self, self-consciousness and reality exist in language as explanations of the happening of living of the observer" (Maturana, 1998 p.27).

Within this context, our body, biophysical functions, nervous system, different levels of neural activity, language, cognitive experiences, self-consciousness, emotions, are all a result of the process of structural coupling with the medium. And what we are

today, at the moment of writing or reading this document, is the result of an ongoing wave front of ecological evolution.

> "At the same time, history is not part of the dynamics of states of a living system because this latter takes place only in the present, instant after instant, in the operation of its structure in changes that occur out of time. History, time, future and past — as well as space — exist in language as forms of explanation of the happening of living of the observer, and partake of the involvement of language in this happening of living. Therefore, it is in the explanation of the happening of living through the coherences of language that an observer can claim that the structure of a living system that determines its changes of state in the present always embodies its history of interactions because it continuously arises in the present in a structural drift contingent to such history" (Maturana, 1998 p. 22)

Human self-consciousness therefore is both a biological process and also a social phenomenon; involving basic perceptual, sensorial and emotional experience to self-awareness; in a level of cognitive abstraction which allows us to hold mental images, formulate values, beliefs, and the sense of identity, act intentionally and communicate through symbolic language (Maturana, 1988 p. 27).

3. THE BIOLOGICAL FOUNDATIONS OF CULTURE AND DESIGN

3.1. MEANING AND THE EMERGENCE OF CULTURE

The symbolic nature of human language involves the communication of meaning. By the attribution of meaning to our surroundings we bring forth our worlds. It involves the inner and subjective world of self-consciousness, a dimension that is dependent on context, concepts, values, beliefs and circumstances. As mentioned above, it is in conversation with others that objects arise *as aspects of our languaging with others as well as culture, which emerges as a domain of shared meaning from our networks of conversation* (Capra, 2002, Maturana, 1988). As Maturana explains:

> "[…]objects and any entity that arises in language pertains to a domain of inter-objectivity that we live with other language beings with whom we generate (we language) the objects and other entities that constitute that domain"[...] "Living in languaging is living a domain of shared objects in inter-objectivity" (Maturana 2002 p. 28).

Therefore objects do not exist by themselves but emerge as we give meaning to them. The domains of shared objects are also domains of shared meaning which is the same domain to which human culture pertains and is materialized. So in our cognitive processes of knowing, when constituting our networks of conversation and our domains of existence – in living and doing things together – we bring forth our culture; as the totality of socially transmitted behaviour patterns, value-systems, arts, beliefs, institutions, and all other products of human agency and thought.

According to Capra (2002), all the phenomenon that are an essential part of human social life – rules of behaviour, values, intentions, goals, strategies, designs, power relations – whatever their diversity, they are organized in a *network pattern* of relationships, sharing a common feature that provides the natural link to a systems view of life. He synthesizes his proposition as following:

> "When we study living systems from the perspective of form, we find that their pattern of organization is that of self-generating network. From the perspective of matter, the material structure of a living system is a

> dissipative structure, i.e. an open system operating far from equilibrium. From the process, finally, living systems are cognitive systems in which the process of cognition is closely linked to the pattern of autopoiesis (Capra, 2002 p.60).

Hence, departing from Maturana's explanations, Capra proposes his own understanding from three interconnected perspectives: *form, matter and process*. Where form and matter are integrated by means of processes that, as proposed by Maturana, are cognitive ones: In the ongoing process of living in relationship with the medium, the living system is in continuous process of `knowing´ by responding and adapting congruently with it. Capra takes as an example the metabolism of a cell:

> "It consists of a network *(form)* of chemical reactions *(process)*, which involves the production of the cell's components *(matter)*, and which responds cognitively, i.e. through self-directed structural changes (process), to disturbances from the environment" (Capra, 2002 p. 62).

> "All these cognitive phenomena are nonmaterial, but they are embodied – they arise from and are shaped by the body. Thus, life is never divorced from matter, even though its essential characteristics – organization, complexity, processes and so on – are non material" (Ibidem p. 63).

The extension of the proposed phenomena to the human social structures departs from Maturana's explanations that we exist in language and it is through our networks of conversations that we bring forth our world, where we recur to language to communicate our inner world of concepts, ideas, images and symbols, which is a critical dimension of social reality that, according to Capra, involves the communication of meaning and then, human action flows from the meanings we attribute to our surroundings (Capra p. 64).

After form, matter and process, meaning is the fourth perspective proposed by Capra to extend the phenomena of living systems to the human social domain, and a full understanding of social phenomena must involve the integration of these four perspectives:

> "Culture is created and sustained by a *network* (*form*) of *communication* (*process*), in which *meaning* is generated. The culture *material embodiments*

> (*matter*) include artifacts and written texts, through which meaning is passed from generation to generation" (Capra, 2002, p.64).

Therefore, and reviewing what has been seen so far — as living systems — we are socio-biological languaging beings that share the same organizational principle with the whole community of life. As all living systems, we are structure-determined systems, which means that everything that happens to us and everything that we do, we do in relation to ourselves and according to the characteristics of our structure (bio-physical and psychological) at that moment. *We share the same organising principles and patterns of connection inherent to ecological systems. We have brought forth our living in continuous, interweaving, biophysical and social processes that is entailed in the evolution of language, self-awareness, conceptual thought and the social world of culture – including its multilevel and multi-scale materialization and its relationships with the Natural world as we are living today*. In the words of Capra:

> "At all levels of life, from the metabolic networks of cells to the food webs of ecosystems – the components and processes of living systems are interlinked in a network fashion. Extending the systemic understanding of life to the social domain, therefore, means applying our knowledge of life's basic patterns and principles of organization, and specifically our understanding of living networks, to social reality" (Capra, 2002 p. 70).

It follows that in varying degrees, social systems and their structures are living systems because they involve not only living human beings but also language, consciousness and culture, making them "evidently cognitive systems" (Capra, 2002 p. 72). And networks of communication are also self-generating systems:

> Each communication creates thoughts and meaning, which give rise to further communication, and thus the entire network generates itself – it is autopoietic. As communications recur in multiple feedback loops, they produce a shared system of beliefs, explanation and values – a common context of meaning – that is continually sustained by further communication. Through this shared context of meaning individuals acquire identities as members of the social network, and in this way the network generates its own boundary. It is not a physical boundary but a boundary of expectations,

of confidentiality and loyalty, which is continually maintained and renegotiated by the network itself (Capra, 2002 p. 71).

3.2. DESIGN AS THE EXPRESSION OF DOING THINGS TOGETHER

From a biological perspective, it is in living and doing things together that we do constitute our networks of conversations and generate a world and a culture as well. In review of Humberto Maturana and Fritjof Capra work, human cultures too are self-generative networks of complex human relationships with a certain ecological medium. What differentiates human systems from other natural living systems is meaning (Capra, 2002).

A certain culture is thus a common context of meaning, with shared systems of beliefs, explanations and value-systems, socially transmitted behaviours and other products of human agency that are all sustained by a constant multiplicity of feedback loops of processes of communication and cognition. The process, through which we build and sustain human culture, passing it from generation to generation, is communication. It is through communication, in our living and doings things together that we bring forth the world, which is also made out of material things and objects to which we confer meanings and that also contributes to the passing of a certain culture from generation to generation.

The materialization of culture then is an embodied process. Any act, intention, or projection towards the future — our designs therefore — are all created through us, with a purpose, and carrying meaning. Clearly design is inherent to the human world of living and doing things together. Through design we materialize our inner worlds of values, beliefs and intentions: *All the material structures that emerge from the network of human interactions and relationships constantly shaping the web of culture, come through design in a process of mutual influence*; *all the symbolic and visual communications; material objects; activities and organizing services; complex systems and environments for human activities; and so on. Design is the natural expression of doing things together that is inherent to human ecology — see figure below.*

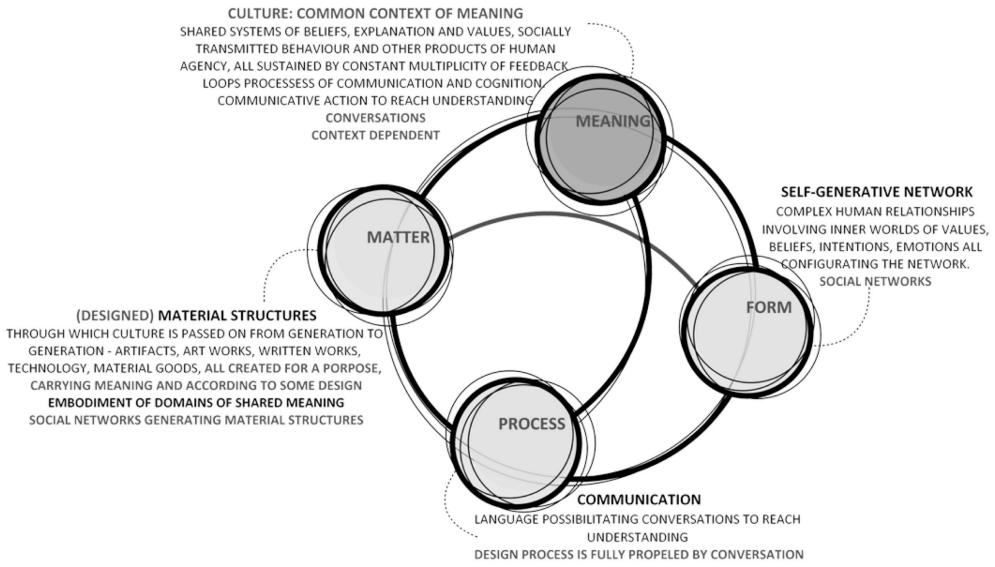


Figure 4 - Culture and design. After Fritjof Capra (2002) explanation

Hence, nothing that we do as designers is trivial. We do intermediate the processes that confer meaning to matter, the transformation of natural, or raw elements into a myriad of objects of human culture that can both promote or harm certain ecological conditions, which may result in cheapening or enriching life. Following that, everything that we do becomes part of the world that we live in. Our responsibility therefore is total.

What we materialize through our designs is a result of a whole network of human ecological relationships, of worldviews and value-systems. That is to say that designers cannot respond to the issues posed in Part 1 framed by the same cultural background that has created such issues in first instance. But how can designers become effective agents of social and cultural change? This gets back to the explanations on ecosophy earlier on in Part 2. It is essentially by recognizing this ecological — and perhaps also spiritual — principle of interconnectedness not only theoretically but also by consciously living it. Design is intimately connected to our dimensions of being and is the expression of our doings.

We are more than passive rational interpreters —we are participants of ecological dynamics in body, speech and mind. And Nature is not a fixed amount of objective bits of information waiting to be discovered, “but patterns that will be revealed by the appropriate ideas” (Hollick, 2006 p.25). What did set us apart from nature in first instance was a certain mode of thinking — a worldview, a conception of the universe

and of the relation of humanity to it. That is why we need to articulate new worldviews capable to reunite what was separated and to engender new contexts of meaning and values systems. This comes in first hand before the materialization of a certain supposedly sustainable development. As it will be argued later, it does not correspond to the search for a certain idyllic past of narcissistic closeness to nature. In first instance, it is a recognition and a review of a certain status and conditioning of humanness. In this sense, what follows is complementary to this emerging ecosophy. This is a proposal for a triple step to sow the seeds of deep ecological principles of sustainability via the *(1) building of an ecological literacy by (2) getting inspiration from ecological lexicons and (3) engaging in ecological thinking.*

4. OVERCOMING DEFAULT SCENARIOS: ECOLOGICAL LITERACY AND A TRIPLE STEP TO SEED ECOLOGICAL SUSTAINABILITY

The situation of human agency and design cannot remain limited to a theoretical understanding, which may not really move people to change. To become effective it necessarily entails to permeate the realm of human agency as a major *living accordingly* step that effectively makes possible an empirical understanding in order to build an ecological ethos and ethics. This proposed triple step was fully inspired by observations acquired in the research process.

This began by creating literary understanding, following establishing relationships and observing to create deeper understanding. The first step was to understand the causes and the extent of our ecological issues — this has resulted in Part 1. Based on the premise that the root cause of such crises is a certain mode of thinking, it was necessary to build understanding to propose a different worldview able to encompass our intrinsic ecological participation as part of our social and cultural organization — which has resulted in this ongoing Part 2 and the subsequent.

In this process, the designer/researcher opted to forfeit living in the city to live on a farm and to adopt a different lifestyle. This was so because at that time there was an emerging gap between the researcher/designer's way of living and the awareness of what was being researched. The aim of this movement was to build coherence among thinking and practice. In other words, it was necessary to live accordingly At the same time, it was a reasonable assumption that to build a different human relationship with nature and to understand its dynamics it makes sense to propose that it is necessary to experience it by living it. Close enough to promote major shifts in the meanings one attribute to it and to much of the things one does, such as work, learning, feeding, building, wellbeing and so on. As in professor David Orr's questioning:

> "Will people who no longer believe that they need nature be willing, nonetheless, to protect it? If so, will people no longer in contact with nature know how to do so? And was it not our efforts to cut ourselves from nature that got us into trouble in the first place?" (Orr, 2002 p. 18)

By engaging in activities such as growing food, beekeeping and maintaining the property, it was possible to confer new meanings to the surroundings, individual agency and relationship with place. It was possible to understand that to cultivate food is a meaningful and healthy way to connect with natural dynamics where one will follow a path of observation and interaction depending on the senses, and feedback one gets from plants and animals. One can get literary understanding of agriculture and animal husbandry via books, a great deal of information to be filtered from the Internet, workshops, or other experienced people. However the most valuable way to improve skills along this process was the root-based learning by doing where, intuition and holism will also prevail.

The food garden is a complex system and to understand it may help one to interact, to manage, adapt, and see the wide range of choices we have before us. The same is valid for beekeeping. Bees are complex social beings with a subtle relationship with environmental conditions within which their development depends on an array of different variables. To manage beehives not only involves theoretical scientific knowledge but a good understanding of their complex environmental relationships through careful and diligent practice and observation (Warré, 2007, Storch, 1985). The cultivation of food or the activity of beekeeping entails holistic thinking to understand root causes of problems and new opportunities — An awareness that was transferred to this thesis.

Such activities do not fit in with the managerial and reductionist ways of engineering nature for human purposes because they are embedded in larger systems: A problem that arrives — such as pests for instance — cannot be simply solved by a single solution as this tends to create further problems that may be rooted in the internal structure of the complex system (Meadows, 2009). It is not a surprise then that global food production is one of the greatest causes of environmental degradation throughout the world and its pervasive industrialization is also the root cause of a myriad health problems both to people and ecosystems (Kenner, 2008, Holmgren, 2009b, Brogan, 2011). The importance of situating such information here in this thesis relies on the fact that these are examples of activities that do allow an understanding of local action, global consequences, personal responsibility, and

spiritual growth. It allows one to create a world that meets one's scope of understanding and with some degree of affect, as was remarked by Chris Maser:

> "We are at this juncture because we humans have forgotten that we are an inseparable part of Nature, not special case apart of Nature. Although this juncture originates as the thoughts and motives in our hearts and minds, it is manifested through our decisions and the subsequent actions we commit in our surrounding environments and on landscapes throughout the world" (Maser and Maser, 2000 p. xiii).

Furthermore, this immersive process has allowed the entrance of different references to reinforce the emerging framework as one went through that journey, such as Permaculture (Holmgren, 2009b, Hopkins, 2008, Hopkins, 2011, Bush, 2011, Holzer, 2010, Crawford, 2010) and Natural Beekeeping (Crane, 1999, Independent, 2006, Warré, 2007, Heaf, 2008, Bush, 2011, Siegel, 2011, Chandler, 2012b, Chandler, 2012a, UB, 2013, USDA, 2013) and the transition culture (Hopkins, 2008, Hopkins, 2011, Pinkerton and Hopkins, 2009). These references also entered the thesis domain to inspire the empirical practice with the schools of Torres Novas — that were proposed by the designer/researcher as a citizen of this specific municipality. Indeed, it was amidst this process that the possibility to work with the public schools in this municipality became possible — see it on Part 3.

Under these circumstances the proposed triple step has also emerged through that major journey of constant reviews and reflections of the process. The building of *Ecological Literacy*, the acquiring of inspiration from *Ecological Lexicons* and engaging in *Ecological Thinking* are essentially about the constitution of a framework — in this case this ecosophy D.1 — capable to be transversal to Design subject thinking and action in ways that are suited to the problems and purposes of the present. In this way, and together with such a proposition, other thoughts — emerging from within design domains or not — were situated to emphasize the steps.

4.1. BUILDING ECOLOGICAL LITERACY

The attempt to situate design within ecological perspectives (Wahl, 2005) has as one of its main exponents, the work of Professor David Orr (Orr, 2002, Orr, 2005a, Orr, 2010) and also the work being developed within the Centre for the Study of Natural

Design (CSND) that has been purposefully promoting the encounter of design, ecology and philosophy (Baxter, 2005, Baxter, 2007b, Baxter, 2007a, Wahl, 2005, Wahl, 2006a, Wahl, 2007, Wahl, 2009, Wahl and Baxter, 2008, Brogan and Baxter, 2010, Brogan, 2011, Preece, 2011). The first adopted step towards an ecologically situated design in this thesis has departed from what David Orr has referred to as *ecological literacy,* that is the ability to understand the basic principles of ecology and living accordingly (Orr, 2002), or that according to Capra it is to become ecologically literate:

> "[...] i.e. to understand the principles of organization, common to all living systems, that ecosystems have evolved to sustain the web-of-life" (Capra, 2002 p.201).

Generally, the term literacy connotes the condition or quality of being literate, especially the ability to read and write. It is also the condition or quality of being knowledgeable in a particular subject or field. Being ecologically literate departs from here and expands to use the term ecology to propose the construction of a literacy that encompasses human and non-human dynamics to become transversal to human thought. It also has to expand in a way that the ecological literary understanding also indicates the skills, attitudes, competencies, dispositions and values that come from participation, active learning and self-reflection in real life issues. Fundamentally, the social dimension is realized within a broader ecological dimension and to become ecologically literate is to consciously participate in it. It has of course deeper implications on several "hows" and "whys" of human agency including design and education (Stone and Barlow, 2005, Stibbe, 2009).

In the understanding that, on the journey towards an ecologically literate design there are a range of words, terms, perspectives and streams of thought and possibilities that can be further explored and incorporated in design practice and thinking, this thesis proposes the term and the building of ecological lexicons. Hence, both the ecological lexicon and thinking are part of the process of building an ecological literacy. Theoretically and philosophically, beyond the work of Humberto Maturana that was used as a starting point, there are also pioneers of ecological thinking and action, such as Aldo Leopold, Arne Naess, José Lutzemberger, as well as the subjects of Deep Ecology, Ecofeminism, Permaculture, Biomimicry and among

other knowledge domains such as psychology, philosophy, sociology, anthropology, neuroscience, much of which are represented in the work being developed within the CSND.

This thesis became a collaborative part of the CSND through its supervisor, the coordinator and co-founder of the group, Professor Seaton Baxter. The CSND's underlying philosophy is deep sustainability. It provides a multidisciplinary platform to challenge existing design perspectives, motivation and practices, and to actively debate and construct a way forward into the 21st century, consistent with such new and emerging alternative worldviews. Design for sustainability, ecological design, biological design, biomimicry, bionic design, eco-design, integral design, holistic design and bioregional design are all conceived as expressions of the broader redefinition of design, as investigated and promoted by its research and activities. It works as an anchor point that allows students to obtain a degree of common focus whilst sustaining diverse approaches by researchers from different backgrounds (Aiteken and Baxter, 2007, Baxter, 2005, Baxter, 2007b, Baxter, 2007a, Wahl, 2005, Wahl, 2006a, Wahl, 2007, Wahl, 2009, Wahl and Baxter, 2008, Lloyd et al., 2010, Preece, 2011, Wood et al., 2009). It was out of the realm of the CSND that ideas like scale-linking design and salutogenic design have emerged (Wahl, 2006) or approaches like the biological and philosophical accounts of the emotion of loving that suggests this emotion is the foundation of environmental ethics and ultimately, the practice of ecological design (Preece, 2011). Also the exploring of food networks and design thinking (Brogan, 2011) and the importance of design in the planning and making of outdoors activities for the early learning experience of children (Wood et al., 2009). In the realm of design research, the work of CSND is therefore deeply engaged in the production of ecological literacy that can transcend traditional design domains.

4.2. GETTING INSPIRATION FROM ECOLOGICAL LEXICONS

The general concept of the ecological lexicon departs from the appreciation that people' cannot be expected to shift their worldviews if they don't know the most basic terms and principles that define ecology, deep sustainability or even the reasons and the extent of our ecological issues. An ecological lexicon is a set of terms

and concepts that could be used both as creative thought starters or further research that might be coherently incorporated in people's daily living.

This has emerged in different situations during this thesis' research. The first was by exploring basic terms like sustainability and others deriving from definitions of ecology, ecological thinking, ecological design, resilience, threshold, symbiosis, ecosystems and living systems. The second situation was on becoming aware of the causes and the extent of our ecological issues. This process has provoked a mixed array of senses. For instance, one may experience negative feelings, or even denial when reflecting upon the impacts of peak oil, climate change, generalised pollution and resources depletion in one's daily life. It has triggered personal reactions including a sense of incoherence among the designer/researcher lifestyle and the emerging awareness, as was stated above. In these circumstances the thesis' ecological lexicon was always a useful thought starter to, rearticulate and surpass confusion, to build understanding and inspire further coherent action.

An important example is the exploration of the idea of coherence, or *sense of coherence*, as suggested in the Antonovsk's (1996) concept of Salutogenesis— that literally means health generating —which is decisive in facilitating individual movement towards a healthier status. Antonovsk Hypothesized that generalized resistance resources (GRR) like material support, eco-strength, stable cultural background, social support, and the likes, provide the individual with mechanisms to cope with the continuous "stressors" with which one – or a community – could face when relating with their environments (Antonovsk, 1996, Becker et al., 2010, Horsburgh, 2000). By making sense of the countless stressors over time, together with the ability of comprehensibility (the understanding of the challenges), manageability (ability to make use of available resources), and meaningfulness (emotional understanding of the challenges) allows the emergence of a strong sense of coherence that empower people and communities to become more resilient and healthy (Antonovsk, 1996, Becker et al., 2010, Horsburgh, 2000). Hence, to get to know ecological issues and its dynamics is to make sense of them. Coherence constitutes way of supporting personal ecological transition and ultimate source of wellbeing — See further explanations following, in salutogenic design. This is the sort

of holistically worldview that connects with the designer/researcher activities within the living on a farm scenario and comes as proposed by David Bohn:

> "If one include everything coherent and harmoniously in an overall whole then his/her mind will tend to move in a similar way, and from this will flow an orderly action within the whole and the individual that can then consciously take part in the same undivided wholeness of flowing movement" (Bohm, 1980 p. xiii).

Therefore the building and exploring of ecological lexicons can empower individuals and their communities to become ecologically literate and to cope with the emerging ecological issues. This led to propose that the building of one's ecological lexicon and literacy is also the building of a *coherent whole between thinking and practice* that embarks on different dimensions of thought, from the scientific, to empirical, philosophical and even spiritual (in the sense of a meaningful living) that corresponds to the dimensions of comprehensibility, manageability, and meaningfulness as proposed by Antonovsk's (1996) concept. Hence, with regard to the designer/researcher, as one who has started to compile a researched theoretical framework so as to gradually recognize the impact of living in the soundness of other individuals and ecosystems and to preach for the ecological resituating of human thinking and practice, it became necessary to review one's lifestyle the, as a major source of wellbeing to cope with the emerging information and situation.

According to this image below, the ecological lexicon was composed not only as a major theoretical support for this thesis but also as support and inspiration for a major personal transition. Subsequently, it was reorganized and used with the students of the schools of Torres Novas — seen in Part 3. The thesis' ecological lexicon was coined in four years of research and became as diverse as it did to support the emerging theoretical framework. It contains a proposed four dimensions of thought, which it entails and could inspire other people and designers alike to explore it and confer their own articulations.

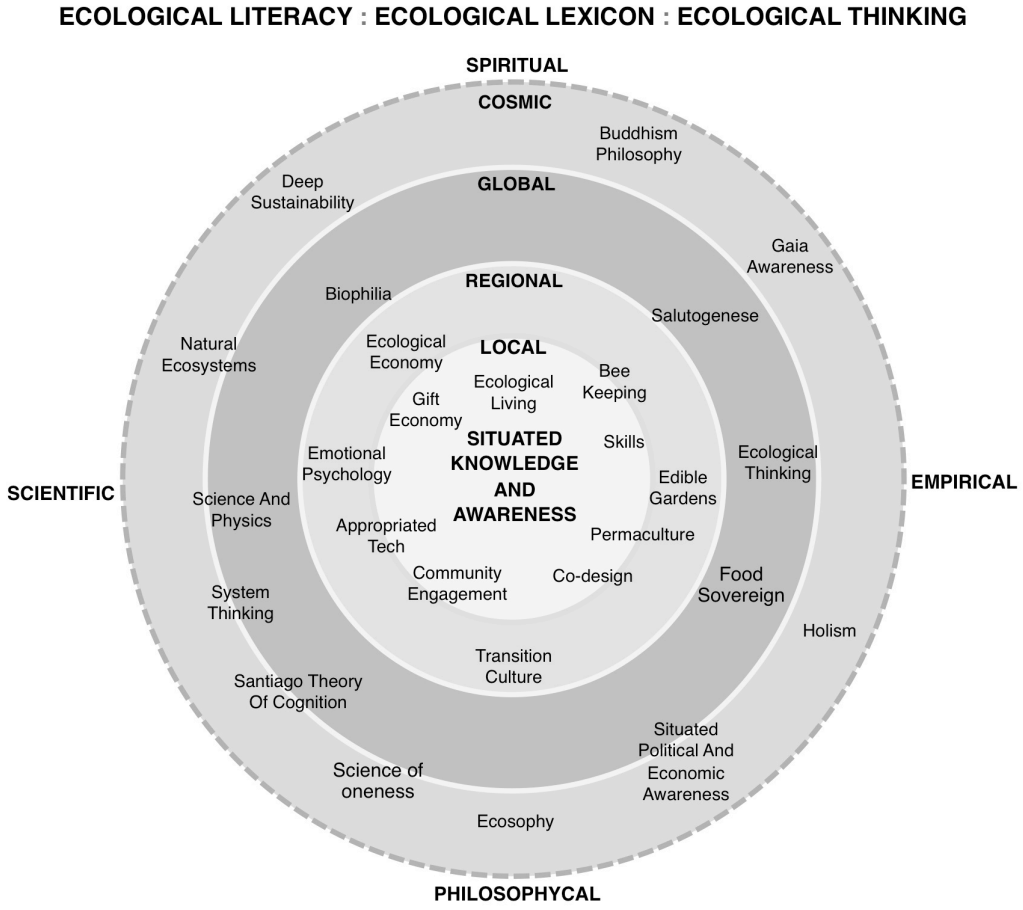


Figure 5 – The figure above is just a possible illustration of what an ecological lexicon can be. It departs from the situation of knowledge to the domains of one's living in a way it can be comprehended, manageable and meaningfulness. These are all terms that somehow came across the research living experience but not necessarily became part of the thesis' explanatory framework.

The building of ecological lexicons can nurture designers' creativity and open a wide array of perspectives for innovative design research. The Centre for the Study of Natural Design is an example in this case: From a common underlying philosophy that is deep sustainability it provides researchers with a wide array of research subject issues that clearly compose a major ecological lexicon for design practice and thinking and beyond its domains. And as one goes through this ecological lexicon, they can gradually become an ecologically literate person.

At same time, it is also necessary to situate one's action and to bring the global issues to the scope of one's understandings. It is only by scaling down these issues to the scale of our living that individuals and their communities will be able to confer meaning to the impact on food production, consumption, generalised pollution, energy and resource scarcity and to then begin to develop skills needed to cope with

the consequences. Hence, a full comprehension of what has being theoretically exposed-above will certainly entail a deeper experiential relationship with the broader community of life to situate and balance our thinking and agency; in other words consciously living what is proclaimed. In this way, and also in the context of a Ph.D. research, that is supposed to generate new practical and useful knowledge, the practice of ecological thinking comes thus to complete the triple framework.

4.3. ENGAGING IN ECOLOGICAL THINKING

From the work of Humberto Maturana there is the recognition that the way we think and relate to the world, is a process of multiple and mutual interactions of complex causes and consequences. This is briefly complemented here by the explanations proposed by the philosopher Luc Ferry (2011 p. 94) that will help to understand the idea of ecological thinking. According to him the modern world arose out of a long process that encompasses the collapse of ancient cosmology, the questioning over religious authority and the emergence of a scientific revolution accompanied of technological progress that gave way to anew era, which, in many aspects, we still inhabit today: the humanism.

As explained by Ferry, along this process and among numerous facts playing a role, the enclosed and harmonious world of ancient cosmology that used to frame human living gave place to the idea of the world as infinite and chaotic. What followed is that it was up to humankind to introduce some order into the universe: “man found himself for the first time alone, deprived of the support of both cosmos and God” (Ferry, 2011 p. 95)

So, moving on from the idea that the world was no longer a cosmos but was chaotic and knowledge was no longer a form of contemplation, humankind began to search for rational explanation, for natural phenomenon by attempting to actively establish causal relations between them. The attempt to establish this chain of rational connections by the division of the whole by the accounting of its parts eventually came to be termed as the scientific method (Ibidem p. 99); an influential rationalistic way to see and relate with the world that came to influence the whole of human thought.

> "The new task of contemporary science was no longer to frame itself as the passive contemplation of a beauty inscribed beforehand in nature; it was to do a job of work, namely the active construction of laws which would endow a disenchanted universe with meaning. Science was no longer a passive spectacle; it was an activity of the mind " (Ferry, 2011 p. 99).

Among this evolutionary process of human thought, humanity also came to distinguish itself as separate from the rest of nature (Ferry, 2010, Ferry, 2011a). By setting itself apart from Nature, humankind became not able to consciously inhabit the interconnectedness, diversity and the complex and unpredictable dynamics of the natural world. By renouncing participation, humankind has also dislocated her knowledge from such dynamics. So, the attempts to separate things by the principle of causality and as separate autonomous entities brought further compartmentalization of knowledge and lead to yet further specialization and separation of explanations from situated observation and engaged participation (Code, 2006, Hollick, 2011). This is to the point that it has moved individuals' learning from the realm of lived experience to the realm of the controlled experiment (Agamben, 2005), and that many western societies associate knowledge expertise is exclusively to the scientific community (Hulme, 2009, p.72-107). This forms an influential chain of knowledge production centred on the individual expert which, in many instances, is dislocated from the specific location and the sensibility from where problems arise and can be solved and also further from the fully ethical, social and ecological consequences of its applications (Code, 2006).

This can be most exemplified with all the resulting issues exposed in Part 1 and also on the long-lived waste, resource depletion, the loss of biodiversity, exploitation of people and places, all fruit of technological expansion to attend *an human-first value system* and logics of commoditization of all things, the frantic production and consumption— altogether, products of scientific research, development and advancements (Orr, 2002 p. 23). According to the words of David Orr, the "environmental problems, then, are mostly the result of a miscalibration between human intentions and ecological results" (Orr, 2002 p. 14). This is not a mere critic of science, but a situation and discussion to state that — as was supported by Hulme (2009 p. 106) — to "recognize the limits off scientific knowledge" and on how we regard knowledge production.

> "And we need to appreciate that such knowledge could be (perhaps inevitably will be) transformed in the process of leaving the laboratory and entering the social world.
>
> "[…] we must be more honest and transparent about what science can tell us and what it can´t. We should not hide behind science when difficult ethical choices are called for." (Ibidem, p. 106-107)

And it is also true in the compartmentalization of knowledge and rampant specialization of a society that tends to look to the challenges of this century as a series of isolated problems to be solved. From an ecological perspective, and based on Humberto Maturana explanations, it seems necessary to embody the idea that knowledge happens in the living of the individual and to recognize that it brings diversity of human knowledge that are essentially ecologically situated processes. As a matter of course, we need new systems of references to support human explanations and meanings that is a shift from human-centred to eco-centred perspectives.

This does not disregard science; to the contrary, it might bring it together with relativity and quantum physics, ecology, and other sciences as well as holism, intuition, and spiritual knowings (Hollick, 2006). This also includes other situated epistemologies, such as all the "local tacit knowledge" that might entail i.e. indigenous strategies for drought management and traditional agricultural practices (Hulme, 2009 p.82).

Ecological thinking as was defined by Professor Lorraine Code (2006) is a form of relationship with knowledge production and human agency that starts with what she explains as *epistemic responsibility*; which is the historical, geographical, and demographical situation of knowledge production according to the complex intersections between knowledge, subjectivity, ethics, politics, science and human agency. Ecological thinking, as she proposes, emerges to disrupt the predominant social imaginary of command and control of the prevailing scientific worldview; by interrogating its influential rationality, individualism, reductionism, and exploitation of people and places as well as to promote a socio-political imaginary that is sensitive

to human and geographical diversity, respectful of the natural world and responsible in its own democratic epistemic practices.

A democratic epistemic practice recognizes the validity and diversity of individual knowings that emerges from situated living and that is sensible to the dynamics of other people and their specific places. Also, the one who knows is responsible for what and how she knows, and by its ethical, moral and ecological implications of what is brought forward as knowledge. Whatever the knowledge, it will become part of the world and consequently of the reality of a certain group of people. This is the same for every human design. Hence, according to Code, this epistemic responsibility is essential for establishing and maintaining networks of trust:

> "[...] an understanding of responsibility that is epistemological as it is ethical and political. In public and in more "private" knowledge alike, honouring such responsibilities is crucial to generating and maintaining trust" (Code, 2006 p.ix).

Where trust emerges as the very possibility for establishing and maintaining ecological living:

> "[...] a well-functioning epistemic community counts among its defining features an assumption that most of its members, most of the time as matter of course, can draw – if cautiously – upon a reservoir of beliefs about soundness, the everyday reliability of other people's knowledge, in matters from the mundane to the esoteric. Intricate networks of trust, I suggest, are constitutive of the very possibility of viable epistemic lives and respectful coexistence. I name honouring such trust as integral to epistemic responsibility" (Code, 2006 p.vii).

There is strong evidence to suggest that human-centred thinking and the influential rationalism has prevailed upon human thought as a way of seeing the world that does not recognize the subjective aspects behind objective knowledge production and human agency, nor does it recognize its full consequences on the realm of the sociological, psychological, political and ecological implications (Bohn, 1980, Meadows, 2009 Hollick, 2011). Throughout society and behind all knowledge production, technological innovation, scientific advancements as well as governance,

there are certain value-systems and agendas, intentions and ambitions. Where these underlying intentions are the fruit of individualism, hidden agendas and do produce further compartmentalization, exclusion, exploitation, inequalities and degradation, such trust is not at all possible.

Ecological thinking is way of being in the world, and it:

> "[...] differs radically from the masterful way of autonomous man who, in assuming he can be master of all surveys, allows surveying to substitute for engaged participation, and mastery to suppress diversity for the sake of instrumental simplicity" (Code, 2006 p.280).

It conceptually offers the possibility to meet the "living accordingly" dimension of becoming ecologically literate as proposed by David Orr (Orr, 2005b p. 85-95) and to fit the purpose of this triple step explanation. It means that ecological knowledge emerges from the living of individuals in the circumstances in which they live. It connects with Code´s epistemic and moral-political hypothesis of ecological thinking:

> "[...] the transformative potential of ecological thinking can be realized by participants engaged in producing a viable habitat and ethos, prepared to take on the burdens and blessings of place, identity, materiality, and history, and to work within the locational possibilities and limitations, found and made, of human cognitive corporeal lives (Code, 2006 p.05).

In the realm of this thesis, this conception of ecological thinking is the possibility to learn to see horizontal patterns and interconnections of diverse, complex epistemological terrains to set coherent worldviews, to engender alternatives ways of living and being in the world, which is sensitive and respectful of diversity and of the particular. It also recognizes the natural dependence of knowledge production on interactive negotiation and the intrinsic worth of all beings. To Code, ecology offers a way of repositioning epistemological inquiry in its traditionally epistemic and its ethico-political dimensions to uncover an imaginary where different ways of thinking are possible and ecologically situated and sensitive and trust promoting (Code, 2006).

Still, as is recognized by Code, an ecologically conceived community is a sine qua non condition for the production, circulation, and acknowledgement of such claims (Code

2006, Preface). It is the thought of this thesis that in face of the dominant politico-social imaginary of material growth — which homogenises different cultures, where economic ties become divorced from social ties and disrupts local networks of reciprocity via consumerism and individualism, which breaks community, identity and the sense of place in a top-down manner — it is necessary to promote major connections and the broader resituating of living in a way that individuals and their communities can bear the full consequences of their participation in ecological dynamics, carefully observing, participating and situating it to be able to co-create and craft ecological ways of living.

Finally, it is important to have complementarity between ecological thinking and ecological literacy. The recognition and acceptance of epistemological diversity and complexity according to their locational possibilities and limitations, together with the attempt to become ecologically literate, that is to be consciously situated to participate in a knowing by living manner in the dynamics of certain socio and ecological systems. By a systemic principle, there might be intentions or purposes in living ecologically. One is trust-promoting as suggested by Code. The other is to learn and live accordingly the dynamics of ecological systems, an issue that, once recognized the human interdependence with the whole community of life, is to be found in living and doing things together. To this is necessary to add the proposal of Dr Daniel Wahl (2006), that the underlying intention of every human design is to set broader and long-term ecological health. And also, when one put together Dr Gonzalo Salazar Preece (2011) and Professor Lorraine Code propositions it is possible to understand that the emotion of love is also the possibility to constitute networks of trust and ecological living. The materialization of ecological living shall then be the result of a certain ecological awareness and intentions toward broad ecological health, which does entail ecologically literate designers.

5. ECOLOGICALLY LITERATE DESIGN

The following is a review of what this thesis regards as ecologically literate design, which became part of the thesis' ecological lexicon aiming to provide further reflection. This is a sequence from three authors engaged in promoting understandings of design according to ecological principles; namely, Professor David Orr's Ecological design, Dr Daniel Wahl's Salutogenic design and Dr Gonzalo S. Preece's Co-designing in Love. This will make the bridge among what was presented so far and to further connections with co-creativity in design and its importance for fostering broader people participation in creative processes and ecological awareness.

5.1. ECOLOGICAL DESIGN

As has been exposed in this thesis, the building of a culture of deep sustainability will entail engaging ecological participation and a great deal of creativity in order to foresee alternatives with wisdom to understand if our presence in the natural world will reduce, or intensify other problems like resource depletion, generalized pollution, conflicts, economic downturns, hunger, political stability health and deep human happiness. According to David Orr (2002) and similarly to what has been exposed beforehand on ecological thinking, this is about how to create communities where people evolve into responsible citizens, to fit their places in a way to resemble resilient systems,

> "[…] where feedback between action and subsequent correction is rapid and people are held accountable for their actions" (Ibidem p.09)

Under these circumstances, ecological design emerges as a large concept that integrates different knowledge, such as science, practical arts political ethics and economics aiming to transform human activity from destruction to participation. Discarding the fantasies of a certain past of narcissistic closeness to Nature, to David Orr (2002, 2005b), the starting point to ecological design is the heritage of design intelligence that is evident in many places, times and cultures prior to our own where design was a slow, patient and skilful cultural process to allow living to simply flourish. This is the process by which culture and communities could manifest all-

encompassing stability and long-term prosperity in certain scales that could also favour the comprehensibility, manageability and meaningfulness of living that treasures the richness of diversity and the harmony between human intentions and the genius of particular places (Orr, 2002 p. 04-12).

> "Ecological design then, requires not just a set of generic skills but rather the collective intelligence of a community of people applied to particular problems in a particular place over a long period of time" (Ibidem p. 09)

It does entail participation, careful observation and for that reason, ecological design is

> "[…] the careful meshing of human purposes with the larger patterns and flows of the natural world and the study of these patterns and flows to inform human actions" (Ibidem p. 20).

And an ecologically literate person/designer would activate it by observing that Nature's various systems have been adapting, learning and evolving through successful strategies of living for 3.8 billion years and it is a model from which to design the systems supporting our living. And it is fully participative and co-creative as

> "[…] it is not so much an individual art practice by individual designers as it is an ongoing negotiation between a community and the ecology of particular places" (Orr, 2002 p. 28).

In this case, Orr also proposes that the standard for ecological design is neither efficiency nor productivity but health. It begins by the health of the ecosystems and people supporting common living, as in many levels

> "[t]he etymology of the word "health" reveals its connections to other words such as healing, wholeness, and holy. Ecological design is an art by which we aim to restore and maintain the wholeness of the entire fabric of life increasingly fragmented by specialization, scientific reductionism, and bureaucratic division" (Ibidem p. 29)

Steering the purpose of ecological design toward health is a major connection between the work of David Orr and Daniel Wahl's (2006, 2006b, 2007) proposition of

a *salutogenic design approach*. Although, when considering Wahl's proposition, it is necessary to understand the concept of salutogenesis as conceived by Aaron Antonovsk, which with the explanations coming from Maturana and Capra, is essential for a deeper understanding of the emergent concepts of ecological design as well as supporting the idea of coherence among thinking and practice proposed beforehand.

5.2. SALUTOGENIC DESIGN: DESIGNING FOR HUMAN AND PLANETARY HEALTH

5.2.1. SALUTOGENESIS: COHERENCE GENERATING HEALTH

The concept of Salutogenesis was introduced in 1979 by Aaron Antonovsk as the study of health development, an approach that contrasted with the concept of pathogenesis that is the study of disease development. As explained by Becker:

> "Pathogenesis works retrospectively from disease to determine how individuals can avoid, manage, and/or eliminate that disease. Salutogenesis works prospectively by considering how to create, enhance, and improve physical, mental, and social wellbeing. Salutogenesis provides a framework for researchers and practitioners to help individuals, organizations, and society move toward optimal wellbeing" (Becker et al., 2010 p. 01)

According to Antonovsk, pathogenic medicine and all western medical thinking is under the same "mechanistic" worldview in which the human organism "is a splendid system, a marvel of mechanical organization" (Antonovsk, 1996 p. 13) which assumes that humans are healthy except when facing avoidable problems and diseases. The prevailing mindset is a reactive one. In other words, there is no need to act in regard to one's health until some problem occurs (Becker et al., 2010). The roots of this general mindset of western medicine are the same as those of the ecological issues, where the "mechanical organization" of the human body is fragmented into autonomous compartments that are the domain of specialists and where the totality of the individual and medium of their existence is generally disregarded.

Antonovsk has adopted what Becker has called a "pessimist approach" but which this thesis supports as a systemic approach: where humans are susceptible to disease injury, general problems, entropy and degradation "unless they actively pursued a

course of action to cause health" (Becker et al., 2010 p. 02). The mindset is a proactive one. As Antonovsk has explained:

> "Influenced by the concept of inevitable pressures toward entropy even in open systems [therefore considering human beings as living systems], I was led to propose the conceptual neologism of Salutogenesis— the origins of health.
>
> If we start from the assumption that the human system (as all living systems) is inherently flawed, subject to unavoidable entropic processes and unavoidable final death, what follows is a set of ideas which can provide a theoretical basis highly congenial to the proponents of health promotion, allowing it truly to carve out an autonomous existence—though one undoubtedly in partnership with curative and preventive medicine" (Antonovsk, 1996p. 13).

Similarly to the theories of Humberto Maturana and Fritjof Capra, on salutogenesis, Antonovsk also regards the individual on the totality of their interactions, where to help a person to move toward greater health must relate therefore to the broader ecological aspects of the individual. He has also emphasized the complementarity among salutogenesis and pathogeneses, prompting health professionals to work in order to facilitate health rather than merely limit disease. Therefore health research should identify, define and prescribe pathways, factors, and causes of positive health placing people in a proactive mindset to only then be supplemented by a pathogenic approach (Antonovsk, 1996, Becker et al., 2010). Antonovsk's proposal represents a holistic vision of health that is a much broader concept that involves the individuals and their communities, their relationships and environments (Wahl, 2006a, Becker et al., 2010).

The concepts proposed by Antonovsk are perceptible in contemporary definitions and aims underlying health promotion. In 1986, the first International Conference on Health Promotion, meeting in Ottawa and organized by the World Health Organization (WHO), defined the following:

> "Health promotion is the process of enabling people to increase control over, and to improve, their health. To reach a state of complete physical, mental

> and social wellbeing, an individual or group must be able to identify and to realize aspirations, to satisfy needs, and to change or cope with the environment. Health is, therefore, seen as a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities. Therefore, health promotion is not just the responsibility of the health sector, but goes beyond to reach healthy life-styles to wellbeing.
>
> [...] our societies are complex and interrelated. Health cannot be separated from other goals. The inextricable links between people and their environment constitutes the basis for a socio-ecological approach to health. The overall guiding principle for the world, nations, regions and communities alike, is the need to encourage reciprocal maintenance - to take care of each other, our communities and our natural environment. The conservation of natural resources throughout the world should be emphasized as a global responsibility.
>
> "Changing patterns of life, work and leisure have a significant impact on health. Work and leisure should be a source of health for people. The way society organizes work should help create a healthy society. Health promotion generates living and working conditions that are safe, stimulating, satisfying and enjoyable" (WHO, 1986 p. 1-3).

In other words, health is the state of complete physical, mental and social wellbeing, of an individual or group and it is socio-ecologically constructed and the

> "[...] Political, economic, social, cultural, environmental, behavioral and biological factors can all favor health or be harmful to it" (WHO, 1986 p. 01).

This all-inclusive perspective of health promotes a major connection with that which has been presented so far: there is a major connection among human wellbeing and broader ecology. The soundness of people and their communities is fully dependable on the soundness of the cultural, the physical, the emotional and the natural environments. The soundness of human living is fully connected to the soundness of other life-supporting ecosystems. *Returning to David Orr's previous proposition that the primary standard of quality for ecological design is health*. The ecological issues of our time are ultimately a matter of health in its broadest sense. This is the

connection to the work of Dr Daniel Wahl. However, for the purpose of the proposed ecosophy D.1, it is necessary to deepen some aspects supporting salutogenesis.

5.2.2.SENSE OF COHERENCE

Looking for answers on how to move a person toward health Antonovsk has proposed the concept of a *sense of coherence* (SOC) that is decisive in facilitating individual movement toward a healthier status. He hypothesized that *generalized resistance resources* (GRR) like material support, eco-strength, stable cultural background, social support, among others, provide that which is necessary for the individual to cope with the continuous "stressors" with which one – or a community – could be bombarded with when relating to their environments (Novak, 1998, Wahl, 2006a). According to Antonovsk, this refers to

> "[...] a property of a person, a collective or a situation which, as evidence or logic has indicated, facilitated successful coping with the inherent stressors of human existence" (Antonovsk, 1996) pp15.

Drawing on Antonovsk Ideas Horsburgh (2000) describe GRR as phenomena that provide an individual with sets of life experiences that are characterized by consistency, participation in shaping outcome, and under-load-overload balance – See figure 5 below. GRR are therefore individual characteristics acquired by living by means of socialization and other individual structural characteristics of the individual. They are consistent and repeated life-experiences that provide the individual with a set of references to be used by them to balance environmental pressures — stressors — influencing participation and in shaping their own biography in a major cognitive process — see figure below. In the words of Antonovsk, the generalized resistance resources:

> "[...] foster repeated life experiences which, to put it at its simplest, helped one to see the world as 'making sense', cognitively, instrumentally and emotionally [worldview]. Or, to put it in information-systems theory terms, the stimuli bombarding one from the inner and outer environments were perceived as information rather than as noise" (Antonovsk, 1996 p. 15).

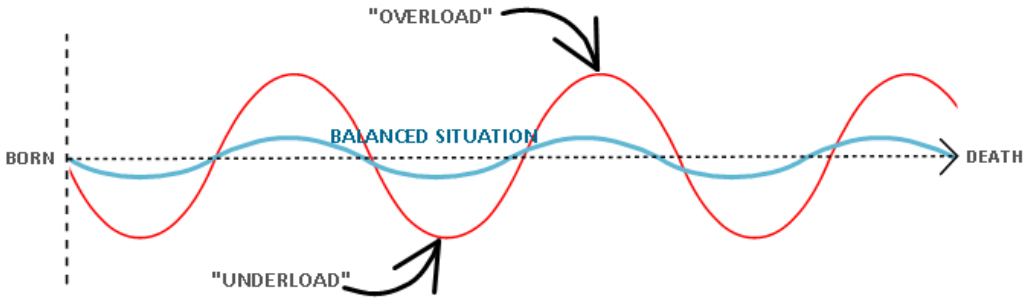


Figure 6 - Under-load overload balance: under and over load are peaks that even positive, or negative can lead the individual to a situation of illness. A balanced situation is to reach a near equilibrium between ease/disease situations

The generalized resistance resources can help to connect some of the emerging concepts as a starting point to for understanding, enacting and crafting broader ecosophies. The following table was based on Horsburgh (2000) organization of GRR to which insights were added from other references used to build this framework:

Table 3 *generalized resistance resources* adapted from (Horsburgh, 2000 p. 179)

Generalized Resistance Resources

1. Material resources, such as Money, shelter and food and their quality. "Obtain a yield" is one of the principles in Permaculture (Holmgren, 2009)
2. Knowledge and intelligence – Through knowledge of the world and by the acquisition of coping skills. It also entails emotional intelligence, linking to Maturana and Verden-Zoller's concept that "the only emotion that expands intelligence is love, and this is so because intelligence has to do with the acceptance of the legitimacy of the other and the expansion of the possibility for consensuality hat such acceptance entails" (Maturana and Verden-Zoller, 1996 p. 07);
3. Ego identity – a sense of inner self that is integrated but is flexible – that connects with the sense of self-love as proposed by Preece (2011) where the individual lover is self-accepting as an authentic being that is also situated in a certain medium and feel love towards it This is also the core of an ecosophy;
4. A coping strategy that is rational, emotional, flexible and farsighted – and that is shaped on the exercising of conscious living and doing. Or yet in crafting skills for healthy living which also constitute part of an ecosophy (Naess, 2009);
5. Social support – ties or deep interpersonal roots and commitment – family, friends and community;
6. Commitment and cohesion with cultural roots;
7. Cultural stability;

8. Ritualistic activities and answers provided by a certain culture (e.g. celebrations, ceremony for crop failure, ceremony for accession of leaders, etcetera), or as from Code (2009) the knowledge and explanations from the mundane to the esoteric found and made of human corporeal lives;
9. Religion, spirituality and philosophy – a stable set of answers to the perplexities of life. Also part of setting and ecosophy;
10. Preventive health orientation – general worldview, proactive attitude, life choices amongst others;
11. Genetic constitutional GRRs;
12. Individual state of health

Following the GRRs, it is by making sense of the countless stressors over time and the resources on which one can depend, craft and acquire that allows the emergence of a strong *sense of coherence* (SOC), which makes people and communities more resilient and healthy. Furthermore, in the words of Antonovsk:

> The strength of one's SOC is shaped by three kinds of life experiences: consistency, underload-overload balance, and participation in socially valued decision-making. The extent of such experiences is molded by one's position in the social structure and by one's culture—above all, I am persuaded, by the kind of work (including housework) one does and by one's family structure, with input from many other factors, ranging from gender and ethnicity to chance and genetics (Antonovsk, 1996).

The emergence of the SOC constructs a generalized orientation toward the world — a worldview; and ecosophy —a continuum that is comprehensible, manageable and meaningful. The strength of one's SOC is a significant factor in facilitating the movement toward health. In other words, a sense of coherence is built through relationships in living and doing things together and of their quality and consistency – see also “meaningfulness” in the following table. Aiming at its operationalization, Antonovsk differentiates three components or elements of SOC that, when confronted with stressors, will facilitate a person with strong SOC movement toward health: comprehensibility, manageability, and meaningfulness, maintaining mutual interrelationships among them (Antonovsk, 1996, Novak, 1998)—It is sketched in the table below by Novak (1998) and Antonovsk (1996).

Table 4 - Comprehensibility, manageability, and meaningfulness, Adapted from Novak (1998) and Antonovsk (1996).

SOC Life Experiences
Consistency of the experiences, under-load-overload balance and participation in socially valued decision-making
SOC Basic Components
"**Comprehensibility**" of phenomena occurs if stimuli of the internal and external environment make sense in a cognitive way so that they turn out to be clearly ordered and structured, and if "a solid ability to review reality" is witnessed. The person will “believe that the challenge is understood” (Antonovsk, 1996 p. 15)
"**Manageability**" of our internal and external world is represented by the measured ability to make use of the resources at one's disposal in order to cope adequately with several demands. The person will “believe that resources to cope are available” (Ibidem p. 15) – In other words, individuals or a community comprehend, are aware or yet can see the whole picture of what is at stake — *problems and solutions are within the scope of people’s understanding and their capacity to promote and sustain a healthy situation*.
"**Meaningfulness**" according to Antonovsk’s claims is to be understood according "to the emotional and not only according to the cognitive meaning of the word". "Life makes emotional sense", even more so if "disastrous experiences are willingly accepted as challenges to search for sense and to overcome them with dignity". The person will “wish to, be motivated to, cope” (Ibidem p. 15). It connects with the concept of resilience (Folke, 2006, SRC, 2007)

Hence, the sense of coherence one holds is multi-level and subjective depending on the individual’s experience. So, recognised the conditions of their particular knowledge, individuals can have different levels of comprehensibility over their domain of existence, as well as being able to manage their existence accordingly – congruent – with the complexity of such a domain as long as they are allowed to, or facilitated to engage in socially valued decision-making. *It is in participation; in living and doing things together that an individual could make sense of their particular conditions of existence. Andin doing so could give meaning to living.* As described here in Antonovsk words:

> “What gives one a sense of meaningfulness; which type or style of resource one thinks is appropriate to apply to a given problem; in whose hands the resources are, as long as they are in the hands of someone 'on my side' (e.g. God, a friend); how much information one thinks one needs to

> comprehend—the substantive answers to these questions may vary greatly from culture to culture, from situation to situation. What matters is that one has had the life experiences which lead to a strong SOC; this, in turn, allows one to 'reach out', in any given situation, and apply the resources appropriate to that stressor (Of course there can be mistakes and failures; but the person with a strong SOC learns from these, and is not doomed to repeat them)" (Antonovsk, 1996 p. 15).

The importance of the Salutogenic concept to this thesis is the connection it promotes for participation of the individual in meaningful activities from where a sense of belonging could emerge. This is a fundamental connection to the idea of design that this thesis aims to support: The proposition of the idea of *design as the expression of doing things together*. Yet, salutogenesis may definitely become part of the crafting of an ecosophy and, for the purpose of this research, it will touch the domains of the intentions underlying education and design.

In face of the ecological issues, challenges and concepts proposed so far, the capacity to generate a culture of deep ecological sustainability is intrinsic to our capacity to enact a collective understanding that long-term prosperity and wellbeing is largely dependent on certain social and ecological relationships, which also entails the soundness of broader ecological systems to which we belong; which ultimately — even if we could create our personal oasis and mandalas — is the terrestrial biosphere which we share with the broader community of life.

Once again, meeting Antonovsk proposed perspective: The social and consensual relations within the community are supportive of the individual in building their soundness and acknowledging their belonging to their domain of existence — family, friends, community and also place of living. So, how and why we design, build and maintain our communities are deeply connected with the basic components of SOC: Meaningfulness, manageability and comprehensibility. These also facilitate the constitution of a strong sense of place that are the cognitive, emotional and spiritual bonds people form with the environment they are immersed in and that has been denied, suppressed and devaluated by mechanistic worldviews of Nature (Antonovsk, 1996, Williams and Stewart, 1998).

The connection proposed by Dr Daniel Wahl (2006) among the concept of Salutogenesis and design relies on the purposes underlying every human design. According to Wahl, Antonovsk's conception so far has focused on human health, but it can be "equally applicable and relevant to ecosystems and planetary health" as all individuals are fundamentally embedded in, and affected by the social and sociological systems that contain them and, in his words, "[...] he clearly saw the individual and its community within the wider context" (Wahl, 2006ap. 177), and:

> "[...] as biological organisms and natural participants in nature's scale-linking process, all human beings can, and do, affect the health of individuals, communities, ecosystems and the planet as a whole [...] we are only slowly waking up to the cumulative [...] effects human actions are having on the planet Earth. Since that planetary and human health are fundamentally linked, preventing environmental damage and maintaining health ecosystems is the most effective long term strategy to promote health in humans" (Wahl, 2006 p. 166).

Wahl has proposed that the underlying intention of any human design is to generate broader ecological health:

> "Design for human and planetary health aims to explore strategies that sustainably integrate humanity into the health maintaining and life-supporting processes of the planetary biosphere" (Ibidem p. 174).

With that objective in mind, design emerges as a transdisciplinary integrator and facilitator of sustainable solutions to integrate divergent value-systems and worldviews.

> "It is this visionary and creative character of design, which gives design its central role in envisioning and creating a healthier and more sustainable future. Scale-linking design for systemic health offers a holistically informed response to changing circumstances in the complex dynamic system that unites nature and culture, as well as mind and matter. It can help to create the political, social and economic institutions that are relevant and appropriate to changing circumstances within the interconnected and interdependent complexity of the real world. Issues like climate change, poverty, resource depletion, terrorism, inequality, and global environmental

> degradation can only be tackled through such a concerted response" (Wahl, 2006b p. 289).

Finally, this gradually shifts the locus of design activity from the predominant focus on the materialization of the objects of human culture to a metadesign domain — the immaterial aspects of concepts, value-systems, beliefs and intentions that are the psychological, epistemological and ontological aspects behind design that do affect human experience and which need be recognized as a crucial catalyst of human transition to a culture of deep ecological sustainability (Wahl, 2006a, Wahl, 2006b). In accordance with the role of integrator and facilitator proposed by Wahl, this thesis suggests that designers can move to a domain where they can be also the activators of such processes. Entering the dimension of a certain design activism where designers can be activators, integrators and facilitators of sustainable solutions and where the framework to inform such activity is an ecologically literate one.

Table 5 - Final comments on Salutogenesis

A final consideration of Salutogenesis:

According to Antonovsk, as persuasive as the hypothesis might sound, a measurement tool would have to be developed to allow it to be tested empirically (Antonovsk, 1996). Following Antonovsk concerns, Becker exposed evidence of research that has already "generated some valid and reliable measurement tools" (Becker et al., 2010 p. 04) in which he emphasizes the Salutogenic Wellness Promotion Scale (SWPS) a tool to measure health promoting actions in the physical, social, emotional, spiritual, intellectual, vocational, and environmental dimensions:

> "The studies with the SWPS have shown statistically significant gains in perceived health, life satisfaction, and job performance were positively correlated with the number of health promoting actions with which participants chose to engage. These studies have also documented that those who engage in a greater number of health promoting behaviors have lower levels of disease, depression, and symptoms" (Becker et al., 2010) pp4.

5.3. CO-DESIGNING IN LOVE: TOWARDS THE EMERGENCE AND CONSERVATION OF HUMAN SUSTAINABLE COMMUNITIES

It is precisely in the immaterial aspects underlying design that Dr Gonzalo Salazar Preece (2011) explores how human sustainable communities are designed, built and maintained to develop newer conceptions on ecological design. Preece's work has also departed from the work of Chilean Biologist and Philosopher Humberto Maturana, to propose that the emotioning of love and homing are fundamental aspects of ecological design (Preece, 2011).

In review of what was exposed from Maturana and also from Capra earlier in this Part 2, we humans do operate in a multidimensional interactional ecological space where we do operate and exist in language. As we exist in language we do it in emotions as well. And if language is the process through which we can unveil our inner worlds of values and emotions and to create common contexts of meaning, when we distinguish emotions, we distinguish different domains of relational behaviours. According to Capra, emotions do constitute a relational fundament on which we human beings do all that we do as languaging beings when constituting our networks of conversations (Capra, 2002 p. 70).

And different networks of conversations constitute different domains of existence in which emotions will determine the kind of relationship one can enter; or not, in the instant it happens (Maturana, 2002 p.28). Maturana and Verden-Zoller explain as follows:

> "What we connote biologically as we speak of emotions referring to ourselves or to other beings, are body dynamics dispositions (involving the nervous system and whole body) that determine what we or they can do or not do, in what relations we or they can enter or not to enter, at any moment" (Maturana and Verden-Zoller, 1996 p.03).

This is reflected in Damasio's statement that "there is no such thing as mind without emotion"; we are "feeling machines that think" (Damasio, 2010 Minutes 1´42 and 2´12). Anxiety, cheerfulness, dejection, envy, gloom, grief, happiness, hate, loneliness, love, sadness, tension, weariness are a few of many emotions pervading

human relationships. Within that, according to Maturana and Verden-Zoller (1996), human beings are love dependant animals. It becomes evident for instance

> "[...] when we become ill or deprived of love at any point of our lives as love is the domain of those behaviors or dynamic body dispositions through which another arises as a legitimate other in coexistence with oneself, and fear is the domain of those behaviors or dynamic body dispositions through which one move away from the circumstances in which one finds oneself" (Maturana and Verden-Zoller, 1996 p.03).

From that perspective

> "[...] love is not a virtue, or something special, it simply is a biological phenomenon as the domain of those behaviors through which social life arises and is conserved; it is simply the biological dynamic that constitutes trust and mutual acceptance in body and spiritual relations of nearness and intimacy" (Ibidem p. 03).

A child, for instance, learns her body and self-consciousness, in interplay and trust in body acceptance with her mother. In this relationship the child acquires self and social awareness, developing the whole world as the expansion of their bodies:

> "A child learn his or her body or the body of the other in relations of free play and total trust and acceptation with his or her mother" (Maturana and Verden-Zoller, 1996 p. 03).

The child is a biological being in itself but it is dependent on the support of another human to become a human adult – that is to say, the kind of adult that one will become is highly dependent on the social interactions coming from early childhood-parenting interaction and is also highly dependent on love.

> "We humans exist in the psychic space that we create in our living in our childhood, and our identity as humans of one kind or another, is defined by our psychic existence in conservation of the self that we become" (Ibidem p. 04).

This is also a crucial connection to Antonovsk's Generalized Resistance Resources and the developing of one's Sense of Coherence. This is so because, children will tend to

conserve their identities and the type of relationships they have experienced in the domain of child-mother-family-friendship-community relations and so on. It is determinant of the kind of space — or domain — of relational behaviour that we are likely to reproduce and to participate in living and doing things together and ultimately in our broader domains of shared meaning that is culture. It will be determinant to the kind of relational domains that we aim to nurture and consequently, to the world we aim to bring forth — these are all part of our broader human ecological relationships.

Children and the type of environments, experiences, rituals and so on that we provide for them are of special importance, as they will perpetuate the type of ecological relationship they have lived. They will perpetuate a certain cultural background:

> "It is fundamental for a child to grow in a relation of total trust and body acceptance in free play first in his or her relation with his or her mother (female or male since mother is a relation of care), and then as he or she grows in relation to the other persons with which he or she lives (in nursery, kindergarten and school), to become a self-respecting and socially integrated adult (Maturana and Verden-Zoller, 1996 p. 05).

This makes sense and gives special relevance to Mahatma Gandhi's teaching that we need to be the change that we want to see in the world. Also, according to Maturana and Davila's (2012) explanations, we, adults of today, are the future of humanity as living is happening now and what we do now will determine what happens in the future:

> "Either we transform our relationships in the world that we live now, or the future of humanity will be more destructive then of loving care" (Maturana and Davila, 2012 minute 2'30).

Correspondingly, according to Preece's explanations, it was together with the epistemological separation from Nature, subject and object dichotomies in which reality became transcendental and rational, a negation of the emotional domain of humanness took place, dominated by arrogant and aggressive emotional patterns of living; mainly characterized by the scientific human dominium over nature, where

there is a separation of self-love and love of the rest of nature. In Preece's proposition, "love is the emotion that allows the emergence and cultivation of intimate socio-ecological conversations" (Preece, 2011 p.28).

As previously proposed in Part 2, design emerges from our ecological relationships as our expression of doing things together — or the expression of certain human domains of existence in doing things together. As such emotioning and intentional emotioning take part in this process. Love, emerging from both Maturana's biological perspective, and Preece's explanations is proposed as an essential part of an ecological design practice:

> "[…] co-designing in love is the essence of ecological design [and with this in mind] ecological design can create platforms that may trigger and conserve the emotion of loving in human beings" (Ibidem p. 17)

In the *Steps to an Ecology of Love*, the emotioning of love is explored by Preece as the basic biological emotion, together with explanations of self-love, to characterize it as the opposite of selfishness: While selfishness is an arrogant and pejorative disposition "that intends to control the path of living for the benefit of desires that ultimately negate the possibility of valuing the legitimate existence of others and oneself"; self-love, according to him, is the only way that the individual lover can "coherently both accept himself as an authentic being and situate himself in an ecological medium, and love it" (Ibidem p. 228).

In addition to this, in the *Steps to an Ecology of Homing*, the emotion of homing is explained as an ecological and continuous embodied process emerging from and being conserved through the course of our interactions with other living beings and non-living things. In the process of homing we generate a built environment constituted by objects, buildings, environments and complex systems, all of which are part of our natural, ecological existence. And the process of homing is "one whole human participation and creation of a world from within" (Ibidem p. 262) through our socio-ecological living. Finally Preece defines *ecological design as the interdependence of both, or as "homing-in-loving":*

> "Through co-designing in love, a cooperative and respectful creation and conservation of a physical and sense of home emerges, which in turns is

> fundamental for the conservation of a loving manner of designing" (Preece, 2011 p. 17).

Also, to Preece, ecological design is a form of conversation in which we create particular forms of homing and only through interplaying this loving manner of designing that we can develop a coherent and harmonic sense and practice of homing where design is inextricably connected with place. Preece has lived within three Western-European eco-villages, which have come to constitute his case studies of contemporary initiatives of localizing homing sustainably. This was a field-research that has resulted in an ethnographic report supporting his thesis.

What can be identified out of those sequential explanations in Part 2, is as an emergent property of ecologically situated manners of design: *an essential character of collective endeavour that design processes can activate, facilitate and where it can integrate different knowledge and worldviews to constitute ecological manners of living*. Furthermore, it seems to value an all-inclusive process where everyone can be a designer — a co-creative participant. For that reason, what follows in this thesis is an attempt to extend the idea of design process as a platform. This stems from the idea that, *design does emerge as a relational domain of co-creative relationships to be explored*. In the subsequent Part 3 is an exploration of that idea, where the field-research conducted within the schools of the Portuguese municipality of Torres Novas was aimed at creating further understandings in this emerging role for design and designers.

6. CO-CREATIVE DESIGN: SETTING RELATIONAL DOMAINS FOR DEEP ECOLOGICAL SUSTAINABILITY

6.1. INTRODUCTION

Following the previous explanations, this section is drawn over the work of Dr Elizabeth Sanders and of Professor Sandra Jovchelovitch. Dr Elizabeth Sanders has been extensively exploring and reflecting participatory design research as well as mapping its changing landscape. In conclusion of Part 2 the work of Professor Sandra Jovchelovitch is observed in order to support the theoretical idea of *design as a co-creative relational domain* that is not only essential to set deep ecological sustainability but also the possibility of people to create awareness of their participation in broader ecological processes. This subject promotes a major connection between the emerging theoretical understanding and the practice held at the schools of the municipality of Torres Novas. The major connection to the work of Sanders is based on the common underlying idea of the co-creative evolution underlying design practice and its intention to support a transformation toward more sustainable ways of living in the future (Sanders and Stappers, 2008 p. 01).

As an interdisciplinary exploratory field of work, design has been expanding its boundaries and increasingly involving people in what is mainly regarded, studied and developed as *user-centred design* or *participatory design* – that are in fact two broad and well established research domains informing design processes (Sanders, 2008). While the domain of *user-centred design* research and practice has its origins in the United States and major focus on design usability and utility, participatory design has its origins in north Europe and its practice runs under a mindset that invites people to participate in the process as partners (Sanders, 2006).

Both have been evolving since the 1970's and are now influencing each other. In an attempt to situate this research within and to explore a possible path to introduce ecological awareness via design processes, participatory design research will be exposed as having evolved as a co-*creative relational domain* within design research and practice and that it is similar to what Sanders has been characterising as

generative design research (GDR) and *co-design* (Sanders, 2006, Sanders and Chan, 2006).

According to her, GDR has being radically changing traditional design processes, creating new collaborative tools, rules and methods for research, expanding design boundaries, creating new relational design spaces, blurring roles and creating new ones (Sanders, 2000, Sanders, 2002, Sanders and William, 2003, Sanders, 2005a, Sanders, 2005b, Sanders and Chan, 2006, Sanders and Stappers, 2008, Sanders, 2008, Sanders, 2009, Sanders et al., 2010, Sanders and Westerlund, 2011, Sanders, 2006).

6.2. MOVING TOWARDS THE FUZZY FRONT END

The increasing participation of people in design processes has been accompanied by a movement of its focus and locus of research from the back end, in which people are seen as users of materialized design structures, towards the domains of concepts and ideations that precede traditional design processes which has been characterizing different *relational spaces* within design practice and research (Sanders and Stappers, 2008).

Initially, design processes were characterized by an *expert-driven relational space* within which people we serve through design were seen as consumers, users, and or customers of a given product or service, with processes being focused on the "thing being designed, e.g., the object, communication, space, interface, service, etc., looking for ways to ensure that it meets the needs of the end user" (Sanders, 2002 p. 01).

Chasing innovation, companies and professional organizations has shifted from observing and interviewing passive user's opinion to bringing them through the process establishing new relational spaces for experiencing and adapting and giving them new roles that can range from providing different expertise, informing, inspiring, and even in ideating (Sanders and William, 2003, Sanders, 2005b, Sanders and Stappers, 2008). In coming closer to early design phases, it inaugurates a new and growing *co-creative relational space* that Sanders situates at the *"fuzzy front end"* of the design development process (Sanders and Stappers, 2008 p. 02).

The front end of design process is a metadesign domain of aims, dreams, values, beliefs, intentions and aspirations that Sanders explains as the *fuzzy front end* (FFE) which is characterized by a range of activities that precede traditional design process and take place in order to inform and inspire the exploring of open-ended questions with all its ambiguity and chaotic nature (Sanders and Stappers, 2008). As she explains, this is a critical phase of the co-creative process that entails understanding users and contexts of use (Sanders and Stappers, 2008) and the identification and the collection of data that will have influence over the whole process (Cross, 2005). The FFE can be an end in itself as well as followed by the traditional design process of the conceptualization and formalization with the analysis and synthesis of data generated in early phases.

Such a move towards the FFE also shows that the relational space of participatory research has been gradually situating its focus on the early stages of the process and improving people participation there. It has been involving researchers, designers and a range of different people in an *anticipatory co-creative design process* that may pervade the whole design process, blurring the roles of all its participants. By the use of specific tools to unlock co-creativity, the main aim of such move is to unveil and widen anticipatory understanding of the final goal by all the participants (Sanders, 2006, Sanders and Chan, 2006, Sanders and Stappers, 2008).

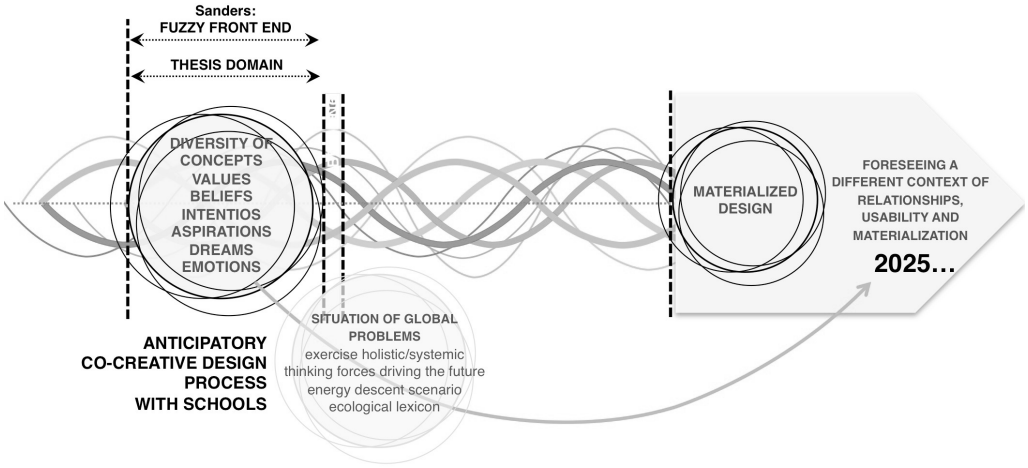


Figure 7 - Thesis domain situation within design practice

In the image above, a situation of the thesis' practice is proposed, based on the introductory explanations. This is the metadesign phase of concepts that Sanders has explained as the fuzzy front end, which in this thesis was regarded as an *anticipatory co-creative design process.* In the field-research it was the relational domain to situate global ecological issues and to foresee via ideation different contexts of

usage, relationships and possible materialization for the schools of Torres Novas in face of the whole context proposed in Part 1 and according to the ecological ideas emerging from Part 2. — See Part 3.

6.3. EVOLUTION OF PARTICIPATORY DESIGN RESEARCH

Participatory design research and practice has been taking place since the 1970's changing the way people are served and referred to by designers from customer, consumer, user, and participant to co-creator. According to Sander's work, a new generation of tools and techniques has been developed to generate and disclose people's creativity from ideas to objects, spaces, systems, and social innovation according to their own needs (Sanders, 2005b).

The evolution of participatory design has been useful and used across the entire range of design domains but its rate of adoption varies greatly. It is more absorbed, adapted and developed within the domains of service and product design that includes software design and interactive design, meanwhile architectural design and planning design has being slower to change (Sanders, 2005b, Sanders, 2009). Also, participatory design gradually has been shifting from the focus on products to focus on design for certain purposes — See the Sander´s explanation in the table below:

Table 6 — "A snapshot in time of traditional and emerging design practices" from Sanders(Sanders and Stappers, 2008 p. 07)

The traditional design disciplines focus on the designing of "products"	While the emerging design disciplines focus on designing for a purpose
Visual communication design	Design for experiencing
Interior space design	Design for emotion
Product design	Design for interacting
Information design	Design for sustainability
Architecture	Design for serving
Planning	Design for transforming

6.4. CHANGING ROLES

The move from user-centred design to co-designing has been changing the roles of the players within the design process. The roles of the user, researcher and designer which were well defined are now becoming blurred (Sanders and Stappers, 2008). Originally the user was a passive object of study for the researcher; and this one

would provide the designer with insights, or information to generate new ideas and knowledge. Gradually, the user became a critical component of the process and the designer and researcher closer collaborators. In co-design the roles are of equal importance as all participants are co-authoring the process, as explained by Sanders:

> "[…] the person who will eventually be served through the design process is given the position of 'expert of his/her experience', and plays a large role in knowledge development, idea generation and concept development. In generating insights, the researcher supports the 'expert of his/her experience' by providing tools for ideation and expression. The designer and the researcher collaborate on the tools for ideation because design skills are very important in the development of the tools. The designer and researcher may, in fact, be the same person. The designer still plays a critical role in giving form to the ideas" (Sanders and Stappers, 2008 p. 08).

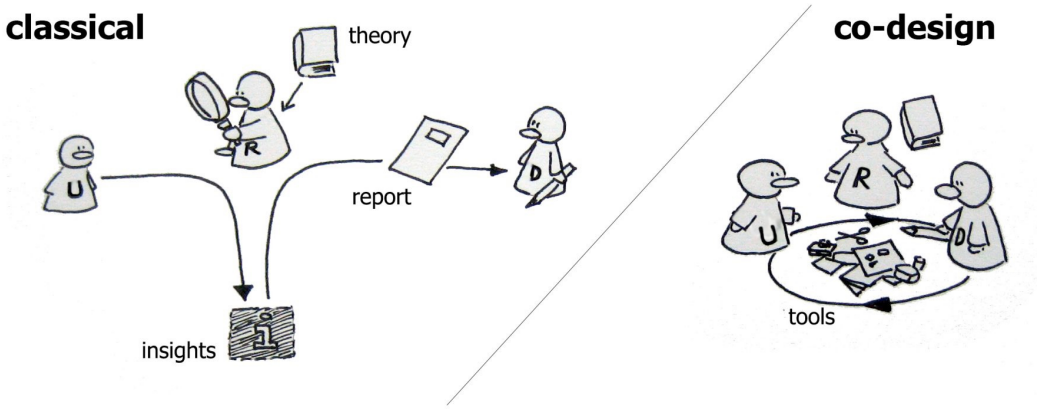


Figure 8–The evolution of design research as defined by Sanders. Initially the social scientist was the interface, until the roles of designers and researchers blur and the user become a critical component of the process (Sanders, 2002 p. 02).

6.5. UNCOVERING CO-CREATIVITY

In her 25 years of practice in participative research, Sanders has uncovered four different levels of creativity that people seek. According to her, people will have different levels of participation in co-authoring the process that will depend on their levels of expertise, passion, and creativity that she organizes in 4 levels of "doing, adapting, making, and creating" (Sanders, 2005b, Sanders and Stappers, 2008):

- **Doing:** people feel creative when engaged in everyday activities as exercising and organizing, or even shopping. It requires minimal amount of interest and

low skill requirements. Consumers in consumerist culture satisfy their creative needs through shopping (Sanders, 2005b).

- **Adapting:** Personalization of objects to fit their needs. Adaptation emerges when products, services and environments do not exactly meet people's needs. It requires more interest and skills than doing (Sanders, 2005b).
- **Making:** Use one's own hands to make something different. There is usually some kind of guidance involved, e.g., a pattern, a recipe, or note that describes how to assemble things together. It requires genuine interest and some experience, the spending of more money and energy. It is much closer to a person's favourite activities and hobbies (Sanders, 2005b).
- **Creating:** It differs from making as it relies on the use of raw material and absence of predetermining guidance. The motivation behind it is to express oneself or to innovate. It requires passion and a high level of experience (Sanders, 2005b).

Table 7 — Levels of creativity, adapted from (Sanders and Stappers, 2008)

Level	Type	Motivated by	Purpose	Everyday activities	Design Spaces and everyday activities	Design space	Everyday Activities
1	Doing	Productivity	'Getting something done'	Organizing my herbs and spices		Design for consuming	Shopping, buying, owning and using
2	Adapting	Appropriation	'Make things my own'	Embellishing a readymade meal		Design for Experiencing	Doing and Using – customization
3	Making	Asserting my ability or skill	'Make with my own hands'	Cooking with a recipe		Design for adapting	Adapting, modifying, or filling in
4	Creating	Inspiration	'Express my creativity'	Dreaming up a new dish		Co-creating	Making and creating

Every level of creativity is correspondent to different relational space within the design process. Although those distinctions, every user can experience grow in the process, or continuous processes, ranging from basic levels toward higher levels of participation. It develops in the individuals over time and through experience and participation (Sanders, 2005b, Sanders and Stappers, 2008). In this case the designer/researcher can be a facilitator of "people's expressions of creativity at all levels" and thus they can become part of the design team as "experts of their

experiences" (Sanders and Stappers, 2008 p. 09) in living, working, playing, and learning (Sanders, 2005b).

6.6. GENERATIVE DESIGN RESEARCH

Participatory design research, as explained by Sanders, has evolved twofold. [1] The research by researchers – people trained in research and/or applied social sciences that have tended to focus on the *informational approach* drawing on the scientific model of research and relying first on extrapolation of past events as a way to move forward. [2] The research performed by designers that have tended to take an *inspirational approach* that is generative, evocative, built through experimentation, ambiguity and surprise. "It draws primarily from the future and the unknown, using imagination as the basic expression" and it is "discovering its own tenets of good research such as relevance, generatively and evocativeness" (Sanders, 2005b p. 08). Both ways are required in the emerging design spaces of co-creation and adaptation as well as in generative design research (Sanders, 2006).

Generative design research can be understood as design relational domain emerging from processes of co-creation within the field of participatory research and are design-led, it is fully within a participatory mindset and is characterized by the use of design thinking and generative tools by all the participants from the FFE (Sanders and Chan, 2006, Sanders, 2006):

> "The name 'generative tools' refers to the creation of a shared design language that designers/researchers and the stakeholders use to communicate visually and directly with each other. The design language is generative in the sense that with it, people can express an infinite number of ideas (e.g., dreams, insights, opportunities, etc.) through a limited set of stimulus items. Thus, the generative tools approach is a way to fill the fuzzy front end with the ideas, dreams and insights of the people who are to be served through design" (Sanders, 2006 p. 06).

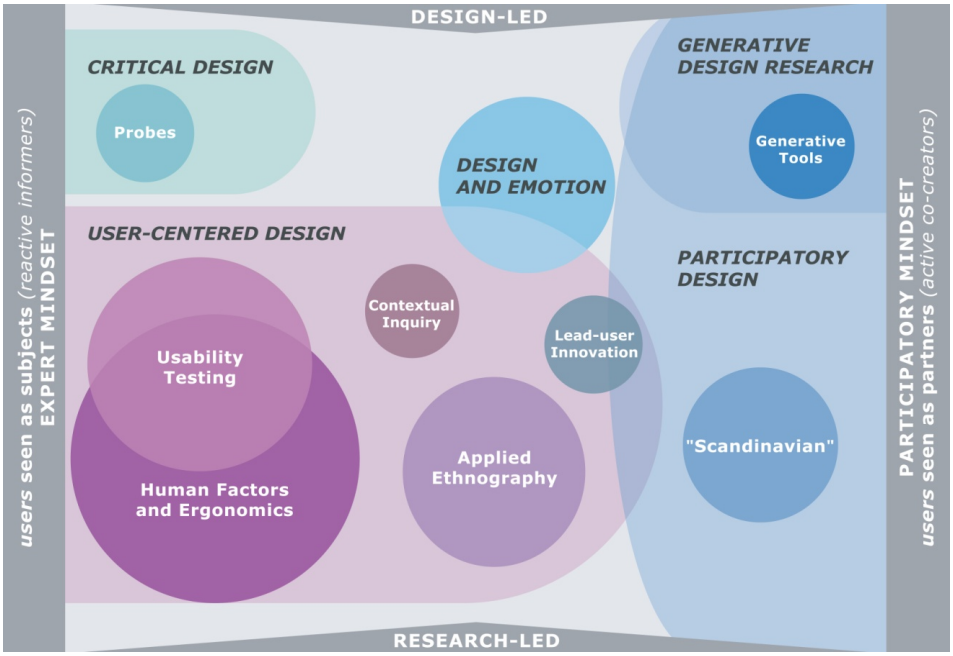


Figure 9 - Emerging Trends in Design Research: Changes over time in the landscape of design research where GDR is in a fully participatory and design led mindset. Available on Make Tools – online (Sanders and Chan, 2006)

Generative design research has a tendency to blur the differences among research and design in the way the roles of designer and researcher tend to blur as well. But as researchers, designers will need to learn how to provide guidance, and platforms as well as clean references to encourage people at all levels of creativity (Sanders, 2006, Sanders and Chan, 2006, Sanders, 2008). Inspired by Sander's findings and in that which regards this thesis, a situation of participatory design tools within certain communities of practice and for social purposes and activism, can indeed empower everyday people with means to generate and promote sustainable alternatives to everyday decision-making in subjects as vast as food production, housing, energy, schooling. When seen together with the building of ecological literacy, ecological thinking and future thinking, what emerges is that possible role of design in activating, facilitating and integrating different knowledge to enhance people participation when imagining, endeavouring, and crafting an ecologically sustainable culture. This is complementarily implicit in the explanation offered by Gonzalo Salazar Preece:

> Design is a particular form of languaging about creating eco-cultural tools that facilitate (or "coordinate") other eco-cultural coordinated activities. By "eco-cultural tools" I do not mean, as modern epistemologies assume, that, through design, we create static and consummated objects (such as tables,

> cars, or houses), as if they were static artifacts in themselves, separated from the flow of being-in-the-world. To say that design belongs to a human abstract and bodiless procedure that creates artificial and static things/worlds positioned over a natural one is, in phenomenological and bio-cognitive terms, inappropriate. *We do not design without our embodiness, but through it. We do not design over a natural world, but within it*. Thus, by "eco-cultural tools" I mean that, through design processes, we rather create ongoing platforms that, not only are part of the process of living, but also facilitate that process of living. Briefly, through design we do not create static objects, but facilitate a mode of living (Preece, 2011 p. 60).

6.7. THE EMERGENCE OF A CO-CREATIVE DESIGN DOMAIN

A co-creative relational space is thus the possibility of individuals to understand participation through social processes as well as in broader ecological processes alike. Collective creativity or co-creation as Sanders and Stappers refer here

> "[…] to any act of collective creativity, i.e., creativity is shared by two or more people". [And its application may range] "from the physical to metaphysical and from material to spiritual" (Sanders and Stappers, 2008 p. 02).

And collective creativity applied across the whole span of design processes is co-design. Co-design is therefore a specific domain of co-creation. Sanders's proposition is wider and refers to co-design as the creativity of designers with people not trained in design working together through the whole process of design development (Sanders and Stappers, 2008). *Therefore co-design is the chance for people to co-author projects "equal in stature and in possession of unique and relevant expertise"* (Sanders, 2005b p. 04) that — together with ecological thinking or ecological manners of design — can harness and support a transformation toward more ecologically sustainable ways of living.

If understood as part of our living and doing things together, co-design might exert transformative pressure over the dominant worldviews so as to embrace a co-creative attitude with the means to legitimate other individuals' creativity within the scope of their knowledge in bottom-up initiatives that can transcend the boundaries of traditional design practice and research. If explored and extended to governance,

planning public infrastructures and several human systems, it also threatens existing power structures that are built on top-down hierarchy and control “by requiring the control to be relinquished and be given to potential customers, consumers, or end-users” (Sanders and Stappers, 2008 p. 05) and also to citizens evolving into an egalitarian generation of ideas and sharing — a conversation in mutual trust. It is also antithetical to consumerism, as it moves closer to address collective needs in place of individualized aims. Therefore, more than a new domain of research with its methods and set of methodologies, “it is a mindset and an attitude about people” (Sanders, 2002 p. 01).

7. PART 2 CONCLUSIONS: DESIGN CO-CREATIVE DOMAINS ACTIVATING PARTICIPATION IN THE PUBLIC SPHERE

The co-creative relational space emerging from participatory practice in generative design research is the possibility of people creating awareness of their participation in social processes and — for the purposes of this thesis — it could evolve to create awareness in their participation in the dynamics of natural processes. A relational space, which is compared here, to the public sphere of participation conceived by Jürgen Habermas and approached by Sandra Jovchelovitch (1995), can be determinant to both individual and collective awareness.

The work of Sandra Jovchelovitch emphasizes the psychological importance of participation in the *public sphere*, that she defines as the conceptualized space where processes of socialization – conversation and understanding – take place; it is the space within which we constitute our system of values, ideas, shared beliefs and practices and is therefore the ground for the emergence of intersubjective realities (Campbell and Jovchelovitch, 2000, Jovchelovitch, 1995, Jovchelovitch, 2007). Delivering on Habermas explanations, she clarifies that the public sphere is conceptually situated within the encounters of the three spheres that characterise the bourgeois society: The private sphere — of the individual self and intimacy — the market sphere and the governmental sphere (Jovchelovitch, 1995).

According to Jovchelovitch, their interconnection is essential in modem societies as the existence of a public sphere is decisive to sustain the possibility of democracy and citizenship – where all people in their speech and by their action participate in that sphere of life that is common to all, and therefore cannot rely on purely private interests and intimacy.

> "Furthermore, it is decisive to the constitution of a private life that bears in itself the full consequences of the fact that people live together and there is no human life without the presence of other human beings" (Jovchelovitch, 1995 p. 81-102).

As she widens the understanding on public participation it meets Maturana and Capra's previous explanations on the ontogenesis of human biological existence (Maturana and Varela, 1984, Capra, 2002). According to Jovchelovitch, the participation in social life is

> "[…] deeply rooted in the process through which the human subject develops a self, creates symbols and opens up to the diversity of the world of others [and that] the individual, in herself, is the outcome of a process of socialization"[...] "*Individualization and socialization are different aspects of one the and same process in the ontogenesis of human experience"* (Jovchelovitch, 2007 p. 04).

And the processes through which we form our social representations

> "[...] are embedded in the communicative and social practices of the public sphere: dialogue, talk, rituals, patterns of work and production, art, in short, social mediation. As such, analyses of social representations must concentrate on those processes of communication and vivid experience that not only generate them, but also confer upon them their peculiar structure. These processes are all mediations, since there is no experience of social life that can be considered immediate. To communicate is to mediate between a world of infinitely different perspectives; to work is to mediate between human needs and the raw material of nature; to develop rites, myths and symbols is to mediate between the alterity of an often mysterious world and the world of the human mind; they all reveal to a greater or lesser extent the quest of humans to make sense and to give meaning to their existence in the world" (Jovchelovitch, 1995 p. 81-102).

So by living and doing things together, by co-creating — co-designing — in this public sphere, we do construct our participation in society as we shape ourselves as individuals, as part of our regular conversations and negotiations within which we comprehend, situate and confer meaning to our living and surroundings. And furthermore, as Jovchelovitch explains:

> "[...] it is through participating that a group of people can develop awareness about its own resources and can engage with significant others in the public arena. These significant others [...] can be dominant, oppressive, potential

> allies, peer communities, and so on. Awareness about its own conditions and identity, acquired in the process of engaging with others and stating a project, takes us back to Freire's conscientization – the process of constructing critical awareness about oneself and the world. Thus, rather than being a precondition, which can be measured, community participation is an achievement of social and individual life (Campbell and Jovchelovitch, 2000 p.04).

This growing area of co-design and generative design research could indeed develop into the very possibility of a realization of certain public spheres that could allow the relationship between the individual and society to participate in it with equal stature, and in possession of their unique individual and relevant knowledge. The same can be extended to human participation in the broader community of life — if allowed space for further exploring, experiencing and understanding that the soundness of living is intimately connected to the soundness of natural ecosystems.

Therefore, it is from this co-creative paradigm, that a new relational domain of collective creativity has been emerging. It goes beyond the traditional getting together around design for objects and products of consumerist culture to give importance to the participation in itself and that can be extended to broader participation in social processes alike. Co-creative design processes are thus — from the perspective this thesis aims to support — the very possibility to introduce, contemplate and practice a conscious ecological living, expanding from conscious social participation to broader and conscious ecological participation within the dynamics of ecological systems. Indeed, according to Sanders

> "[…] the co-creative paradigm is being espoused by those exploring the intersection of science and spirituality as one of the primary means for transformation of the dominant worldview that is taking place today. This transformation is from an unsustainable way of life to one "in which both science and spirituality reconfigure our most basic understandings of human consciousness and how to live harmoniously in a healthy and sustainable ecosphere" (Institute of Noetic Sciences in Sanders and Stappers, 2008 p. 05).

According to Preece:

> "The most appropriated form of ecological design is the root based, communitarian learning-by-doing creation and conservation of sustainable forms of conversing; the role of design is the creation of platforms that enhance the cultivation of cooperative and respectful homing" (Preece, 2011 p. 28).

Ultimately, the establishment of such platforms, that are co-creative relational domains, could activate participation in public spheres and also help people to understand their participation, to endeavour and craft a soundness future by individuals and their communities rooted in place.

PART 3. THE BUILDING OF THE ECOLOGICAL IMAGINATION OF THE SCHOOLS OF TORRES NOVAS

1. INTRODUCTION

Part 3 describes an ideation process workshop which was specially designed to be held at some of the schools in the Municipality of Torres Novas, Portugal where the students were invited to imagine their school in face of the issues and theoretical understandings developed in Part 1 and Part 2. The objective of the exercise was to explore ways in which design could contribute to foster ecological literacy through participatory processes, a reflection on the role of the designer as an activator, integrator and facilitator of an ideation process as a platform to co-creatively construct an ecological imagination of the schools of Torres Novas.

With reference to the previous Parts of this thesis, many of the issues we are living today, as well as those approached during this exercise with the schools, such as peak-oil, climate change and generalised resource depletion, are outside of the scope of the general understanding of people. And when one cannot understand or consciously experience such ecological participation the result is that one can neither fully understand their place in it nor the consequences of basic and apparently trivial choices one makes (Antonovsk, 1996, Bohm, 1980, Ferry, 2010, Ferry, 2011a). This encompasses all the impacts generated by our human systems, from food, transportation, housing, generalised consumption of technology and gadgetry, human work, building materials to energy and everything else that is part of modern living and its underlying intentions. In other words, all these issues generated by the impacts of human living in the Natural world could well remain distant fictions to most of us until they become personal, experiential reality. This is especially important in what regards all the general people that is left aside important top down political decision-making. Design can play an important social role in this regard.

Since that, all the exercises proposed here are based on the idea that it is necessary to resituate people and their doings and the ecological issues within their scope of understanding. Furthermore, if it is essentially through social participation that the human subject develops a self, creates symbols and opens up to the diversity of the world of others (Jovchelovitch, 2007), it can certainly be fomented and extended to the realm of our broader ecological participation (Capra, 2002, Maturana and Varela, 1984). So if we want to become committed to the building of a culture of deep ecological sustainability, it seems reasonable to claim that it is necessary to find ways in which we can experience our intrinsic participation in the dynamics of the social and ecological systems to fully understand them. As was suggested by David Orr (2002) we are to become ecologically literate citizens. Therefore, as will be further explored in Part 3, the sort of participation promoted by co-creative design processes could be of vital importance.

Similarly, if we assume that learning happens in the totality of the individual through congruent interrelationships with others and places, it not only brings importance to the type and quality of the environments we generate to live, but also to the kind of relationships we nurture along the processes in which we materialize it. This is especially relevant for design and educational settings that are in fact human systems that are simply reinforcing practices and pathologies that cannot and should not be sustained over the long-term. In this respect what this thesis aims to propose and support in Part 3 is that design need not remain limited to the scope of turning the objects and building environments surrounding educational contexts green but also that designers themselves may become involved in education by becoming activists of certain processes.

Having recognized the dimension and limits of such an endeavour and mindful that autonomous initiatives in these times where political and social institutions are not able to respond to the increasingly globalized and complex issues before them, the invitation for the scholar community to think about their own future and to hold them accountable, is in itself, a sort of design activism. In this sense, modest projects and initiatives if deployed in mass could create a network of experiences, alternatives, domains and territories that are more ecologically viable and desirable.

2. THE EXERCISE

The exercise that will be described in Part 3 was designed and negotiated between the second half of 2011 and the first half of 2012,and was to be implemented in October and November 2012[13]. The opportunity for this project became possible through a network of friendships built up throughout the research. First, professor João Rosa, who made arrangements for a pilot exercise with his students of the first year of design at the School of Industrial Design of the Polytechnic College of Tomar. This was very important for reviewing the whole exercise whilst in progress. Second, by the generosity of Luis Filipe Dias, at that time, Director of the Municipal Library of Torres Novas who dedicated part of his precious time to listen to the proposal and then adopt it as part of the regular range of activities, which the Library had to offer to the scholar community during the period of 2012 to 2013.

As a matter of course, the exercise follows the research backdrop in searching for alternatives for the growing awareness that, in face of human ecological impact over the Planet, we are likely to enter a period of scarcity of the overall natural resources supporting an industrial society. This was referred to as an *energy-descending scenario* that may significantly change much of what we take for granted about our collective future. Hence, it was an invitation for the students and their teachers to ideate their scholar context in the face of such a scenario. To deal with such scenarios as peak-oil, climate change, resource depletion and other emerging socio-ecological issues that may create negative impressions and emotions, including denial, which can prevent people from engaging in creative thinking about the future (Hopkins, 2008, Hopkins, 2011). Moreover, in addition to the construction of a specific scenario for this ideation process, specific informative and generative tools were designed to situate people, help them to surpass the potential negative perspectives and unlock creativity. Succeeding this, a final questionnaire was developed, to understand the effectiveness of the exercise and to obtain further information from the ideas and understanding of the participants experience on the whole.

[13]The implementation refers to the exercises used to analyse and write up this chapter. Early in the year 2013 there were also some additional exercises carried out with a different public of different age group. However, as the outcomes were much the same the option was to keep the initial series that will be described in Part 3.

Early on, in the initial attempts to collaborate with the schools, a series of factors surfaced that eventually came to influence the exercise and its final format. Portuguese schools are subject to major structural transformations, largely due to schedule and budgetary constraints and bureaucratic procedures which provoke a lack of autonomy and a certain amount of difficulty in creating alternatives out of the scope of the regular curricula and annual programmed activities (Martins, 2013). For these reasons, it was also not possible to propose exercises involving the implementation of physical objects, making it necessary to work within these constraints and build a concise exercise to generate ideas.

In endeavouring to overcome major bureaucratic constraints and to facilitate the acceptance of the exercise proposed through the Municipal Library of the city of Torres Novas, the main branch responsible for the network of local scholarly libraries and for promoting correlated cultural and extra-curricular activities for the local scholarly community. This has also facilitated contact with other local people working with schools and provided valuable information for the organization of the exercise. The core exercise will be exposed first to help with understanding.

2.1. THE DESIGN AND IMPLEMENTATION OF THE ACTIVITY

The activity was structured around three leaflets used as generative tools for an ideation process. These were explained through conversation by asking questions and provoking reflections with support of a flipchart. Both the leaflets and flipchart were used to avoid the dependence on digital slide shows and due to the probable lack of appropriate conditions that may have been found in these public schools; for instance, poor lighting control in the facilities allocated for the exercise and the eventual impossibility to obtain projection equipment for the schedule. Nonetheless, this enabled a more interactive approach based on conversations elicited from the sketches on the flipchart (see image below).

Figure 10 — During the conversations with the students it was possible to draw on the flipchart to explain the concepts and to incite their reflection and participation.

The overall exercise was organized in two distinct phases. One that was called explanatory conversation, which was a reference to the way information and explanations were delivered through question-based conversations and drawings, and with support of the leaflets. This was followed by a brainstorming session — this was the ideation process involving their own school and information which they were exposed to in the first phase. The exercise ended with the application of a questionnaire. The three developed graphical elements and this whole process will be described in the following sections.

2.1.1. AN ENERGY-DESCENDING SCENARIO FOR 2025 AND BEYOND

This was a direct outcome of the research carried out on concepts related to the energy-descending scenario in Part 1. This information was synthesized onto the leaflets as described below and used in the ideation process. For instance, a fundamental transformation of what we take for granted about the future was the starting point to facilitate the ideation process with the schools. The subjects leading to the proposed scenario in the leaflet were presented and discussed in in brief with the participants. Beginning with, the main issues we are facing, such as peak-oil, climate change and resource depletion and how these subjects are interconnected and mutually influencing each other. This enabled the students to understand that the proposed scenario was not a simple imaginary fact created for the purpose of the exercise, but a plausible one in light of the emerging issues. This was complemented

by the other two elements that are called the “constitution of the ecological being” and the “ecological lexicon,” explained later.

The leaflet depicting the scenario was also used to set a clear context in which to situate the ideation process. Before the ideation process one of the students was asked to read the text aloud which was then followed by a moment for reflection:

> “A culture of sustainability emerges: The depletion and shortage of traditional sources of energy (oil and coal) and the climatic changes in transit become part of the European reality by 2025 and a culture of sustainability becomes urgent. This is accompanied by the adoption of drastic measures to cut and control the energy consumption in all societal levels, which causes profound shifts in the way our social relationships take place as well as human relationship with the natural world.
>
> The decreasing of energetic abundance led to the drastic reduction in consumption, industrial activities. All followed by the necessity to relocate all available sources of renewable energy, food production, the economy and work. Hence, it means the reduction of complexity in local systems of work, production, distribution and sharing. At the same time, the use of technology becomes restricted to the essential.
>
> Urgent necessity of valorization of learning by doing, self-learning, reflection, and nurturing of social and environmental wellbeing emerges; and also revalorization of the interest in manual skills, community involvement, and sharing of events and knowledge. New design rules and the management of biological and technological resources, the recovery of woodlands, ecosystems and biodiversity become sources of wealth and wellbeing” — This is the Scenario built up for the exercise. See also the image below.

When the issues regarding the scenario were delivered and discussed with the participants, they were able to envision a different future themselves and usually it was one of perplexity and negativism, as described by Rob Hopkins (2008; 2011). Hence the generative tools — the 3 leaflets — were developed in order to help them to get past this negative state. So the scenario presented in the leaflet was also

created in order to offer a few ideas they could explore as thought starters and also to prevent strong negativity. The two additional tools are now presented.

Figure 11 – The leaflet with the scenario and enticing pictures to illustrate it and to enact positive visioning.

2.1.2. THE CONSTITUTION OF THE ECOLOGICAL BEING

The *constitution of the ecological being* is a short explanation that derives basically from Humberto Maturana's ideas on the biological constitution of culture and social identity to illustrate essential principles of human interconnectedness with the dynamics of ecological systems and thus to relate ourselves — human beings — as responsible for the emerging scenarios and also as the ones responsible and capable to counteract it (Maturana, 2002, Maturana and Varela, 1984, Maturana and Verden-Zoller, 1996, Preece, 2011, Antonovsk, 1996). It was also created to promote ecological principles and the understanding that the richness and diversity of other life forms have intrinsic values in themselves, which contribute equally and mutually to the flourishing of human and nonhuman life on earth. Hence, deep ecological principles to nurture (Orr, 2002, Naess, 2008).

The graphic explanation of the ecological being was developed to summarize the ideas emerging from Part 2 and to facilitate the reflection on it. In the image below, the right wing represents the socio-cultural environment and the social network of culture and its general aspects that affect us all, like family, communities and institutions that will influence the worldviews of individuals. Represented on the left wing is the biophysical environment with its biological relationships. It expresses the importance of how environmental relationships are important to individual and collective health and the health of life-supporting ecosystems.

These two dimensions are constituents of the individuals' behaviour towards the world and the meanings they attribute to their surroundings, which involve sensations, emotions, mental dispositions, and also reason. They serve to provoke reflection on the complexity and the multitude of factors influencing their attitudes and to provoke reflection on the types of skills and abilities that would be essential in face of the proposed scenario. This image was not simply delivered to the students. During the explanatory conversation, drawings were used to complement the verbal explanation and also to promote major connections with the elements compounding the scenario. This was also the context set to explain other short concepts that were all aimed to work as thought starters and that were arranged in form of what was called the *ecological lexicon*.

AUTHOR: DENIS KERN HICKEL FREELY INSPIRED ON BANKSY AND THE BUTTERFLY MODEL. IT BELONGS TO A PHD RESEARCH IN PROGRESS.

Figure 12 The leaflet of the ecological being. Banksy's graphic was used to illustrate the constitution of the ecological being both because it is very illustrative of the desired explanation and because of its appeal to youth.

2.1.3.THE ECOLOGICAL LEXICON

As approached in Part 2, an ecological lexicon (EL) is a set of concepts, terms and words that were conceived from the necessity to create something that could act as thought starters intended both to surpass negativistic approaches to thinking, and to encourage creativity. This was initially inspired by Maturana, Wahl (2006), Preece (2011) and Antonovsk (1996). The lexicon was explored as thought starter, and then was to become the subject of major idea articulation, engendering, and transformation, imparting a new sense of meaning to the subjects proposed during the exercise. The terms and concepts as were written at that time were as follows:

> "Ecology: Is the study of living organisms and their relationships among each other, other species and theirs ecosystems.
>
> Participation from an ecological perspective: Life emerges and is sustained along the natural processes in which we are active participants. By living and doing things together in a range of different environments, we are in continuous interaction to form a web of social and ecological relationships. Our individual identity as well as human culture is the result of participation in this natural process. As biological beings and participants of natural dynamics, every human being affects and is affected by the wellbeing of other individuals, communities, ecosystems, and the biosphere as a whole.
>
> Ecological thinking: To live and act under an ecological perspective is to live in awareness of our own condition as participants in the natural processes within which all our biological and social processes take place. It necessarily implicates new ways of relating with the natural, with knowledge and subjectivity (self-knowledge), politics, ethics, science and citizenship.
>
> Emotioning — The biology of love: All emotions behind human action are biological phenomena. This is the biological emotion of love that allows trust and mutual consensus and permeates all the socio-ecological relationships of proximity and intimacy along the living of each individual being.

> To live is to know: There is no definitive knowledge. To live is the process through which we learn. Life is the school; knowledge and reality are a continuous and open process.
>
> Health: Is a full state of physical and mental wellbeing of an individual or group of individuals. It entails all its social and environmental relationships and worldviews.
>
> Salutogenese: It is the generation of health. The nurturing of salutogenese involves the understanding of the essential relationship among human and planetary health. It also involves the practice of coherence among thinking and action and emotioning and reasoning.
>
> Ecological Design: Is the expression of doing things together.
>
> Lexicon to be explored: health food, edible gardens, symbiosis, cooperation, ecosystems, biodiversity, pollination, self-knowledge, outdoor activities, meditation, yoga, breeding, social network, sensations and emotions, reason, language, aesthetic values, ethics, flexibility, recognize and value different knowledge, and the ancient and situated knowledge."

Many of these terms also formed part of the explanation regarding the constitution of the ecological being. The content of the EL was intentionally organized to emphasize values like emotions, self-awareness, ecology, our interdependence and responsibility to the kind of world in which we live. This series of words were exhibited to enable the participants to choose from and explore at their will during the ideation process. The ecological lexicon's leaflet as was delivered to the students is the image below.

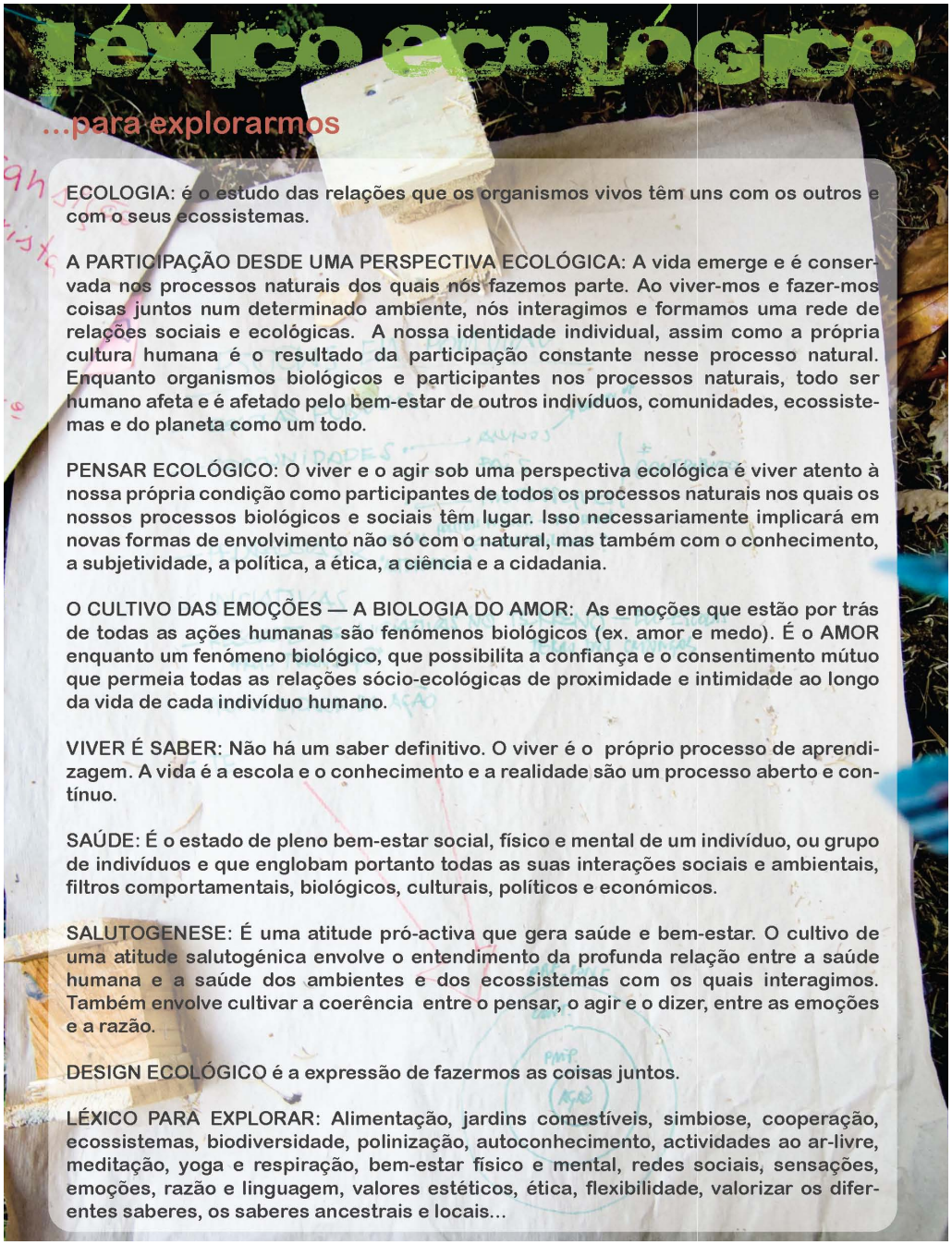


Figure 13 - The ecological lexicon was a set of terms, concepts and words that the students were free to pick and to use along the exercise.

2.1.4. THE IDEATION PROCESS

As mentioned before, these three topics above were presented, debated, explained and interweaved through conversation with the participants. Following this, they were invited to form small groups of 4 to 5 persons for a short brainstorming session to come up with ideas for their schools. Before the session, the specific scenario that was presented above was proposed in order to ensure that the participants could

respond and ideate from the same starting point. This was presented by reading aloud after a brief breathing exercise in silence.

Each group was given the three previously discussed leaflets to support their discussions and allowing them to get back to these issues whenever they wished. Paper and markers were distributed for to the writing of the emerging ideas on the board. In the meantime, the designer/researcher circulated continuously group by group to encourage conversation or to refresh understanding of content where necessary. Directly after the brainstorming session, each group was asked to present, explain and exhibit their ideas on a flipchart.

At the end of each exercise, the participants would be asked to contemplate all the ideas presented on the flipchart while it was said that they could continue working individually in an attempt to implement the ideas they had co-created for their schools. As an option and due to the previously described constraints in the time schedule, the participants were asked to complete an individual questionnaire instead of leading a new round of collective reflection on their outcomes. So it was possible to allow a moment of individual reflection after the exercise, to understand their perceptions of the issues discussed, their explanations and the effectiveness of the exercise. Of the total 90 minutes over which the exercise was delivered, 5 minutes were used for introductions; 45 minutes for discussion; 20 minutes for brainstorming and 10 minutes for completing the questionnaire.

Figure 14 — Students sticking their ideas on the wall after the brainstorming session

Figure 15 — Left, the ideas arranged on the wall and right are the sketches produced during the discussion stage with the students. A flipchart turned out to be a simple and effective tool to draw and connect concepts with the students

2.2. A REVIEW OF THE CREATIVE PROCESS, METHODS AND METHODOLOGIES

Several sources were important for the development of this project. The first source of inspiration came from the work of Lynda Gratton from the London School of Economics about *the future of work* and her proposed "five forces" driving our future that soon became part of the lexicon of this work (Gratton, 2011). It was followed by the review of other authors and references reflecting on future scenarios, that could both support the scenario that was created as well as to enrich the diversity of information. It came from Rob Hopkins proposed Transition Culture (Hopkins, 2008, Hopkins, 2011), David Holmgren's Future Scenarios and concepts of Permaculture (Holmgren, 2009b, Holmgren, 2009a, Legan, 2009), further studies on Ecological Literacy (Stone and Barlow, 2005, Stibbe, 2009) and also from a whole range of other sources both on the subjects of future scenarios and ecology (UN, 1972, Schumacher, 1973, Bohm, 1980, Maturana and Varela, 1984, WHO, 1986, WCED, 1987, Eblen and Eblen, 1994, Gallopin et al., 1997, Sterling, 2001, Stoll-Kleemann et al., 2001, Brown and Carter, 2003, Alier, 2004, Foster, 2001, Resalliance, 2004b, UNDP, 2005, Hollick, 2006, Commission, 2007, SRC, 2007, Sterman and Sweeney, 2007, Bates et al., 2008, Greer, 2008, Hopkins, 2008, Williams, 2008, Greer, 2009, Holmgren, 2009a, Jackson, 2009, Gratton, 2011, Heinberg, 2011, ODAC, 2011, Benenson and Rosow, 2012, ISEOF, 2012). Yet, it is necessary to comment on the work of Elizabeth Sanders, her experiments and explanations on participatory design research, which became an important reference to support and build this kind of activity. All this information was cautiously and specially organized in the practice described above.

2.2.1. GENERAL METHODS AND METHODOLOGIES

Beyond all the references cited so far, other sources such as Dawson (2002), Serrano (2008), Quivy and Campenhoudt (1995) were explored to support and frame the methods, methodologies, tools and techniques that were conducive to the final exercise. This according to the following table:

Table 8 – Methods and methodologies explored

Methodology	Generally this is an exploratory research. According to the work of Elizabeth Sanders the exercise been described in this Act is Generative Design Research (Sanders, 2005b)that has involved people and a range of different and complementary activities arranged in a flexible way to generate ideas on learning environments
Data gathering	Observation of the process (each phase, their relationship and the whole exercise) and a final questionnaire with the objective of identification, organization and analysis of the more relevant patterns that can lead to the proposition of an ecological imagination for schools, eventual patterns indicating increase in ecological awareness and reflection over the outcomes that can inspire further theoretical reflections.
Tools	In order to ensure the exercise ran smoothly, it was designed specifically not to be dependent on electronic data shows. This allowed for the mobility of the set and its application in a variety of different places and situations. Information and theoretical concepts were carefully organized to a pack of generative tools to be used.
Group dynamics	For the pilot activity, a series of techniques that involve role-playing and ludic activities were combined to allow corporal actions and also to facilitate group collaboration and decision-making. During the main activity a brief corporal activity was used as an “ice-breaker” before the introductions and a brief meditation exercise before the reading of the scenario; a question-based conversation to balance explanation and participation and facilitating the group activity along the session were the general dynamics.
Brainstorming	Ideation through enacting creativity to nurture ideas on learning environments based on certain information and situation and specially designed generative tools

The final elements of the exercise were created with the following intentional objectives:

Table 9 – Review of the exercise objectives, generative tools and exercises

Objectives	How
To situate the socio-ecological issues within the context of a specific community	Exposition of specific issues and information and facilitation of the process to connect information. Creation of a specific energy-descending scenario to promote reflection on it. Question-based conversation. Leaflet: Scenario
To build awareness of individual and collective participation within the dynamics of living systems	Graphical explanation of the theoretical concepts approached in Part 2 with graphical support through question-based conversation — Leaflet: "the ecological being"
How to overcome the energy descent scenario?	Specially through the EB and EL to help students to creatively cope with the emerging scenario
Facilitate holistic thinking	All the above together was organized with this objective in mind. A card game was especially designed and used in the pilot exercise. However, due to constrains in schedule it was used to guide the explanatory conversation — see following explanations
Ideation Process	A brainstorming session was conduced to expose emergent ideas from the scenario, the ecological lexicon and their understanding on ecological participation — with support of the leaflets
Validation/understanding the effectiveness	Observation and Questionnaire application

All the graphical elements that were designed and used during this process were 'generative tools' as defined by Elizabeth Sanders (2006). They were intended for the

creation of a shared design language that designers and stakeholders could use to communicate visually and directly with each other to build a collaborative platform, to enhance participation and ideation:

> "[…] The design language is generative in the sense that with it, people can express an infinite number of ideas (e.g. dreams, insights, opportunities, etcetera) through a limited set of stimulus items (Sanders, 2006 p. 06).

2.2.2.THE FIVE FORCES DRIVING OUR COMMON FUTURE

Complementary to the general situation proposed in Part 1, it is also important to remark the importance of the work of Lynda Gratton (2011) as a primary source of inspiration for the whole exercise. Gratton's research is based on the London School of Economics and brings together a research consortium of 200 people, members of 45 different companies from around the world that is aimed at picturing the future of work. By making use of interviews and 2025 day-in-a-life stories she has managed to assemble different versions on how the future of work would be. According to the research, the combination of the *Five Forces* which are driving the future of work are according to the needs of a low carbon economy, rapid advancements in technology, increasing globalization, profound changes in longevity and demography, and important societal changes that together will fundamentally change much of what we take for granted about the future of work (Gratton, 2011).

The idea of the five forces were adopted as an initial reference and, as the exercise was reviewed and refined, further information was added to make it richer and containing more information on both the impacts over ecosystems and the patterns conducing to an energy-descending future, hence, adapting as much as possible to thesis aims. It is important to mention an initial card game that was designed and used only in the pilot exercise together with the other tools. Due to its time-consuming aspect, its intricacies and constrains on time schedule with the public schools it was disregarded as a specific exercise. However, all the information on it was delivered in form of the question-based conversations with the participants.

Moreover, this card game could be used separately by teachers in classrooms. Although there is no feedback until the end of this thesis, some sets were delivered to a few professors. This card game was intended to provoke the participants to

exercise the systemic relationships among these *forces*, the natural resources and our actions in the world. The card game revealed to be somewhat exciting and informative in the pilot activity and will be described following. The image below is of the designed set of cards.

Figure 16 — the card game

2.2.3.A BRIEF NOTE ON DENIAL OF THE ENERGY-DESCENDING FUTURE

The interweaving of the various events underlying our global issues has put people in an uncomfortable state of conflicts as it can dismantle much of what we take for granted about the future (Hopkins, 2008). This was experienced by the designer/researcher when researching and realizing the causes and the extent of a great deal of our ecological issues, which came to provoke a state of anxiety and even denial of certain possibilities. However, it is an emerging understanding that such feelings are inextricably interwoven in one's worldview. For example, in the process of exploring and experiencing a theoretical framework in personal life, the designer/researcher was able to gradually surpass such feelings by engendering of different perspectives and relationships.

These diverse feelings which emerge according to the individuals' worldviews and references are also reflected by Gratton when she states that the arrangement of all these pieces can easily take people to a

> "[…] default future of fragmentation and isolation, exclusion and narcissism within which no one is prepared to get together and engage in cohesive and coherent action to change the status quo" (Gratton, 2011 p. 15).

Rob Hopkins also advises of the inevitable stress and to all sorts of feelings that could emerge from people when facing future scenarios and to what he has called "post-petroleum disorder" with feelings ranging from unreality, irrational grasping, fear, nihilism, denial, among others (Hopkins, 2008 p. 80). In fact, when people realize all the interplaying aspects — thus facing extremely negative and eventually catastrophic but plausible predictions — they may enter in what psychologists call denial: Denial is a defense mechanism in which a person that is faced with a fact that is too uncomfortable to accept, even when faced with what may be overwhelming evidence, will reject it. It may range from simple denial: denying the reality of the unfavorable fact overall; minimization: admit the fact but deny its importance; and projection: admit both the fact and importance but deny responsibility (Hopkins, 2008, Extraenvironmentalist, 2011, Stoll-Kleemann et al., 2001).

This was confirmed during the exercises when, for instance, some students and sometimes the teachers as well, stated that these issues are the responsibility of

third parties, such as politicians and high level decision-makers; or yet when demonstrating confidence in technology to provide a smooth transition to a post-petroleum scenario, and when claiming a feeling of overwhelming impotence in face of such life changing events.

Hence, it is necessary to develop tools, strategies and means to help people to overcome negative prospects brought about by the emerging scenarios as was remarked by other authors (Sanders, 2002, Sanders and William, 2003, Sanders, 2005a, Sanders, 2005b, Sanders, 2006, Sanders and Chan, 2006, Sanders, 2008, Sanders and Stappers, 2008, Sanders, 2009, Sanders et al., 2010, Sanders and Westerlund, 2011, Hopkins, 2011, Gratton, 2011, Holmgren, 2009b). It is necessary to provide people with information, or tools to support individual, or collective strength to cope with their emotions, worldviews, shared beliefs, intentions, and aspirations emerging from their ecological relationships and other deeply rooted cultural aspects to overcome negative prognostics and thrive by taking part in crafting a *"future where co-creation and social participation are the norm*" (Gratton, 2011 p.30). It does involve getting to know how to deal with the diversity of emotions permeating this process and to come up with practical tools to enact participation — the objective of all these proposed generative tools together.

2.2.4. THE PILOT PRACTICE IN THE POLYTECHNIC SCHOOL OF TOMAR

In May 2012, a pilot exercise was held in the Portuguese city of Tomar at the School of Design of the Polytechnic Institute. The meeting with students was scheduled for a whole morning and an assortment of games and activities beyond the ones that were described above were experimented. This experience led to the rearranging of the whole exercise and adapting it to its final format for Torres Novas.

This initial proposition was a complex and long activity composed of introductory exercises, main exercises and transitional exercises linking to the main ones. There was also a great deal of role playing activities that had proven to need lots of time, patience and experimentation in order to go forward. It was an intensive workshop with much of the information intermingled with sessions of reflections, meditation and practical exercises. In the theoretical stage many exercises were designed, with a previous planned schedule for its application. But in practice things were quite

different. As part of the creative process, these primary exercises are arranged and presented below and followed by a brief analysis.

Web of Resilience

Description

A hands on exercise to communicate the dynamics of ecosystems. While it is focused on the description of a local ecosystem the context set by the game can easily lead to the description of inter-dependent local economies and other socio-ecological relationships. This is a common activity in permacultural environments and courses and is inspired by the original proposed by Rob Hopkins (Hopkins, 2008)

Purpose

To communicate the concept of resilience, to understand interdependence (the existence, importance and dynamics of ecosystems as well as our participation within it), to set a "common language of conversation": systemic thinking.

Time

Allocate 20 to 30 min

Resources

One large ball of string and one sticker per person and labels for identifying elements of ecosystems,

Instructions

Write on each sticker in advance, the name of a different element of a Portuguese native woodland; the list could be: Oak, other trees and shrubs and so on, owl, rat, rabbit, fox, birds and so on. You can adapt it for species more appropriate to your area: http://portal.icnb.pt. This exercise is suitable both for indoor and outdoor situations. Following this:

- Invite the participants to stand in as tight a circle as possible.
- Each participant holds the sticker at chest level. The string is then passed around and across the circle. The only rule is that as the string is passed the relationship between the elements of the ecosystems must be made clear.
- As the string is passed around the facilitator can remark on any relevant extra information on woodland ecology and about relationships between the different elements.
- After a while you end up with a complex web of string between the participants. When it is finished, the web must be pulled tight, and then each participant must put their hands on top of it and see how strong it is. At this stage ask people what the connecting factors are between the elements (their relationships).
- Once the web is finished the facilitator can make observations such as suggested by Rob Hopkins: "In nature, this web of relationships is inherent in all ecosystems, and it is the diversity of relationships that makes these ecosystems work. These webs are very complex and resilient, but they are also very fragile. We intervene in them at our peril, as we can never really know what effects we are having, as we have insufficient understanding of the relationships."
- The suggestion here is as follows (Suggested by Hopkins (2008)):While the exercise carried out was pertaining to woodland, it could just as easily be done about a town, with merchants and other workers, the schools, public spaces and buildings, the farmers and so on. Before the availability of cheap oil, our communities and our economies depended on these networks of

relationships and connections. The access to cheap oil gave us the possibility to disregard local relationship and establish economies at another level and scale, such as a regional and global scale. As well as to exploit nature and its resources by disregarding its fragile relationships with unpredictable consequences. Today, people are able to commute long distances to work, to study, to shop and so many of them barely know who lives next door. The cities and our lifestyles have accompanied this trend and spread out towards woodlands and other sensible ecosystems, each time requiring more and more energy and natural resources. To learn and understand the dynamics of ecosystems and living accordingly as well as re-weave this complex web of beneficial relationships it may be essential to achieve ecological sustainability.

- Following this, the facilitator (i.e.) assumes the role of a farmer causing changes in the ecosystem of the woodland to the point of its collapse. As the actions towards the ecosystem are explained, the participants let go of their sticks.

Evaluation

To set a conversation to perceive peoples understanding. Proposed questions: How do you feel about that? How far can we take this awareness in our daily living?

The Five Forces Driving Our Future

Description

This is a hands on and self-learning exercise designed to communicate the relationships among the five major forces driving our future (technology, globalization, society, population — demography and longevity — and energy) and relate them to the natural resources and to the same systemic dynamics introduced in the first exercise. This exercise is freely inspired by the work of Lynda Gratton (Gratton, 2011)but specially designed to fit the purposes of our research. It was complemented and adapted from information drawn from the work of Rob Hopkins (2008, 2011), David Holmgren (2009), and John Greer (2008, 2009)

Purpose

The final objective is to allow the participants to collectively relate the five forces and from there draw a future scenario to portray their own conclusions, reflect on their participation, roles and the need for several levels of shift (personal, collective, social, cultural, etc.) and also to enter into relevant conversation, and collaboration.

Time

Allocate 30 min

Resources

16 Cards specially designed for this exercise, paper (A0 sheets, or roll), support for the paper (a wall or a stationary like a flip chart), pins for fastening, 5 different colourful balls of wool strings and a few pairs of scissors.

Instructions

Invite the participants to go further afield on the subject of the web of relationships and follow this by distributing the cards among the participants (each card contains different information about the five forces. Each one of the forces is divided into 3 or 4 topics). You can give about a minute for people to read and think about the information on their cards.

Following this, ask the participants to walk around the room or within the limits of space you are running the workshop; ask them to greet each other as they wonder around. Then ask them to get together with the next person, and share the information they have. Allow participants to keep conversations going with at least with 3 to 4 different people, or with as many people as possible.

While the exercise is running, draw the five forces around an imaginary circle on the flip chart allowing some free space beyond that and the limits of the frame, at the centre among the five forces place the word “nature”.

End the activity by inviting the participants to be seated around the flip chart and to express their feelings about the exercise; following this, they must collectively draw a web of relationships, to prospect and to establish possible scenarios with the support of cards.

One by one they should stand, read the content of their cards and place them around the related force on the flip chart or board. After that, distribute the different ball of wool strings in five different groups in a way that each ball of wool will correspond to one of the five forces and ask them to approach the flip chart together. They should then build up as many relationships as they are able to find by fastening a string of wool on the pins or by making use of a pen. To facilitate the exercise, follow their actions by eliciting information that may help them to relate the elements.

Evaluation

At the end of the task, ask them to contemplate the result and say: Finally our human systems are subject of the same web of relationships as the natural ecosystems and that all our systems depend on the availability of natural resources…do you agree with that?

Conduct a brief brainstorming session by asking some questions:

- Now let us think on our dependence on fossil fuels: To which level of influence on our daily living can we be affected by its depletion? ...Where does our food come from, how is it cultivated? …Where do our consumption goods come from? ...Where do the elements that make such goods come from? As the answers come up you can write them up on the flip chart, creating more relationships
- If we think that we are consuming resources beyond their capability to recover (such as the fishery stocks and soil fertility) or even consuming finite resources like oil and coal, how do you think we should proceed?
- What is the most important thing within such networks? What makes the web? (Relationships)
- How does it affect us? To what extent?
- Which kind of relationships? Can we nurture certain kinds of emotions?
- If we remain spectators, where are we heading?
- A collapse of human civilization?
- Will technology save us?
- Can we adapt or do something to decrease our energetic needs and ecological footprints? Habits, behaviours?
- How do you feel about it? (This introduces the next exercise)

A Visitor From The Future: Emotioning On An Energy Descent Future

Description

Drawing on an energy descent scenario this is a reflective, expressive and emotional exercise in which the participants are invited to act by creatively imagining them selves as someone who comes from the future to talk of their own hypothetical experiences.

Purpose

This exercise is created to give the participants the opportunity to reflect on and express their thoughts and emotions about an energy descent future. This is also supposed to help people to express themselves as well as to exercise listening.

Time

Allocate 15 min

Resources

A previous designed scenario to conduce the exercise

Instructions

Explain the exercise and invite the participants to form two groups and position themselves in two concentric circles so that people inside and outside form pairs by facing each other. After that, invite them to be seated. Tell them that the people inside the circle are visitors that have come back from the future to share their experiences.

Start reading the previously designed scenario to allow people to reflect on it, following this, ask them to describe their experiences. Provide some questions to elicit the information "How hard was it?"…"What have you done?" and so on. The rule is that the visitor talks to the person immediately in front of them The listener is only allowed to listen! Let them speak for at least 2 minutes. At the end the visitor says goodbye and the listeners thank and respond with a gesture. They then change roles and repeat the exercise. Ask both circles to move opposite each other in a way to mismatch the participants. Now, the listeners will become the visitors. If necessary you can re-read the scenario.

Evaluation

Observe the reactions and participation and ask how they felt about the scenario in a meditative exercise.

Meditating on the previous exercises

Description

It is reported that the understanding on the complexity related to our socio-ecological issues can sometimes be overwhelming or even provoke several other reactions that can range from aversion, denial fear, and so on that can condition further action. In this sense we think it is necessary for a moment of reflection and expression of their emotions.

Purpose

This exercise is created to offer a moment of reflection, contemplation and also a moment for expression of emotions.

Time

Allocate 5 min

Resources

A soft ball, or any other object to be displaced within a circle

Instructions

Invite the participants to remain seated and inform them of such feelings and emotions and to think about it for a moment. Allow for a moment of silence. Proceed by releasing the object previously placed amidst people to anyone wishing to comment — it could be any thought or feeling related or not to the workshop. The rule is that the participant can express anything they wish, during which they must not be interrupted, argued or contested. Others may only give support by shaking hands in the air.

To become a speaker they have to move into the centre (or front) of the group with the object in hand At the end, each voluntary speaker is asked to say the following: "My name is XXX, I came here and said so. HO!

Evaluation

Observe reactions and participation

Exploring And Ecological Lexicon And Building An Ecological Imaginary

Description

Expositive, brainstorming and hands on ideation exercise. We shall present an "ecological lexicon", a series of terms and concepts emerging from the thesis theoretical framework as a starting point and source of inspiration to design their collective vision through expressing their aims and dreams on a timeline.

Purpose

The objective is twofold: [1] To expose and discuss such concepts with the participants and, at same time, relate them to the other previous exercises in a timeline. [2] From the previous exercises and concepts, the aim is to make use of the timeline to allow the framing of a series of possibilities and ideas, thus allowing them to project a future scenario.

Time

Allocate 30 to 60min

Resources

The previous established "ecological lexicon", roll of paper, the previous exercises kept on the wall and in sight, pens and notepaper with an adhesive edge for all the participants.

Instructions

An ecological lexicon or imaginary, or yet an ecological literacy is a collection of references that aim to give people a source to facilitate and inspire to deal with their condition/situation as participants in the dynamics of natural and ecological systems. A timeline is a way of displaying a list of events in chronological order and in this case we shall use it in a reverse manner — from 2025 to 2012 — in a way to set the "bigger picture" in first stage. It expected to work as a way to design a collective ecological imaginary of the school based on the given ecological lexicon and the systemic thinking/awareness exercised in n the previous exercises. A timeline, we expect, might work as a project or as a scenario and as a form of orientation that help to understand and visualize where we are heading to and how to attain it.

Let's start the exercise by remembering the other previous ones and the energy descent scenario (reread if necessary): How can we overcome, or be prepared for such a future? Is the education system and school environment prepared for such a possibility? Following this, you might distribute handouts of the proposed lexicon to familiarize the participants with the concepts while you set the scene for the final exercise.

Explain that the objectives and that these ideas, concepts, phrases and words are a pack of elements that can help them to overcome and/or adapt for such scenario.

Setting the scene: Draw a timeline from 2012 to 2025 on paper fixed to the wall, large enough to allow people to fix notepapers, images and whatever else flows from their imagination. Also, fix a separated A0 sheet of paper (or flipchart) to conduce a brainstorming session on the ecological lexicon.

Following this, ask for a volunteer to read the first concept and then discuss their understanding making sure to relate it to the school context and the energy descent situation. Take note of all the ideas emerging on the flipchart. Repeat this until all the points are covered. At the end, ask them to make use of their notepapers to write words or phrases with their ideas for 2025 and to fix them one by one around 2025. Ask them for a breakdown of the whole picture: split the line between 2012 and 2025 with more reference points (e.g. 2012, 2015, 2018, 2021, 2025) and ask them to write, filling these sections from back to front with ideas and actions that they think would help to implement their visions to 2025. Pay attention to the fact that they might be encouraged to reflect individually by themselves.

Second round: Time to share. At the end invite them to contemplate all the notes placed on the timeline. Ask them to pay attention to the diversity of ideas and try to not making any kind of judgement. Following this by asking the participants the following:

Are you able to organize yourselves to set a collective vision? Setting ideas, principles, aims, and ambitions?

Place another sheet on the wall and let people work. Provide them with scissors, old magazines, pens, strings, pins, glue, and tape. Finnish the exercise by repeating the "meditating exercise" and invite them to express their emotions and feelings about the workshop. End the session by congratulating their achievements, and hank them all.

Evaluation

Observe the dynamics of the exercise for future arrangements and analyse their drawings for ideas about ecological schools. Ask the participants to fill out an evaluation form. This will give you the chance to keep final conversations.

Questionnaire

Below is the first questionnaire submitted to the students immediately after the workshop. This one was the first approach and proved to be too broad with too many open questions leading to different interpretations by the students. And during the period that separated this pilot practice and the practice at Torres Novas' schools it was rearranged to be more focused.

Workshop Ecological Imaginaries For Portuguese Schools

Questionnaire

Group of questions 1: To develop relations of trust and confidence

1. What brought you to this activity?
2. What aspects of the activity have you liked?
3. What haven't you liked?
4. What can be improved?
5. What you do take with you from it?

Group of questions 2: Global vision/Worldviews

1. How do you feel and with which emotion would you describe your participation in the context of the global ecological crisis?
2. How do you feel and with which emotion would you describe your participation in the local ecological context of your school?
3. What is the importance of education and the scholar environment for building an ecologically sustainable society?
4. Do you like being at your school? Why?

Group of questions 3: Ecological consciousness and values

1. At this moment, do you feel a participant of the natural world? Why?
2. Think about your daily life, what you really like, your family, your friendship, your ambitions, attitudes, behaviours and choices: Which ones are closer to sustainable ecology and which ones are further?
3. In which one of these activities were you more engaged? Why?
4. How does the school take part in the above answers?
5. In view of what was seen during the workshop, do you consider your school ecological? Why?
6. What can be changed in the content, activities and environment at your school for it to become ecologically sustainable?

Group of questions 4: Action in the world

1. Define in a feeling/emotion your understanding about the issues we approached today (e.g. overwhelmed, indifferent, fear, will to act, sad, happy, etc.).
2. Do you have the capability to be part of a solution at any level? If so, how do you make use of such capability? If not, what blocks you?
3. Do you have the will to participate in the decisions of your school in what regards to its contents and daily activities? If so, what would you like to see and do, and how would you like to be part of it?

2.2.5. OUTCOMES OF THE PILOT PRACTICE

This workshop was facilitated on the morning of May 16, 2012 to a group of 10 students of the first year of the school of design. The exercise started later than planned, as some of the information shared in the school was not clear for the students. It also had a 20 minutes break in the middle as some of the students had to reorganize their personal schedules in order to remain in the workshop. It somehow broke the dynamics and part of the participative atmosphere. However, it was sufficient time to establish a general idea of the whole practice and its structure.

Some of the exercises despite their intentional role, like the “visitor from the future”, were not taken seriously and was also subject of cheating by some of students. As it was designed to work with younger audiences on the subsequent phases, and with less time available, it was promptly eliminated. Also some of the oral terms, concepts and phrases used during the workshop were too complex to grasp. Hence, the oral language that was used during the exercise was also subject of more careful examination and training in further activities.

The card game of the five forces proved to be meaningful both in its content and dynamics but too extended to be used in Torres Novas. The *lexicon* was delivered in a more expositive manner, which was not effective. It was decided to let participants explore the lexicon during the ideation phase or to find a way to expose some concepts beforehand. This came to be the introduction of the Ecological Being in the subsequent activities. The questionnaire was quite broad, not objective, leaving space for too ambiguous interpretations and questionings outside the scope of the objectives, thus becoming subject to major transformation after this pilot.

On the whole, feedback from the students was positive with some of the participants expressing intentions to spend “more time discussing it”, and also welcoming “interactivity”, “the different type of approach” and the “creativity of the approach”. Despite the positive feedback it was not clear if after such a long activity they would have grasped the core idea as — according to results of the questionnaire — they were very convinced that technology was the way forward for sustainability and that it was also the responsibility of third parties. After the workshops in Torres Novas, it was evident that this was a common feature with older students. The older they

were, the more likely they were to maintain preconceived or formatted ideas about the issues and proved to be more difficult to clear these ideas

The length of the workshop also proved to be exhaustive, and in the end, the students were visibly tired. Some criticism was also present in the questionnaire but much of this was directed at the external events related to the school (the lack of information and the break between the initial and final parts were considered too long, provoked by the reasons mentioned above). Below are some pictures from this

Figure 17 — Pictures from the workshop held in Tomar

2.3. THE WORKSHOP WITH THE SCHOLAR COMMUNITY OF TORRES NOVAS — DETAILED DESCRIPTION

The activities with the schools of the Municipality of Torres Novas were preceded by a series of propositions and meetings with staff at the Municipal Library of Torres Novas (MLTN) that effectively made it possible. The MLTN team is committed to developing and delivering a dynamic series of activities that can range from supporting reading groups and exhibitions to the general fostering of cultural and local literacy that are offered to the scholar and also to the general local community.

It was as a citizen of Torres Novas that the designer/researcher proposed that the research workshop could become part of their efforts to spread cultural literacy by adding an ecological literacy within the local schools and also to the municipality as a whole. Furthermore, it was expected that the workshop would act like a seeding process for other thematic activities based on the ideas, which would lead to greater collaboration aimed to last longer. This expectation has become fact as after the workshops used to extract information there were invitations to facilitate new workshops within other schools and also to become the co-organizer — together with other citizens and local institutions — of a seminar to be held in June 2013 with the objective to get together with the community to share a series of projects being developed by teachers, citizens, and other researchers aimed at education in Torres Novas (2013).

The work with the MLTN has involved a series of 7 exercises with four different schools with groups of kids with ages ranging from 13 to 15 and 17 to 20 and also their teachers, in the city of Torres Novas, during the autumn of 2012. The option was taken to organize the activities in 2 groups of different ages in order to understand if there was any different information or particularities according to the table below:

Table 10 — Details on the participants

Ages	School	Workshops	Observations
13-15	Arthur Gonçalves School	1	This group of classes was equal in ages, also in the fact that the workshop was facilitated at their schools, in rooms with plenty of natural light and the weather was overcast to rainy. It encompassed a total of 5 workshops and 109 individuals.
	Chora Barroso School	2	
	Manuel de Figueiredo	2	
17-20	Professional School of Torres Novas	1	This group of classes is also equal in age; also the workshop was facilitated in the Municipal Library, in the same multi-purpose room with no natural light. It encompassing a total of 2 workshops and 32 individuals
	Maria Lamas	1	

The first workshop at Artur Gonçalves School was subject to a rearranging of the activity dynamics after lessons learnt in the pilot. This first group was exceptionally composed of 35 individuals, which became chaotic to manage. It was also not possible to maintain a close conversation with a large group like this. So this group was disregarded from data analysis, but was essential in helping to understand the dynamics of the introductory exercises. That is to say, it was necessary to simplify it and make it much more objective. Complementary to what was described earlier in Part 3, below is a table of the final exercise organization.

Table 11 — Exercise final format

Explanatory conversation	Introduction/breaking the ice: A brief introduction to the purpose of the exercise Crash course: Invitation to explore and reflect about the possibility on an energy-descending scenario via question-based conversation and exposition of information and concepts on the subject To explore our participation within such dynamics: the ecological being Material: A flip chart, and the leaflets Time: 50 minutes
Ideation	After exploring the elements leading to an energy-descending scenario the students were invited to form groups of 4, or 5 individuals. Pens and paper, the ecological lexicon and a copy of the scenario were

	distributed among the groups. A brief conduced meditation before and after the reading of the scenario (30 seconds each). A student was invited to read the scenario to the others. The question asked: How would your school be in this 2025 scenario? And according to the elements of our conversation? Ideation process: facilitation group by group When finished, the students were invited, group by group, to expose their ideas to the other individuals. Time: 20 minutes
Questionnaire application	Time 10 minutes

As in the pilot exercise, below (in the next page) are more detailed descriptions of the exercises to proceed with further analysis.

Table 12 - Explanatory conversation

Explanatory conversation
Description
This was a question-based conversation. This is a direct outcome of the theoretical framework in which the participants were invited to explore and interrelate both our socio-ecological and biophysical dimensions in the constitution of their individual identities, how the environment influences them and how each of their actions influences the environment. Also discussed was how they would act in the world through mind, speech and body and, how the emotions, sensations, mental dispositions, motivations and aspirations, reason, language and meaning emerge from our ecological relationships and how important they are for broader individual and collective well-being during their lives. Issues driving the future were exposed together to promote connections. That was the building of relationships among subjects such as nature, globalization, energy (peak-oil), food, well-being, society and climate change. Always allowing space for them to participate even by means of questions, or spontaneous interjection. Thus challenging their beliefs and worldviews, everything was done with the objective of bringing awareness of our fundamental ecological systemic relationships and to help participants to relate all these features to the current socio-ecological problems, and to also to envision a holistic worldview and to resituate their schools in the “energy descending scenario” with help of the “ecological lexicon” in the subsequent ideation process. In the explanatory conversation graphical schemes were drawn on a flipchart making it easier to establish the relationships among explanations and ideas emerging during the conversation. Flexibility that a stationary PowerPoint, or image would not allow.
Purpose
This exercise was aimed at situating ecological issues and to promote major connection in a holistic manner
Time
Allocate 50min
Resources
A flipchart, a blackboard, or an A0 sheet fixed to the wall for drawing.
Instructions
To proceed according to the description
Evaluation
Observed reactions and participation – Evaluated understanding of the ideas emerging from the brainstorming/ideation process and through the questionnaire.

Table 13 - Ideation Process

The ideation process
Description
This was an ideation process based on the whole initial explanatory conversation, making use of leaflets with the energy descending scenario and the ecological lexicon.
Purpose
This was the moment pupils could sit together in small groups to meditate a little more on the whole subject, to give their opinion, and co-creatively and within the context set to raise ideas for their schools. This also helped them to make a general analysis of the situation where they could collectively exercise critical thinking and make judgment on values concerning the context they are facing.
Time
Allocate 30 min
Resources
Leaflets of the scenario and ecological lexicon, pens, sticky paper
Instructions
Split the group into smaller groups of 4 to 5 individuals. Distribute the leaflets, pens and sticky paper to each group. Before starting the ideation process, a student was invited to read the scenario. It was not necessary to explain the ecological lexicon to the group, as its elements were also the subject of the explanatory conversation. The group was encouraged to read and discuss the elements further, leaving them free to explore as many concepts they wished. The activity was facilitated by visiting each group to discuss, ask questions, recall their attentions to the past conversation, explanations and missing links, or even clear emerging doubts. At the end, the groups were invited to expose their ideas to the group as a whole.
Evaluation
Observed reactions and participation – Evaluated understanding on the ideas emerging from the brainstorming/ideation process and through the questionnaire.

At the end, the participants were invited to come up to stick their ideas onto the flipchart and explain them to the whole group. It was not a very easy task as many lacked confidence to stand in front of the group. A certain degree of intervention was necessary, such as asking questions to elicit their ideas.

The whole exercise was concluded with the drawing of a timeline of their ideas for 2025 and 2012 saying the possibilities that exist if they wish to explore and craft their imagined future. A short period of time was allowed for the expression of any emerging feelings but also their silence was welcomed. At the time the questionnaire was distributed, they were asked to individually reflect while completing it. As they

gradually handed in the completed questionnaire, there was an opportunity to thank each of the pupils for their participation.

2.3.1. THE QUESTIONNAIRE

After Tomar, the questionnaire was subject to major changes for the series of workshops to be held in Torres Novas. As well as being too broad and extensive, the questions were too subjective, some repetitive, and did not answer to some of the fundamental questions such as: Would this process change their perceptions and understanding on the proposed ecological issues? And what type of ideas regarding schools would emerge?

So for this round, the questions were reorganised into two groups, one was about the activity and the facilitator — to understand their perceptions of the exercise, whether they enjoyed the activity, what to improve, and the most fundamental: *Did it change the way you see and relate to the world?* This way the fundamental question was exposed early and in a direct manner, leaving space for understanding more about the context of schools set in a future scenario. The second group of questions was organized to get answers from the proposed exercise. So it starts by asking how they feel about the proposed issues, which was also an important complement to question nº 4 of group one. The participants were then asked about their general regular participation in school as well as their perceptions of the proposed exercise in order to create a transition to a whole set of questions regarding the type of transformation they would like to see and/or participate in— see the questionnaire below:

Table 14 — The final questionnaire

Questionnaire

About this activity and the facilitator:

1. What did you enjoy in this activity?
2. What didn't you like?
3. What can be improved?
4. Did it change the way you see and relate to the world?

Since the proposed exercise:

1. Define your feelings regarding the issues proposed during this activity:
   a. Indifferent
   b. Overloaded
   c. Concerned
   d. I am part of the solution, and I have the will to act
   e. I don´t make a difference, I don't want to act
2. How is your participation in your school today?
   a. I limit myself to going to school and to accomplish what the school proposes
   b. I enjoy going to school and I get involved in its activities
   c. I like meeting my friends there
   d. I don't like going to school
   e. Any other comment?
3. What is the importance of the role of school in order to build a culture of ecological sustainability?
4. Do you think your school is qualified to face the proposed challenges? Why?
5. According to the issues presented during this activity, what do you consider as being the most important:
   a. To proceed with alterations to school facilities?
   b. To proceed with alterations to pedagogy and content?
   c. To increase students' participation in the school decision-making processes?
   d. Any other, Why?
6. How would you like to participate to change school?
   a. Having a voice about the school programme and curricular activities;
   b. Having a voice and giving an opinion about the organization of the school environment;
   c. By proposing and arranging complementary and extra-curricular activities;
   d. To manage and be responsible for your own learning together with teachers and colleagues;
   e. All the above.
7. In the context of your school and from the proposed exercise do you have the capacity to be part of the changes?

- If yes, how can you act right now? Cite some examples.
- If not, what stops you from doing so?

Do you have any other comment?

For the purpose of analyses, the groups were separated according to their ages: Children from 13 to 15 and 17 to 20. This was so as to understand if there were fundamental differences among the ages and also because the setting for the activity was different. The younger groups remained at their schools and older groups attended the session at MLTN. Apart from this, the older students were approaching the end of their schooling and, in this case, were also working towards specific grades in order to obtain a technical degree. Therefore, they were heading out of the school and also nurturing expectations of finding jobs. Moreover, they revealed that they were to be tired of school and its expositive classes. They were much more up to doing things. In this case, the explanatory conversation was reduced and more time was given for group discussion and ideation. In doing that, it also became necessary to spend more time monitoring the groups to facilitate progression via conversation. Their situation affected their willingness to think about a school they did not feel to be theirs. In addition to this, these groups were holders of more formatted mindsets in relation to school and in regard to their confidence in third parties to solve the problem of sustainability.

The younger groups were more open to different ideas and willing to participate. However, the questionnaire revealed that both groups were equally positively affected by the proposed exercise with direct consequences on their expectations for the future. Following this, a questionnaire for analysis was provided along with the transcription of their ideation. The ideas for a transcription from Portuguese to English may present some repeated issues, as among the groups similar ideas have emerged.

2.3.2. QUESTIONNAIRE REVIEW (GROUP 13-15)

About the activity and the facilitator

Based on the overview of the whole process and on the questionnaire, this group of students have expressed great involvement with the proposed activities. Based on their answers it is possible to understand that these kids were concerned about their participation within the school, also on the proposed issues and about the possibility to maintain discussions about their future and to craft them.

Also from the exercise, there were positive expressions about the possibility of nurturing different forms of relationships with the world, about the values, meanings, the environment, to talk about ecology and development, to know more about climate change and its imposed limitations, the need to care more about the entire proposed subject and to cultivate more attention to it. Many pupils expressed a desire for more time to explore the proposed subject.

Regarding the main question, to the majority of the students (96,2%) the workshop has presented a new perspective able to change their perception/relationships with the whole world. Only 3,8% of the individuals say no (3 students). From these 3, 1 says not to have time to be part of the change. The other 2 said no because it was already a major concern to them. But at same time these two students claim to be part of the solution.

In reference to the proposed exercise

1. Referring to the subject proposed by the workshop the students feels:

a)	I am part of the shift, I wish to act	42
b)	Worry about	35
c)	Indifferent	4
d)	Burdened	0
e)	I don´t make any different, I do not wish to act	-

2. How do you perceive your participation within your school today?

a)	I like to go to school and get involved with proposed activities	35
b)	I like to go to school to meet with friends	35
c)	I limit myself to go and accomplish the work proposed by the school	10
d)	I don´t like school	5

Understandings:

- Students become concerned about the socio-ecological problems exposed
- There is a will to participate in decision-making regarding school.
- Importance to the possibility of social relationships offered by being in the school with friends.
- At same time, a similar portion of the participants see themselves as part of the solution nurturing a will to act, and others expressed that they have become concerned about it, when we look at question 6 it is possible to see

that both groups demand more participation in school and are more willing to discuss the issues the activity has presented.

3. What is the importance of school for building a culture of ecological sustainability?

Despite not seeing the school as adequate to face the challenges proposed, and perceiving the need for major alterations, the students are still confident about the role of the school to support a transition to the proposed scenario. This can be seen in the following testimonies:

- "The school is where more attention can be brought to the proposed theme"
- The school is a place of "teachings"; that "helps to prepare for the future and for the outside world"
- "Transmission of knowledge and sensitizing people"
- "Learn how to better deal with the climate"; "learn how to deal with future"
- "Help to see the world differently and not to waste resources"
- The "importance of life and material things"
- "To explore natural resources sustainably"
- "Teach for action" and "**To have participative activities such as these to teach students to improve life in the future**"
- "To change cultures, how to make the world a better place, learn to survive with problems and to resolve a few of them"
- Build up more general knowledge about the environment "that is part everything we behold" and sensitize the scholar community to the duty of changing behaviours"
- "Everything is part" (of the shift)
- **This is important because together we can find solutions and to learn to be more open."**
- "This is where children grow up and develop their mentality and attitudes for facing the future"
- "Sensitize to ecological problems"
- Cultural development and to prepare students to build this new culture"
- "To be more aware of the people and the environment" and "to expose new information"
- "To create the future"
- "This is the environment with which one relates to"

4. Do you think that your school is adequate to face the proposed challenges? Why?

No: 60 individuals – 70,1%

The students that said No relate their answer to the general environment of the school, content lack of information about the subject presented in the activity and, the need to adapt to the future. It is interesting how students were likely to move from their initial emphases of associating ecological issues with possible new technologies towards a more holistic picture of school. At the same time, there were also important answers/testimonies about the school environment such as "the school is not adequate because":

- "There are no green spaces"
- "It is a complex structure with too many people"
- "It does not have the conditions to be self-sustainable"
- "It needs to resort to new ecological techniques and activities"
- "There are not enough professional/practical courses (which according to the proposed exercise and conversation we interpret it as the lack of practical, or "learning by doing" style of activities)

When facing and discussing the possibility of a totally different future, concerns about people, relationships, doubts about the current educational activities emerged. Also, there were concerns regarding the lack of information on the proposed subject and to the lack of participative activities, concerns about the school general organization and lack of openness for debate of ideas and students general participation as we can see from some of the testimonials below:

- [The school] "does not make us concerned about the environment"
- "People are not informed about" [the socio-ecological problems]
- "...what we learn today will be simply general culture as the school is adapted for the present"
- **"It depends: the school is not always a place open to opinions"**

Yes: 17 individuals – 22,1%

A major part of the individuals that believe their school is adequate are from Chora Barroso, which is believed to be related to the fact they have recently occupied brand new installations. On the other hand, students from Artur Gonçalves relate

their positive answer to their school characteristics such as teachers or on the activities currently developed and also on the capability of the students themselves.

Did not respond or do not have an opinion: 6 students – 7,8%

5. What to change...

• Alterations in the curricula and pedagogy;	41
• Increase students participation in general decision-making about their school;	22
• Alterations to school facilities;	20

6. How would you like to participate in changing your school?

a.	Being heard and being able to opine about school organization and environment	14
b.	Being heard about syllabus content and activities	16
c.	Proposition and organization of complementary and extracurricular activities	23
d.	Manage and be responsible for your own learning together with your teachers and colleagues	2
e.	All the above	25

7. Are you part of the change?

Questioned on if they felt able to be part of the necessary shift to an energy descent scenario, 67 students said yes. They had listed possible actions they could participate in from now on such as activities to inform and engage people, thematic talks, classes about the environment as well as other kinds of practical classes with major participation of the students and thinking about the future and the environment as is presented in some of their testimonies below:

- "Being more ecological, responsible, and assisting in environmentally friendly actions". Informative and sensitization campaigns to "spread the word encouraging people to take full advantage of possessions and not to waste ". "To protect the environment".
- "Not to remain only in the realm of conversations but to be activists". With activities like "tree planting, agricultural activities, carpentry, sewing". Practical skills with "more professionalization courses and extracurricular activities", "handicraft".

- Substitution of books by electronic devices, internet and testing of practical skills
- Recycling through “maximum utilization of the available material resources”. “Start to recycle more, increase general culture, being open minded, value simple things”
- “Learn how to work the land and reveal what is going on to other people”
- “Prepare for the future by resorting to activities related to the environment and the future”; “Save oil” and to explore “other options of transportation”

Ten students do not feel part of the shift because they “are not sure about it”, “do not want to get involved”, “lack of capability”, “I cannot change anything”, “I cannot command the school”. “This task is not my responsibility but is the responsibility of the headmaster.” and “I do not have time”.

Following is a transcription of their brainstorming sessions:

Class 2 - Chora Barroso

- Students will be more focused on their lessons and more studious
- More connected to nature
- Less Technology
- Agriculture and handicrafts
- Handicraft courses and commerce, less technology usage, more professional courses also with courses in agriculture
- Organic Agriculture, renewable energies, poultry, biologic fabrics, preservation of the forests
- Solar panels and renewable energies, agriculture, shift in transportation patterns, disappearance of industrial activities and the emergence of others more related to the environment and also the emergence of non conventional medicine
- Improved scholar and work status with more technology, less human work
- More renewable energies
- Less pollution
- Natural Medicine
- Handicraft

- 2025 will be worse because there will be energy shortages and climate changes. But on the other hand there will be more technology
- Return to the old
- Less diseases
- Agricultural lessons

Class 1 - Chora Barroso

- To invest in more forest cultivation, in agriculture and search for new energy sources.
- To invest in the teaching of agricultural practices
- Build more ecological cities and schools
- Increase the use of renewable energies and Portuguese resources.
- Photosynthesis will be a form of energy
- School may face difficulties in teaching and feeding students but it will have a vegetable garden
- Schools will be substituted by computers; each family will own a vegetable garden, and will exchange their production
- Energy will come from rain intensity; bicycles will become the main means of transportation
- People will need to learn how to live with less energy
- People will need to consume national products
- Renewable Energies and other alternative energies like water, salt and hydrogen
- To create a farm for poultry raising
- The school can make a vegetable garden
- More professionalization courses
- New curriculum

Class 1 Manuel de Figueiredo:

- To divulge the problems of the future
- Teach the art of agriculture
- Use sunlight
- Wind mills
- A vegetable garden in the school

- Solar panels
- To use plants adapted to the climate
- The elderly will need to give up social conservatism and be taught by the young people
- In 2025 we will start from scratch to relearn everything
- We will live in a society that will value jobs that appear useless in 2012
- School will be very different
- We will not have the subjects we have in 2012. We will learn to work from an early age. All we learn in 2012 is general culture. The school will not be mandatory anymore and all educational materials will be limited
- Cars move by solar energy - windmills - dams - computers will substitute paper
- Management of natural resources: cultivation of food diversity. Use of natural sunlight
- Practical disciplines: sewing, carpentry
- Yoga and meditation
- A single building
- Vegetable garden and orchards

Class 2 Manuel de Figueiredo:

- Protect animals from extinction
- Different lessons: sexuality, medicinal herbs.
- Because of fuel shortage we will not use appliances | lessons will be different
- Value different things and hand skills
- Recover the forest for our well-being
- To protect all species
- Recycle garbage bags
- Classes with more teachers
- Recycled clothes
- Agriculture
- Living in a self-sustaining community
- Free Schooling
- Schools will help people with more than 3 children
- Classes about agriculture

- Better knowledge of biodiversity
- Clean and organized school environment
- Classes about sexuality
- Classes about health and first aid
- More local health facilities
- Classes about biodiversity
- More and non pollutant public transportation
- Use of natural gas
- Classes given through the use of computers and practical activities
- Renewable energy
- Grow food for the school canteen
- New classes: agriculture, culinary, poultry, sewing

- School facilities: self-sustainable, renewable energies, ecological materials, spaces for practical activities
- Evolution of education and use of renewable materials in school
- Less car usage | more walking and cycling and public transportation
- "A thing that does not need oil is air"
- Subjects like economy, ecology, science, subjects in which all can learn (practical disciplines)
- Smaller schools because of the decrease in the birth rate
- Buy less produce more
- Use non renewable energies in a rational manner and learn more about new energy resources

2.3.3. QUESTIONNAIRE REVIEW (GROUP 17-20)

About the activity and facilitator:

These older students had the same involvement in the workshop, however, in conversations they declared to be more comfortable and prone to collaborate in practical activities than to participate in expositive classes about the subject. At the end, they declared they were pleased with the proposed activity and the possibility to reflect about the future on the whole during their time at the school and in a different manner.

To 84,4% of the students the workshop presented a new perspective, capable to promote shift in their perceptions and relationships with the world. To 12,5% of the students the exercise didn´t promote major shifts in worldviews. When asked why via question 7, the answers were: It was not possible for lack of available time to get involved, lack of will, or simply did not answer. Four students saw the explanatory conversation as "less important". These students have suggested going straight to practice as something to change in the workshop.

In reference to the proposed exercise:

1. Referring to the subject proposed by the workshop the students feels:

a)	I am part of the shift, I wish to act	20
b)	Worry about	11
c)	Burdened	-
d)	Indifferent	1
e)	I do not make any difference I do not want to act.	-

2. How do you perceive your participation in your school today?

a)	I like to go to school and get involved with proposed activities	20
e)	I like to go to school to meet friends	6
f)	I limit myself to going and accomplishing the work proposed by the school	5
g)	I do not like school	2

3. What is the importance of school for building an ecologically sustainable society?
These students have responded to trust in the school as a major agent to promote shift over dominant perspectives, as being the place to inform about environmental issues, for gaining knowledge, and to foster involvement in collective activities, to approach collective issues and well-being. An expressive phrase: "the school could help people to live better" (in the sense of the being). Four students did not answer this question.

4. Do you think your school is qualified to face the proposed challenges? Why?
No (26 students):
The school is not qualified because there is a lack of capability and resources. It needs major physical refurbishments and there is necessity for a major shift in

mindsets. There is a will to do things but no real action or debate of ideas. There is a general lack of information and awareness about the proposed issues.

Yes (6 students):

The school has the capability to face the challenge even with difficulties.

5. According to the issues presented during this activity, what do you consider as being the most important?

To proceed with alterations in pedagogy and content	23
To increase students participation in school decision-making processes	20
To proceed with alterations to the school facilities	10

The students did multiple-choice questions. However much more emphasis was given to the what and how they would have to learn in face of the proposed challenges as well as equal importance to increase students participation in school processes as can also be reinforced with question 6.

6. How would you like to participate to change the school?

a.	Being heard and to be able to opine about school organization and environment	12
b.	Being heard on syllabus content and activities	7
c.	Proposition and organization of complementary and extracurricular activities	5
d.	Manage and be responsible for your own learning together with your teachers and colleagues	4
e.	All above	7

7. In the context of the school and since the proposed exercise do you have the capacity to be part of the changes?

Yes (20)

These students say they could be part of the change through sensitizing activities, debating ideas and alternatives, field trips, using renewable energy, making edible gardens, thematic games, showing films to promote major behavioural shifts. Increase the use of public transportation.

No (12)

These students have declared not to be capable to be part of the changes for the following reasons:

- Workload (7): "…lack of free time, I spend too much time in school, sometimes for nothing"
- Lack of will, motivation, capability (3)
- Finishing school (2)

It is important to remark the significantly higher number of students not willing to join efforts for change. Also important to state that while in the younger students the participation during the workshop were more homogeneous, whereas in these groups there were always members of the group who were very engaged and participative, while others were closed and reluctant to participate.

Brainstorm ESETN
School in 2025…

- There will be fewer schools
- Major information and courses about subsistence — food production
- Teach students that technology is good, but conviviality and well-being is more important
- The school will teach the students to value well-being and to reduce emphasis on money
- Use of renewable energy and passive buildings
- Use of information technology and online classes
- Reformulation of education
- Reformulation in the school regarding the fact there will be fewer jobs due to excess of technology.
- Antimatter generators

Brainstorm Maria Lamas
The school in 2025...

- Will promote values like support and innovation
- School with a sense of place, generating local jobs

- Awareness of medicinal herbs: valuing local wisdom
- There will be fewer students
- Develop agriculture, poultry, hunting, local tourism
- Gardening classes
- Incentivize public transportation with the use of bicycles and walking
- Value biodiversity
- Recycling within schools. Reuse of course books, swapping of goods
- Virtual classes and only examinations would be in the school
- Promote better use of available time with volunteering as a way to build knowledge
- Environmental education
- Only few will follow on to university

2.4. LESSONS AND PICTURES EMERGING FROM THE EXERCISE WITH PUBLIC SCHOOLS

Whether these students were able to cope with the kind of information that was given to them was a major concern before the exercises. These expectations, however, were surpassed during the process. When the participants' proposed ideas were reassessed it was possible to form, what was decided to be called an "ecological imagination" for the schools of Torres Novas.

As was observed during each exercise, in the initial explanations and discussions, the students were limited by the mindset of technological efficiency and recycling — this reflects the fact that Portuguese schools remain limited to these subjects when approaching the issues of ecological sustainability. It was possible to understand in conversation during the exercises, in parallel conversation with teachers and the Municipal Library team. However, as new explanations and elements were reviewed, different perspectives and propositions began to appear and a whole new student mindset started to emerge that would attend to the needs of the proposed low-energy future and a more localized living.

The students began to entertain new ideas, as their concern grew regarding the development of individual needs and abilities. It was for instance, expressed by the propositions to develop hand skills such as carpentry, crafts, arts, gardening, food

production and cooperation. According to them it was also necessary to adopt different pedagogies — more appropriate to different activities and individual needs — and to emphasize outdoor activities to get to know the geographical, historical and social sensibilities of place, and the promotion of ecological values in a learning-by-doing manner. Values like cooperation, concerns with self-awareness, sexuality and immaterial wellbeing also came to be recognized. A few groups of students have even proposed the dematerialization of the school, where all the learning would happen as part of living in the community where general tasks would be done via Internet and only some specific activities like meetings, some work, and research would be located in a certain physical place. This, according to these students would reduce the need for dislocation, energy usage and bigger and new buildings. These ideas about dematerialization of the school have emerged from the groups involving older students.

On the questionnaire it was asked in a straightforward manner if the exercise had shifted their perspectives and why? They were asked how they would like to participate in the shifts they had identified. If the school had the necessary conditions to deal with the proposed challenges. Based on the answers and the ideas developed during the activity, the following was derived:

(1) Most of the students declared that the activity did promote changes in the way they saw the challenges of sustainability — views previously limited to a technological imaginary regarding renewable energies and also around recycling

(2) To most participants what was presented and how it was presented was a broad new perspective that could change their whole perception. The holistic way in which the subjects were related and the type of information were declared a novelty by both students and teachers alike.

(3) The participatory nature of the activity and the informal environment generated by the exercise was greeted positively by the students

(4) With regard to the questionnaire, an intention to participate and to become involved in the school daily decision-making in the future was declared. That included taking responsibility for what and how they learnt.

(5) The students have considered it necessary to adapt what is taught in school and how it is taught to fit the proposed paradigm. It does include general

teaching pedagogy and students' participation in decision-making processes. School facilities were considered secondary to these issues.

(6) Also in the face of the proposed scenario, they think their schools are not ready for such challenges; however they have emphasized that schools are essential to the effort of coping with the future

(7) Younger and older students and their teachers declared themselves equally affected by the exercise. The differences between them involved the way they acknowledged how to get involved in thinking about crafting solutions. Younger students are keener to explore the possibilities within school, while older ones declared themselves more concerned with the fact they were about to finish and leave the school, and the possible impacts of the proposed scenarios on post-school endeavours. The teachers differed in their mode of participation basically either by participating as equals to the students, or by trying to command the group where they were participating.

Hence, the capability of the participants to engage in such an ideation process, to understand the potential challenges and their proposed ideas, as well as their expressions to become part of the solution was identified as positive. On the other hand, such a short workshop may have clear limitations to promote effective change in the school as a whole. Both students and teachers may face impediments to creating major space for effective participation and transformation owing to the hierarchical nature of education institutions. There is a series of immediate obstacles to overcome in public schools.

2.5. COMPLEMENTARY RELEVANT ACTIVITIES

Beyond the described workshop, other relevant activities have emerged as outcomes of this practice within the community of Torres Novas. One was an experimental process to implement a garden project with children from ages 3 to 6. The other was the participation as co-creator and speaker of a local gathering aimed at sharing diverse local projects with the underlying subject of education through arts that was called "The Nameless Encounter" — a literal translation from the original in Portuguese.

2.5.1. THE EXERCISE WITH A PRIVATE SCHOOL

Following the workshop, it was decided as necessary to attempt to implement at least one of the ideas generated during the exercise to further understand the role the designer/researcher played Hence, the decision to approach a private school where the school was open to external propositions intended to enrich the pupil's experience. A group of 4 to 6 year olds were invited to build a small bed for planting seeds. This was a single activity, where the objective was to take one of the ideas emerging from the workshops and to implement it as a way to understand its dynamics and potential within the school.

Why an edible garden? This choice was made based on arguments from various authors. First, because gardening has been posited as a powerful and straightforward way to connect with ecological dynamics (Maser and Maser, 2000), and it does touch on aspects of our food and its ecological impacts. The planning, design, implementation and running of a garden and its possible uses are a pedagogical activity in essence for all ages, where different aspects can be explored (Legan, 2009, Holmgren, 2009b, Hopkins, 2008, Pinkerton and Hopkins, 2009). Its importance also relies on the fact that children are becoming progressively alienated or deprived from nature and the very skills and experiences they need to become ecologically literate persons (Loov, 2005, Wood et al., 2009).

In this activity these children did participate in all the stages of preparation, digging, placing layers of compost, manure and straw for planting, seeding and watering. Every stage was explained. They were shown how to touch and sense the dirt and to handle with care new plantlets in a bed. Also, to complement the project, plants that were regularly used for the preparation of their school meals were chosen.

Figure 18 - To some of the children this was the first time they had handled earth. . This picture is a good representation of the atmosphere and the dynamics centered around gardening

Back in the classroom these children were asked by their educators to sketch the activity. Drawing is the way children not familiarized with writing can express much of their understandings, feelings, and also their place and participation in the activity or even in social life. This came to be part of the activity by chance. It was their educator that suggested looking at their drawings. It was surprising and revealing as most of the expressions varied y from representation of the activity to detailed expressions of the experience of doing and of their understanding. Children at this age can perfectly comprehend the activity; confer different senses of its meaning and incorporate it into their imaginations. Other important aspects regarding the whole activity, included in the public schools, happened when looking at the drawings and retrospectively to the pictures of the activities and to notes relating to the activity: The importance children and youth give to participation and how they are naturally keen to creatively participate when they are given a role was clearly evident. This is what happened when the pupils were asked to imagine their schools in face of certain issues and was replicated with these children when invited to set up a small planting bed. This can be seen in the images in figure above and the drawings below — The images are of 5 year old children:

Figure 19 - An expression of the experience of doing: The child has represented her arm in the making of the activity. In the background is the watering can and the different layers composing the plant bed

Figure 20 - This pupil has carefully represented himself in the activity of watering and several other activities involving the planting bed

From that simple exercise in a private school, it is considered that the "doing things together" aspect that participation brings is essential to support learning within the activities proposed by the students during the exercise with public schools. This seems to promote new connections and values, and a sense of meaning followed by real behavioral shifts. Without that practical component, the theoretical or conceptual understanding would probably not be feasible to stand alone to become part of a public school imagination where ecological principles are the norm.

2.5.2.THE NAMELESS ENCOUNTER

Complementary to this activity was the event co-organized by the designer/researcher The Nameless Encounter (2013) called this so as not to create pre-conceptions. It was left up to the participants to draw their own conclusions during the process and among the presentation of a diverse range of projects. The common principle connecting these projects was that they were local experiences in art and design and education via projects.

The Spanish educator Fernando Hernández, from the University of Barcelona was invited both as key speaker and to mediate, connect and promote an assessment of the ongoing experiences during the gathering. The event departed from citizens'

initiative that counted on the support and partnership of the public Library, which hosted it from the 23 to 25 of May 2013. The event was directed at the teachers of the schools of Torres Novas and to the general public, and the outcome was a set of ideas to be followed by educators that later took the shape of an exhibition in the foyer of the Municipal Library. At that time it was possible to present the exercise to different people and to connect and relate it to different educational projects.

Since that a different understanding has emerged the explanations promoted by Fernando Hernández (2013), that is the support of an education model based on projects departing from the premise that everything can be taught by means of a project, since there is a initial questioning leading to further research and based on evidence about it. For this to happen it is necessary that the teacher abandon the role of content transmitter to become a facilitator and a researcher together with the students. And students, instead of passive receptors become subjects in the process. This was exactly the type thing that the exercise described in this part 3 has promoted.

3. REFLECTIONS ON FURTHER ITERATIONS AND FINAL CONSIDERATIONS ON THE PROPOSED DESIGN

In what regards the thesis's objectives and its outcomes the following was reflected. The exercise has promoted ecological awareness. It has clearly moved participants from a status of lack of awareness to a contemplation status — the contemplation for the need to change (See the stages of change model at the end of this section). To really shift educational contexts to the level proposed by the students is a community endeavour which does involve different actors with the will to make it. At this level, designers can clearly become the activators of such bottom up movements with their peers. Furthermore, the sort of exercise was exposed along this Part 3 can be further developed and adapted to be applied in different settings and to involve more and different people. This is a type of activity — a product — a designer can offer to people.

Within the limits imposed by a PhD research, more important then the final achievement was the whole reflection regarding the process and the new locus of practice for designers, the exposition of its importance, the sort of capabilities, tools and transformations one can enact. In fact, it was the exercise, the relationships with a local community, all the preparations and reviews that made possible the sort of deeper reflection necessary to build this thesis' framework. On the following reflections, it has identified a series of issues regarding school settings and different ways a designer can participate on it.

From the perspectives exposed in previous parts of this work and which regards to the issues of our sustainability, it has unveiled that there is a major lack of awareness about the complexity of the ecological issues emerging as well as in holistic thinking and basic ecosystem awareness throughout the scholar community. On the other hand, the interweaving of several subjects in a holistic manner may counter act this by stimulating critical and creative thinking together, by helping people to build an opinion, or judgements about the proposed issues via managing, superposing, and connecting different information. Hence the positive aspects the exercise has enacted and that may offer the build of action competence throughout participative settings are as following:

- Holistic/Systemic thinking, which allow major transversal connections
- Building of awareness about the system and its synergies.
- Team work/co-creativity
- Building of sensitivities to multiple factors influencing the process — building of values and priorities
- Managing and relating data/information
- Emergence of action competence — expressed by their intentions
- Future Thinking and creative vision/generating/ideating

The idea to set a platform to generate ideas for learning environments following ecological principles was the central aspect of this thesis and the exercise was very important to understanding it. The whole creative process per se was a platform — a relational domain — and, despite the need to go further to promote major social transformations, it was essential to understand that such domains enacted by design are essential to foster participative interaction. In fact, and according to the students' testimonials via the questionnaire, it has unveiled a will for participation within the school settings.

It has also opened up the possibility that society may see the designer not as someone strictly connected to the materialization of objects and to the formal aspects of culture but as a major agent of social change via activating and integrating platforms where such changes can happen. Designers can be involved in different projects aiming change by all the capacities enlisted above. Yet, by picking up the emerging ideas from this work, other designers can engage with schools, children, or other social contexts to implement it or even to facilitate learning processes — See the example of the edible garden realized within the private school.

The implementation of the ideas proposed by the students could become subject of further exploration by designers. In fact, it is necessary to give continuity to the process started (see table 16 below). Still one would face challenges, mainly because of being an outsider to the education system and also because of the limitations of the Portuguese public schools that make it difficult to promote, or to make effective bottom-up changes in curricula to accommodate such proposals. However, possible

ways to pursue this design were identified. [1] One is to create more space for this kind of creative activity and involve teachers of different subjects in a trans-disciplinary way. [2] Second is to create activities outside the domains of school in order to connect students with the community; for instance, through a common garden for all schools of the municipality in a public place, or perhaps by promoting a series of outdoor activities to get to know the city's cultural and ecological aspects. *In these cases it would be possible to witness designers not only facilitating the process, but also producing the objects and creating the necessary spaces for such endeavours in a participative manner*. [3] A third option would be to invest in informing teachers. This could be via specially designed workshops and courses or via the engagement in outdoor activities that would facilitate the process of becoming ecologically literate.

The table below summarizes the pros and the obstacles of each possibility based on conversations with local authorities, the conviviality with the students and their teachers, conversation with some teachers and principals, and also from observation of local political disputes. All these possibilities are to be reflected in the arrangement of future activities within the municipality and may be valuable to other designers in different scholarly domains.

Table 15 — The pros and obstacles of possible ways to pursue this design

Pros	Obstacles
[1] To create more space for this kind of activity within education	
• It would gradually sensitize individuals and small groups of people to the need for action from within • Possible to locally implement some of the students' ideas • Possibility of getting a wide range of students together of different ages and teachers from different knowledge domains	• Possible lack of continuity of the activities • Harder to go through the school procedures as an outsider • Lack of resources and financial autonomy to buy or implement physical structures • Lack of autonomy to decide curricular alterations, or broader objectives • Implementation of the students' ideas in every single school • Dependent on the will of individual teachers to host the workshops • It is necessary to motivate the decision-makers to then motivate the whole chain of participants
[2] To create activities outside the school settings	
• It would allow the individuals to contact and interact with local social and ecological realities • There is a local municipal library that manages the network of school libraries, which has certain managerial autonomy and is already promoting specific activities to the education community that could facilitate further activities by incorporating designers and other facilitators • The municipal library did support this series of workshops and aims to keep up the collaboration • The students' ideas could be implemented in a collective and cooperative manner in public spaces • It is exposed to the general public	• It must be connected to the schools' regular schedule of activities • Restrictions and permissions for the students to engage in outdoor activities must be dealt with. • Necessary to organize the responsibilities and intricacies among governmental and local authorities • It is always necessary to deal with local political disputes
[3] To inform the teachers	
• It would sensitize teachers to be the facilitators of shifts within school • There are schools for educators in the Municipality, which could be associated with the process • There are a growing number of activities related to ecological living in Portugal	• It would depend on individuals will to participate • Teachers are stuck among bureaucratic procedures, mandatory top down training activities and classroom duties, which do not leave enough room for other activities

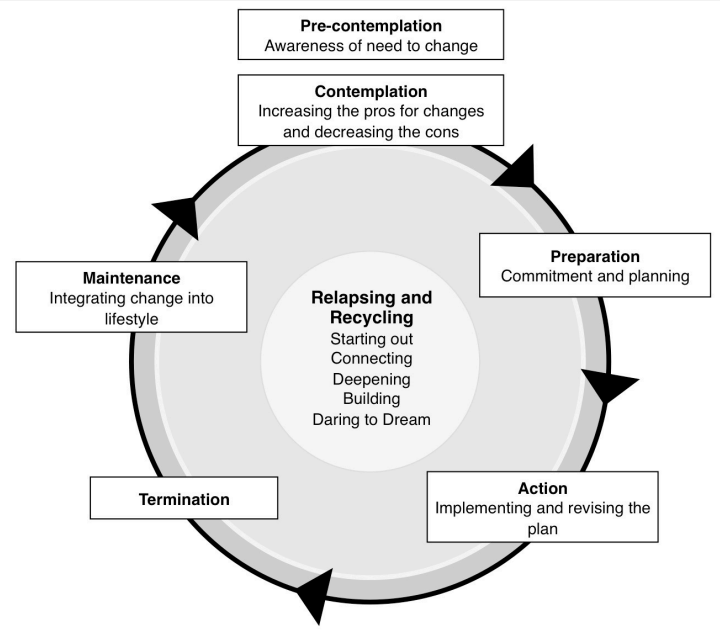
Taking in consideration all the above, the presented energy-descending scenarios, the reflections on the previous Part 1 and Part 2 and also on some of the students proposed ideas, this thesis also suggests that to create ecological sustainability within scholar domains it would be necessary:

- A full rearrangement of education and school according to emerging ecological principles
- To promote new relationships among people, their environments and learning
- To promote practical activities and skills: gardening, foresting, restoring, foraging, building, general crafts and so on
- To promote the contemplation, observation and building of self-awareness and well-being
- To promote bio-regional studies: connection with the sensibilities of place (geography, demography, sociology, culture, politics, ecology)
- Adjusting learning accordingly to the students interests and not to the interest of the others (see also the epilogue)
- In sum, it is necessary to redirect education towards deep ecological sustainability!

The next table was introduced here both as a support to explain what was regarded as the contemplation status the exercise has placed the scholar community and also to explain what does entails a whole cycle of change. A deeper degree of change is in fact present through this work: One is when one put together the exercise with the schools, the garden activity and public reflection and debate promoted by the Nameless Encounter. Second, even that it may be out of the scope and of what can be proved by this thesis is the transformation that happened to the designer researcher. Hence, this kind of activity may not have promoted bigger changes in school settings but it may have left seeds in a fertile soil.

Table 16 — Reflexions on the Stages of Change model

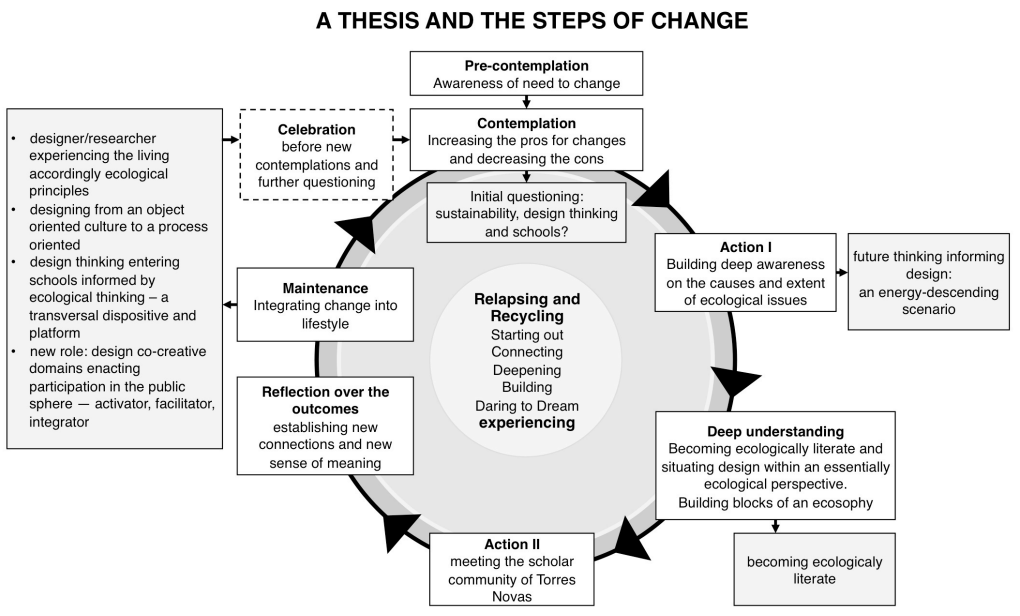
Relating the exercise according to the Stages of Change Model



For the sake of future attempts within scholar domains it is necessary to understand the type of the changes the exercise was able to promote. From reassessment of the exercise and looking to the stages of "change model" as approached by Rob Hopkins (2008) after the psychologist Carlo DiClemente original propositions, it was possible to understand it had offered a new perspective that is able to change people's perspectives, perception/relationships with the world. However, it has not promoted a full transformation in people's worldview because a full transformative process would entail a full cycle process of activities. Hence, beyond generating and ideating the learning environment, to promote major changes it would be necessary for further planning of action, action and implementation, review and celebration, and then back again (Hopkins, 2008) — see the image above.

It has promoted a step forward from a major lack of awareness of what was regarded by Hopkins as a contemplation status. This model has been applied to understand behavioural change and shows that change doesn´t happen all at once but through incremental stages, where every stage supports a step forward until the full integration of change into lifestyle and then back to contemplation to promote further cycles for broader and deeper changes (p. 84 – 89). Further strategies to engage, commit and to foster people participation and empowerment are thus necessary to be developed — the ideas emerging from the exercise are important starting points to reflect on and to engender ways of implementing them. Also, the necessary skills material and means to implement people's ideas that were generated by

this design research — e.g. the planning and implementation of gardens and local food systems. Finally, if this same graphic is applied to the understanding generated with the exercise held at the private school, It is possible to use the same graphic to understand what the research process conducing to this thesis has promoted to the designer/researcher:



As a final reflection on the proposed design, it is possible to support that design may contribute by offering its creative and inclusive process: design thinking is shareable. This is the building up of ideas and inspirational approaches, evocativeness, experimentation, ambiguity and surprise that can bring different perspectives to the learning process to which it is possible to enlist holistic/systemic thinking and action competence to promote the necessary connections among compartmentalized disciplines, school and place. Also it would mean to emphasize autonomy, the living experience and the joy of the learning process. Everything that was proposed until this Part 3 is an agenda adopted to connect with people and to create networks within the municipality that are to improve or to create transitional structures with people co-creating, gaining awareness on the need for change and gradually becoming able to exert influence over political decision-making.

What has been exposed along this thesis approximates design to its immaterial domains of practice in a way that it is possible for the individual designer to question its locus, intentions, aspirations and worldviews permeating and coming through it when materializing a world. It can promote a shift from the idea of the act of

designing and producing to someone else, by designing and producing with someone else. In this case, the locus of design activity moves from an expert driven mindset to a co-creative one, and also, put the designer in the situation of proponent of certain agendas. This is a whole new dimension for design practice that is the one of the process that constitutes broader relational domains where people can engage with significant others and establishing a project through which one can possibly imagine, endeavour, and craft different ways of living.

To explore a creative, desirable and possible viable future is design thinking in its essence — design led ideation processes thus emerge as major tool for collective dreaming. When the designer/researcher was encouraging the students to understand an emerging scenario and depict it in order to build a new one in which they were the protagonists, he was helping people and their communities to situate themselves within a certain background and thus provide awareness, margins and guidance to allow major shifts in worldviews and social structures that the suggested post carbon economy will demand. These are also all skills ad subjects that may be introduced on the educational domains of design.

EPILOGUE: REVIEWINNG AN ECOSOPHY

Figure 21 - Exploring the ecological being as a resilience factor

With seven billion humans over the earth I am sure we could expect to find as many different life stories as different perspectives of the world and the subjects I have exposed along this thesis. Hence, I do not expect it will be accepted as some sort of true or definitive doctrine. I do expect it will be my contribution to a broader conversation.

Conversations are the very possibility to found relational domains where we can found networks of trust, or platforms, and are where each participant can give to know an inner world that is fruit of unique ecological encounters found and made of human corporeal experience. Or a unique process of homing as Preece has suggested. Love, as defined by Maturana and examined by Preece and also by the French Philosopher, Luc Ferry, is the emotion underlying human conversations that are fundamental to found what Code has suggested as networks of trust. Love, as was explained by Maturana, is a dynamic body disposition that allows recognizing other being as an authentic one and to enter in conversations in mutual trust to

reach understanding. An emotion therefore that allow nearness and intimacy and that, at same time, grows from within such relationships. The emotion of love can be cultivated in order to found genuine ecological manners of living.

I produced the above graphic to briefly explain these ideas and our broader ecological participation to the participants of the exercises in the schools of Torres Novas. This graphical scheme is not intended to be an omnipresent explanation of all things. By the contrary, I think it brings the idea of the uniqueness of each individual being. However unique, each one of us can only exists as human being in the presence of other human beings and now, as I have attempted to demonstrate along this thesis, there is no human life without many other ecological forms of life that make it possible. And as the wellbeing of an individual human being depend on her intimate ecological relationships, the same is valid to the whole of humanity: The wellbeing of human living is utterly dependent on the healthy of the ecological systems supporting Gaia — our sacred Planet Earth. This, I propose, is fundamental awareness to shift from the widespread cultural idea of human development to the idea of human — individual and collective — flourishing within the limits of ecological systems.

Whatever my explanations, I am the above image. I am the result of countless encounters with other people and places in a process of mutual influence. Through all the support I received from my family and friends, colleagues, public and political participation, confrontation with external stressors, issues I could solve and issues I could not. Since my childhood, I have developed physical and psychological connections, personal capabilities and I was loved and I could learn to love. I have also developed a relationship with certain places where I could feel at home and of which I have good memories. I was born in a family where some of its members share their love for Nature and for living in itself. It has led me to experience nearness and intimacy with Nature in different times of my life in several ways and through different worldviews.

Some of them are probably responsible for some of the questions I have asked along this research. Eventually I grew up and became a designer, I got married and subsequently a father of my son. The birth of my son has allowed me to experience

unconditional love and the gratitude of this chain we human beings are capable of creating. I have used this thesis as a source of major personal enlightment.

As I am ending up this work lots of feelings and memories about my days in school are coming through. I used to live in the city of Novo Hamburgo in the south of Brazil where I went to a public school that used to be a former agricultural internship school. This was an authentic farm in the city. Beyond the building and all facilities a regular school requires, there were also fields with animals, playfields, ponds and woods where we could run free and explore even the old abandoned corners of this place. Some of these facilities were also used in the school regular activities as old workshops, pavilions and warehouses, where we use to take classes to learn basic agricultural practices, Manual skills like carpentry and domestic activities like cooking the yields from our own garden. There was also a scout group settled in the school that used to organize outdoors activities. I remember when we helped to repair an old barn which became the headquarters of the group and for all the activities we use to do in the surrounding woods.

I also remember walking to school at the age of 7. At the end of the day, we used to get together with friends to return home. On many occasions we would avoid the school doorway. Instead, we usually opted to make shortcuts through the woods, to cross an industrial site and to explore the neighbours' backyards and partake in many adventures through the city. Going home usually took much longer and there were adventures that one could not be imagined.

The city was also the natural extension of both our school and our homes. In the endless summer afternoons, we would run from home-to-home encouraging other kids to come along. We regularly ended up as a pack of kids wondering around, playing, or riding our bicycles, climbing trees for fruit or for the simple pleasure of climbing up and staying there. There were no mobile phones at that time, however, our mothers always knew where or how to find us. Be it by ringing to other mothers or asking in the streets for the whereabouts of the pack of kids.

Now, I find myself wondering who in the present day will allow their children to walk to school or to run free through the city and to play outdoors at such a young age as

seven? Are there public schools with woods and animals and edible gardens in the present day, or even schools that simply promote outdoor learning together with a diversity of practical skills to be tried and acquired according to individual's desires and needs? Of course there are a few and, at least in Portugal, they are mostly private schools only accessible for certain groups of people. Whatever my experience was in Brazil, I am quite sure public schools in Portugal and in many other places for that matter, once had different relationships and responses among people and places.

I have decided to place these personal memories at the end of this thesis, as they are stronger now and to reflect on the purpose of formal education and its ecology. Therefore, I end by discussing the role of school in culture and a reflection of the whole thesis' framework with the aim of setting a broader picture of the kind of environment a designer can find in future attempts to move toward educational domains. This combines the ecological understanding of design that was explored along this thesis, which together is part of my Ecosophy D.1.

1. THE IMPACT OF MONOCULTURAL APPROACHES TO EDUCATION

1.1. THE TECHNOCRATIC AGE

What follows is not intended as criticism but as a broader overview of the natural flow of a prevailing global culture in which we all take part and which is part of anyone. This is a reflection to support that naturally and unconsciously people are reproducing certain practices and pathologies that are the root cause of the present crisis. I would add to this, found from the time I spent with scholars, that people are increasingly finding a mismatch among an increasingly connected world and its flows of information, the issues imposed by the human-nature cultural dichotomy and with what formal education can offer. And that regards the whole spam of progressive education.

In a certain period of the ontogeny of the industrial culture, the adoption of progressive education took place in society. It began during the course of deep structural changes with the purpose of attending to such changes. It became necessary to educate people to occupy new emerging work positions and services promoted by industrialization, scientific development and major socio-cultural shifts as well as to equip people with skills to use and manage emerging technology. It was accompanied by a whole transformation of human thought that — among other things — has seen the discoveries and development of new and intensive energy sources, the progression of a human-centred worldview and the emergence of belief in material progress and wealth, which became remarked by dualistic and arrogant patterns of relationship towards Nature; and where human living became progressively reduced to mechanistic explanations, and knowledge was compartmentalized (Bohm, 1980, Hollick, 2006, Ferry, 2010, Ferry, 2011b, Eisenstein, 2011).

What has happened since then was that we began to progressively live the world to which we were educated for: from a living systems perspective, all the western prevailing school system was organized and has evolved so far within industrial culture with the clear purpose of conserving it, generation after generation, to the point that in the educational system of today, the overall purpose is to maintain and

foster the prevailing worldview of economic growth and development (Goldsmith 1998, Ball, 2004). Whatever reforms the educational systems has suffered until now, they have been made to modernize and to accommodate major shifts of both economic and social demands but its essential purpose has never changed: in order to maintain a certain cultural value-system of economic development.

In fact education became "central to any modern economy" (Wolf, 2002 p. xxi) and has moved well beyond providing basic education and technical provision, to reach detailed police intervention that is necessary to supply the skills the global economy demands (Gatto, 2009, Wolf, 2002). This has made schooling a global trend that does entail an industrial style of enterprise: it must be managed, built, and maintained, as such, by bureaucratic procedures based on efficiency, control, and rule-driven organizations (Wolf, 2002). These are common patterns in a globalized world, where more and more countries are adopting the same patterns of development, and subsequently, more people are likely to demand education as a possibility of social movement to join the economy of and the increasingly competitive global market force (Wolf 2002, Gratton, 2009). In comparison to that which I have exposed in Part 1 — at the pace most of western and eastern countries are responding to the same worldview of material prosperity — ecological issues keep coming mainstream and this cultural model is becoming increasingly more difficult and complex to sustain. At the same time, this is likely to exert more and more pressure over both teachers and pupils and to increase the mismatch among what schools can provide and what people expect from them.

In the realm of this explanation, it is worth mentioning that right after the second world war we entered the period of industrial civilization that sociologist Daniel Bell (1974) has termed "post-industrial society". This essentially refers to the fact that the service sector had generated more wealth then the manufacturing sector and that the majority of those employed were not involved in the production of tangible goods. This also represented the continuous shrink of the unskilled working class, that together with technological advancements, gave place to the rise of the knowledge workers — scientists, engineers, designers, economists, teachers and so on — that came to promote major emphasis to theoretical knowledge rather than empirical, and the focus on innovation and growth. Since then, intellectual and

scientific communities began to gain status and "the husbanding of talent and the spread of the educational and intellectual institutions will become a prime concern of society" (Bell, 1974 p. 344).

This overall movement has also been increasingly giving place to what is called a technocracy. In a general view of the work of Daniel Bell (1974), technocracy is characterized by the establishment of a close relationship of government and the rationalism of science— but where rationality gradually came to be expressed as functional rationalization rather than reason (Ibidem. p. 350). It was followed by the rapid expansion of fomentation and public funding of research and development that mutually serve to inform government decision-making and public policy. The motivations underlying the worldview of technocracy are ones of command and control over systems to predict and shape it for certain predetermined ends:

> "Technocracy is defined as a political system in which the determining influence belongs to technicians of the administration and of the economy and a technocrat is a person who exercises authority by virtue of his/her technical competence" (Bell, 1974 p. 348).

The technocratic worldview emphasizes the linear problem solving; instrumental, orderly, and disciplined approach to objectives, reliance on calculus, on precision and measurement that looks for production and efficiency. Technical skill becomes an overriding condition of competence for place and position and education became the mode of access to power to be fulfilled by an elite (Ibidem p. 358). Again this is not a mere criticism, but a reflection on how certain complex things lead to another (Ball, 2004).

At the pace that generations have become educated within this paradigm, technocracy gradually became influent in government decision-making, conferring the same managerial style to it. Since then, by the principles of circular causality and systemic feedback, educational domains have also become gradually marked by detailed intervention with the clear purpose of fostering competitiveness, innovation and further economic growth (Wolf, 2002). The division of students by grades and rankings is very useful for further progression within the logics of technocracy where education is serving, essentially, as a simple way of ranking, screening and selecting

people in a mass society. As exposed by Alison Wolf, education became a tool of survival in developed and in developing economies: according to her, data has suggested that the more an individual studies, the more likely it will survive global competitiveness, to earn more, and to enjoy stable, or long-term employment (Wolf, 2002 p. 29).

As a result education has increasingly been seen as a commodity that can only be acquired in schools and universities (Edward Goldsmith, 1996, p. 207). This situates knowledge production outside of the diversity and the sensibility of people and places and much of its ethical political and ecological implications (Code, 2006). It also shapes and restrains any other possibility of being outside of the frame of logics governing technocracy and economic growth. Therefore, education is increasingly less a means of individual enlightenment and any other sort of knowledge that goes beyond immediate concerns of work and occupation. That is evident as more and more children go to school without ever making sense of knowledge as a pleasurable, intellectual activity or as an intimate process of conversation, self-awareness and self-development propelled by innate human curiosity and creativity (Goldsmith, 1998, Wolf, 2002, Gatto, 2009).

All the above is no different in Portugal (Rosa, 2012, Aquino, 2013, Niza, 2012, Guinote, 2014) where ideas like efficiency, productivity and rationalization are fully reflected in public policies for education (MEC, 2013) and the technocratic imaginary is clearly expressed by the authorities in statements on the official website of the Portuguese Ministry of Science and Education:

> "Science is the domain where this country has been making clear proof of international competitivity. Technology is essentially of scientific origin, and fundamental science is the basis of scientific development. Thoroughly investment on research and on the education of technicians and scientists of excellence are essential for national development" (MEC, 2013).

This, in comparison with the emerging scenario I have supported in Part 1, and the reflections about the future of work promoted by Gratton (2011 p. 23-48), we are all likely to become subject of more and more competition, economic bubbles, the replacement of jobs by technology, increasing demographics and longevity, decline

of happiness, and the pressure of a post-carbon economy. Education, schooling and schools are merely responding to the current worldview in a major accommodating pace that tends to contribute to a scenario of further separation of human thought from place, other people and all types of social and ecological dynamics and diversity.

1.2. DISORDERS OF TECHNOCRACY

The way human culture evolves has clear impact on individual and collective wellbeing. According to Joel Bakan (2011), the combination of schooling with managerial style, market driven purposes, and pressure for results and the pressure of consumerist lifestyles, has been affecting children emotionally, cultivating compulsive behaviour, and also, increasing the use of legal psychotropic drugs among students to control anxiety and other stress' disorders. According to Maturana (1999), the emphasis on values like competitiveness defines a domain of relational behaviour that denies the existence of other´s knowledge and needs, which stimulates individualism (Maturana, 1999 p. 13). And when we declare ourselves as "rational beings" we deny our whole "emotional being" (Maturana, 1999 p. 13).

Yet, the different knowledge domains organized in separated compartments and by degree of importance, the predominantly transmissive approach and abstract work external to individual longings, discourage individual participation, does not facilitate major connections, critical thinking and disregards diversity (Bohm, 1980, Gatto, 2009, Bakan, 2011). To David Bohn (1980 p. 3-33) such compartmentalization leads to further fragmentation and confusion that goes from the individual to society and the other way round; which leads people to think of things as inherently disconnected and divided, to the emergence and straightening of values like individualism, competition, general disorders of mind and body and the fundamental human-nature dichotomy.

The top-down and hierarchical manner educational systems are organized, lack social participation, inclusiveness, holistic thinking, major connections among theory, practical and real life situations, and the diversity and sensibilities of people and places. Yet, according to Greer, democracy is hard to achieve and what makes it

operational is personal involvement: that is active participation in the local political processes by the majority of citizens (Greer, 2009, p. 147). What is concluded is that this general approach to education, which discourages participation within the school settings — by living systems' principles— will also discourage further public participation in local decision-making. Hence, in another way, technocracy has been fomenting the substitution of deeper forms of democracy and engaged participation by the absence in decision-making processes, by the transference of responsibility to third parties and subjective meritocracy[14]. It may increasingly become governed by social status and/or political affiliation.

This also marks several degrees of separation throughout society. At this moment, the understanding of the full-embodied experience of learning of the individual in the totality of her living and doing things together is non-existent and the experience has given place to the controlled experiment. This was reflected by Professor Lorraine Code (2006) as a dislocation of knowledge production from the sensibilities of people and places. And to philosopher Giorgio Agamben (2005 p. 21-33), the contemporary individual was expropriated of their experience, as these became effectuated outside of the individual being, via the experiment:

> "The scientific proof of experience which is effectuated on the experiment — allowing to translate sensible impressions by the accuracy of quantitative determinations and thus to predict future actions — correspond to this loss of certainty by transferring the experience as much as possible to the outside of the individual being: to the instrumentality and numbers" (Agamben, 2005 p. 25).

Finally, as was stressed by Professor Davis Orr, most of today's educational systems are simply reinforcing practices and pathologies that cannot and should not be sustained over the long term (Orr, 2001 p. 08). On the graphic below is resumed the present explanations.

[14] These are all characteristics that have been encountered in the schools of Torres Novas, as described in Part 3. Where there is a lack of participation, the first reaction is to transfer several levels of responsibility to the realm of the management or an outer political sphere. In David Hulme's (2009) discussion on "Why we disagree about climate change" this lack of social participation is reflected on how society as a whole has been regarding climate change as series of technical issues to be solved by experts through technology or engineering processes. Therefore dislocating it from the sphere of individual responsibility and relationship with climate.

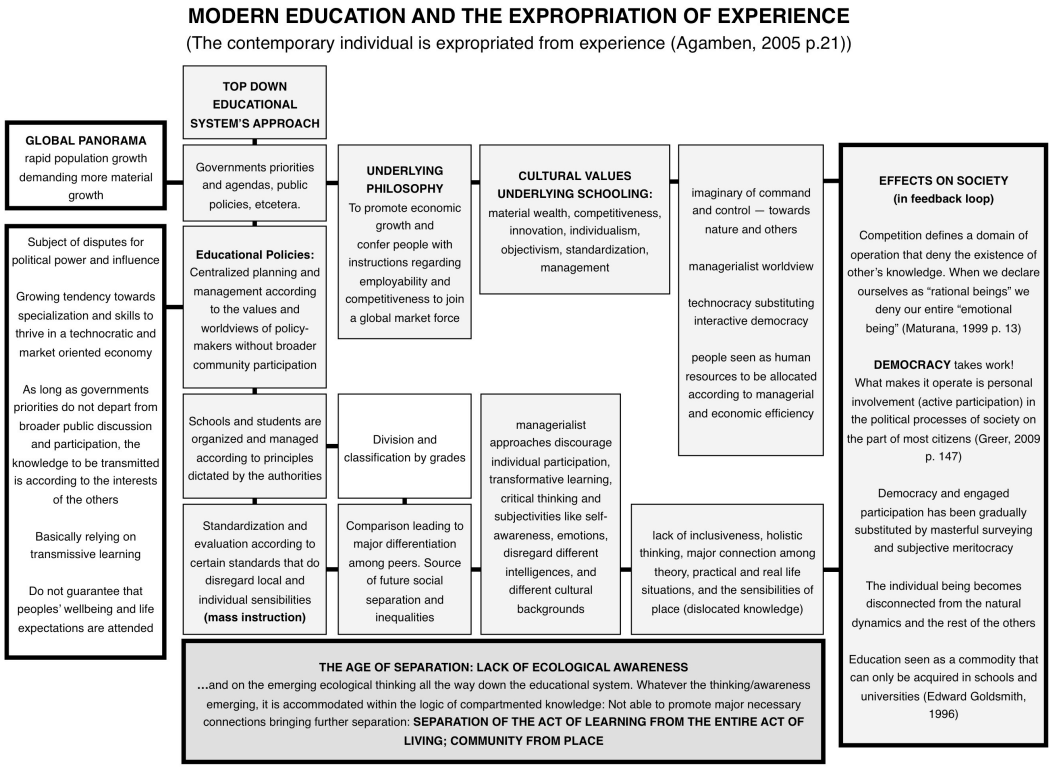


Figure 22 - The sketch above is a graphical scheme that may help to resume the understanding proposed by this brief explanation on the impacts of monocultural approaches to education and the technocratic age we are living — an emerging nuance of the industrial civilization that is surrounding us.

2. IMAGINING ECOLOGICAL ALTERNATIVES

2.1. THE BIOLOGICAL FOUNDATIONS OF EDUCATION

What may disrupt the perspective exposed above? According to the ideas proposed by Maturana in Part 2, to live is to know and we are what we are in recurrent interactions with others and our medium of existence. According to this explanation, to educate happens during the process of living of the individual, when a child or an adult interacts with others, spontaneously transforming themselves in a way that her living becomes progressively congruent with the living of the other, within their relational domain. “To educate therefore happens all the time in a reciprocal manner” (Maturana, 1999p. 29). What does result from this process is that people learn to live according to the manner of living of their peers, in family, community and, ultimately, in a certain culture.

Education thus starts within family domains to reach the community of living, where individuals learn by direct relationship with others and their environment. It starts when a child, for instance, discovers their body and self-consciousness, in interplay and trust in bodily acceptance with their mother (Maturana and Verden-Zoller, 1996). It will be followed by conversation, observation, and even imitation of other individuals. Hence, learning by doing, to cultivate appropriated knowledge and skills, habits, attitudes, values and beliefs.

As in John Gatto’s idea, education is largely self-initiated, “a tapestry woven out of broad experience”, a combination of curiosity, patience, and intense watchfulness, which requires substantial trial and error, risk-taking, and considerable ability to take feedback from the environment — to learn from mistakes (Gatto, 2009 p. 62). Or yet, according to Edward Goldsmith:

> “Education is the cultural process […] the way in which each new born individual is transformed into a full member of a specific human society, sharing with the other members of a specific human-culture” (Goldsmith, 1998 p. 336)

In education we constitute a world. As explained by Maturana, in childhood, the individual lives the world that does constitute the foundation to become a being able to accept and respect the other from self-acceptance and self-respect (Maturana, 1999 p. 29). Which do correspond to become self-loving — according to Preece (2011) and as has been exposed in Part 2. Following, youth, the same individual will experiment this world of interplay from acceptation and respect from the others, according to her self-love and the love of the others or any other emotional relational fundaments that could emerge. As was explained and remarked along this thesis, emotions are the relational fundament on which we constitute our networks of conversations. In childhood and youth emotions through which we set our relational domains are essential in the living of the individual because they are determinant to the kind of individual one will become. Formal education, as a system of values and intentions, do constitute a certain domain of relational behaviours determined by human emotions. Education therefore has long-range effects (Maturana, 1999 p. 30).

Hence, from an ecological perspective, to educate happens in the living with others, in mutual acceptance of trust, whether a child or an adult. To educate does entail the ability of a certain community or society to provide the individual with real life situations to be engaged and to become a responsible citizen. Fundamentally, as stated by Maturana, and also from the ecological perspective I aim to set here, *"how we live is how we do educate" and in living we do conserve the world we have lived as learners or students* (Maturana, 1999 p. 30).

It brings major questioning over the purposes and cultural values of formal educational systems as through education we are permanently retro feeding culture. It means society is renewing itself, or progressively reproducing itself by integrating successive generations into its critical "spatio-temporal structure" (Goldsmith, 1998 p. 331-337). Cultures are subject of the same characteristics of living systems, are self-generative networks, are in permanently recurrent and congruent interactions, are self-regulated, runs itself in feed-back loops, and are subject to entropy, hence, can emerge, rise and fall to disappear, or to give place to something radically different during periods of time. However, a settled culture is naturally conservative and it takes time to shift to something different (Meadows, 2009, Ball, 2004). Of

course there is change and evolution, however, from an inherent living systems' perspective we live in a spontaneously conservative world (Maturana, 1999, p. 29).

Also according to Maturana's explanations as exposed in Part 2, we as a living systems — and culture as human living system — do respond according to our structure. It means we live in reference to ourselves. Whatever the external factor triggering reaction one will tend to adapt in a major accommodative pace in a way to keep the structures that determine that one's identity is intact. Then returning again to the principle of the prologue to state that the living of life in which one is educated for pervades and retro feeds the system´s organizational and structural aspects. In face of an evolving scenario that requires a whole transmutation of human thought we are naturally attempting to conserve our identities as individuals living in a certain culture we hold dear. When we transfer it to the broader realm of culture the natural response is sustainable development, a major accommodating pace of certain social and cultural structures of economic growth and its various nuances, its general cultural aspects, like social systems of values, intentions, beliefs, ideas and practices, which were exposed and discussed throughout this thesis.

At a first glance, this analysis may seem an omnipresent one, however I support, to get to know and to assume some of our limitations as human beings — intrinsic participants of the dynamics of the ecological systems — is essential to build a culture of deep ecological sustainability. *At the same time, to get to know the wonderful complexity of our ego-identities and to consciously experience the process of constructing critical awareness about oneself and the world, is essential to cultivate soundness domains of living and long-term wellbeing*. It by no means poses limits to diverse ways of being, on the contrary, it essentially acknowledges and welcomes human diversity, the uniqueness of the human experience and is wide-open to many possibilities and different arrangements of the dynamics of living as human beings.

2.2. IMPLICATIONS FOR DESIGN

In Part 1, the state of art of our ecological issues were exposed and by the interweaving of several issues this thesis has been situated accordingly. It is widely known that it is not at all possible to predict the future. However, from the evidence

that has been exposed, it is impossible to believe in a future different to the one that has been discussed in this thesis. As I am drawing to the end of this thesis, new information and debates continue to materialize supporting the idea that the technological solutions sustained by the sustainable development agenda will not come to prevent industrial civilization of major collapses (Ahmed, 2014, Chestney, 2014, Hopkins, 2014, Motesharrei et al., 2014). If the warning of collapse was not appealing for most in the last 40 years, a way around this is an invitation to the co-creation of alternatives as a possible way to help people to situate themselves within the ongoing changes and to craft alternatives. This essentially is what was attempted with the exercise proposed for the schools of Torres Novas.

In Part 2, an emerging ecological thinking was exposed and explored in an endeavour to situate design within an ecological perspective. And as long as we bring forth a world in living and doing things together, since conversations and explanations, I have proposed an initial understanding: *That design is the natural expression of doing things together. A process that does emerge from our broader ecological relationships to mediate between a world of infinitely different perspectives and that we bring forth together.*

That which Dr Gonzalo Salazar Preece has proposed gives further depth to this understanding. According to him, design is a domain of conversation in which we enter in the totality of our beings where the emotion of love and the process of homing are key aspects to ecological manners of design. As emotions are the fundament on which we constitute our networks of conversation and which allow us to distinguish different domains of relational behaviour, when we design we bring together all those immaterial aspects that are intrinsic to what each one recognizes as a self. It means that the world, in which we live, is designed by us and comes through us. This is a natural process to that which Preece (2011) defines as “homing”. Furthermore, every other reference reviewed and brought to expose other attempts to define ecological manners of design has demonstrated a common feature: Precisely this character of collective endeavour. *Hence, I would like to advance that design is also a platform of principles and a relational domain of co-creation and participation fundamental to the sort of transition supported in this thesis*. As in the work of Professor Sandra Jovchelovitch, it is through participating that a group of

people can develop awareness about its own resources and can engage with significant others in the public arena.

The locus of the complex human relationships where design emerges is the Earth's biosphere and its diversity of ecosystems where humanness has crafted multiple forms of living and various cultures have settled in place across time. In the presence of the awareness of our intrinsic participation in the Earth's ecological dynamics, I support with this thesis that there is nothing we can name as ecological design as it naturally belongs to the domains of our broader ecological relationships. What I propose is that we have to become conscious of that participatory living process — naturally living, naturally designing. Hence the issues surrounding sustainability are about our living, personal relationships, community, networks and on how to co-create a meaningful existence inspired by ecological systems.

At same time, it seems there is no other way to become ecologically literate then that of getting to know its dynamics and living accordingly. This is something that transcends theoretical explanations to reach human corporeal experience as a way of coming together to share experiences, to engender and be responsible for the emergence of new explanations, meanings, values and a world that is capable to protect long-term soundness for human living. Once again, in such contexts, design processes can enact relational domains for authentic democratic epistemic practices.

Henceforward my suggested ecosophy D.1 has been organized to understand and integrate it in a living by doing manner, the life-supporting processes of planetary biosphere to the human realm. As a matter of fact, all that can be offered through this thesis is a theoretical framework that is up to the reader to explore and to engender in new frameworks, both in practical and philosophical terms. Looking back at the whole thesis, what has been lived along this processes and what has been an attempted for reflection here can be resumed in Figure 23 below as a thought starter for other designers to set their own ecosophies.

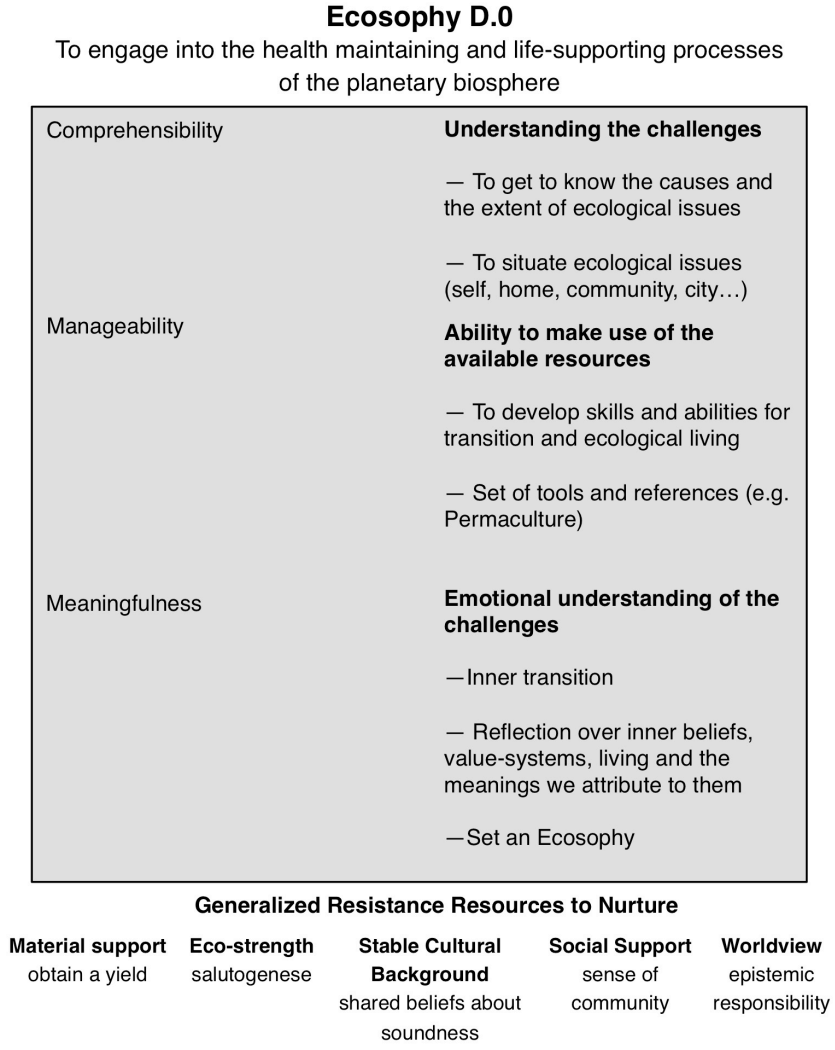


Figure 23 – The ecosophy D.1 reflected upon sense of coherence' basic components from salutogenese

To explain the figure above, I have to get back to my own experience as personally I came across the same issues I have exposed along the thesis. As I got to know and reflect on the things I have exposed and to nurture the awareness about the fundamental interconnectedness of our living, I felt it was necessary to promote a major personal shift to set coherence among the ideas emerging and my actions in the world. The option I took was to live on a farm, to cultivate my own food and to understand my living from such dynamics. It was a novelty and I have had to develop new skills, learn to use new tools and to design different things in different manners. During this course of action I was able to reflect on my inner beliefs and attribute new sense of meaning to my surroundings.

This personal movement allowed for contact with other sources of inspirations as I have exposed. Furthermore, the empirical practice with the Schools of Torres Novas has been aligned accordingly to what I have encountered in this process, where I

have used the Antonovsk's Sense of Coherence basic components as a major source of explanation. So, according to Figure 23 above, what I have lived and reflected in the thesis practice started with comprehensibility that is to understand the challenges ahead, by getting to know the causes and the extent of our ecological issues and also to bring them to the scope of our understanding — i.e. the use of scenarios and the explanations around the ecological being. Manageability is the ability to make use of the available resources. However, it is still necessary to develop skills and abilities for such transition and ecological living. This happened by exploring emerging tools and references — this was how I came into contact with Permaculture principles for instance and why I have proposed an ecological lexicon. Meaningfulness is the emotional understanding of the challenges, which correspond to an inner transition that is to reflect in values, inner beliefs about soundness, every-day-living and the meanings we attribute to it. As I have exposed in Part 3, in that which regards deeper transformations, the exercise with the schools was limited to a contemplation status. However, based on their ideas, their answers to the questionnaire and the activities that happened immediately after the workshops it was possible to support the idea of design as a platform to facilitate the proposed transition.

As I have attempted to demonstrate, our ecological issues are in demand of a transmutation of human thinking to move us out of an accommodating pace. In the sense of the facilitation of relational domains, which invite people to co-create together, gain major relevance to foster conscientization and informed participation by taking part in regular conversations and negotiations through which one may comprehend, situate and confer meaning to one's living and surroundings.

This emerging idea of co-creation, that is when we relinquish the expert-driven mindset of technocracy, to assume the idea and the responsibility of the designer, or any other individual, as a participant together with genuine other knowers — from the mundane to the esoteric — can indeed begin to grow as the very possibility of realization and support of certain relational domains. If we can provide space for conscious social participation, we can also provide space and conditions to extend this understanding to the broader community of life. It is in the relational domains of human living that we can become ecologically literate people by creating means to

learn from Nature and following this, to set ways to live accordingly. *Hence, if we understand design processes as a relational domain of co-creativity, design practice can be reoriented to begin to activate, facilitate and integrate the immaterial aspects underlying the imagination, endeavour and craft of different ways of living. And design co-creative processes are both the possibility of self and collective enlightment.*

This is also a sort of design activism, where designers are required to adopt their own agendas; and in face of the growing awareness to set the purpose of every human design to promote broader ecological health. In this sense, modest projects and initiatives if deployed in masse shall create a network of experiences, alternatives, domains and territories that are more ecologically liveable. Design might not remain limited to the materialization of products or artefacts. Design thinking is shareable.

2.3. A BRIEF IMAGINATION FOR THE SCHOOL

As I have attempted to demonstrate, our public educational systems on the whole are organized to reproduce certain cultural practices, which, at this moment, mean to respond to certain global economic demands of production and consumption where nature is seen as a subset of the economy in a major human centric mindset. It means that students are culturally prepared and assessed to respond to it: To enter these global competitive market dynamics and basically to increase their options to find a job and to occupy a place in an industrial society and to innovate from this very perspective.

And from the ecological perspective that has been supported, these are all characteristics that do not allow the emergence of worldviews of broader social and ecological participation — on the contrary it does foment a whole worldview of top-down hierarchies, dualistic and mechanistic conceptions, compartmentalization, command and control that are the root causes of the issues that have been exposed along with the worldview behind it, which has been exemplified here as technocracy. This was so with the intention to differentiate between expressions of a technocratic society and an interactive democracy.

So, what has been brought to surface is that the traditional public school system does not provide domains of co-creativity, as it is essentially hierarchical and instructive. Since that the children and youth I met during the empirical practice, and the ones before them, and the next generations will do is to keep reproducing basically the same societal imaginary. Hence, what is fundamentally necessary in first instance is to shift the whole purpose of education and its overall understanding as a mere functional compartment of human societies. Hence, aligning with what was proposed above for design, *it is necessary to educate for the situation of human living within the health maintaining and life-supporting processes of the planetary biosphere — with spirit, heart, head and hands*. It means to provide individuals with the capacity and tools to participate in their totality, as authentic beings, in broader ecological dynamics and with the underlying cultural aim to promote long-term ecological soundness.

When educating within these principles, the traditional schools may dissolve to become the garden, the shelter, the community, the city, the landscape, the forests and creeks, museums and libraries and so on. Hence, the school for deep ecological sustainability is a root-based community of learning that aims to facilitate the individuals to experience the totality of being and where it essentially belongs to a place.

This does not mean to simply disregard what school offers today, on the contrary, it means to situate learning and to reconnect compartmentalized knowledge to the essential needs of people and their places where local economies may thrive and scientific advancements can be respectfully aligned with local wisdom. Knowledge production founded in place is where explanations emerge from observation and interaction, where problems arise and can be solved and where people can be fully aware of the ethical, social and ecological consequences of its applications. This may sound like an excessive benign conception of community, but I am daring to dream that it is possible to promote access to open debate and to facilitate ways founded on trust to ensure the journey towards ecological knowledge.

2.4. DESIGN AND EDUCATION — AN OPEN END TO FURTHER EXPLORATIONS

I have already reflected on design and the specific exercise promoted in Part 3. However, I would like to share some last thoughts for future design research. Design thinking is basically the building up of ideas within an inspirational approach that draws primarily from the future by using imagination, over facts, data, certain situations and contexts. It is a process that is generative and evocative, built through experimentation, ambiguity and surprise. This is the type of creative logics designers are trained for but that is also inherent to human creativity. This is so to the point that design is at a worldview level as exposed earlier in this thesis. As I have reflected on ecological thinking entering design domains and since the time I spent with public schools, I will end this work by briefly exposing the potential of design thinking entering educational domains when informed by ecological thinking — see also the Figure 24 below.

Ecological design thinking entering educational domains

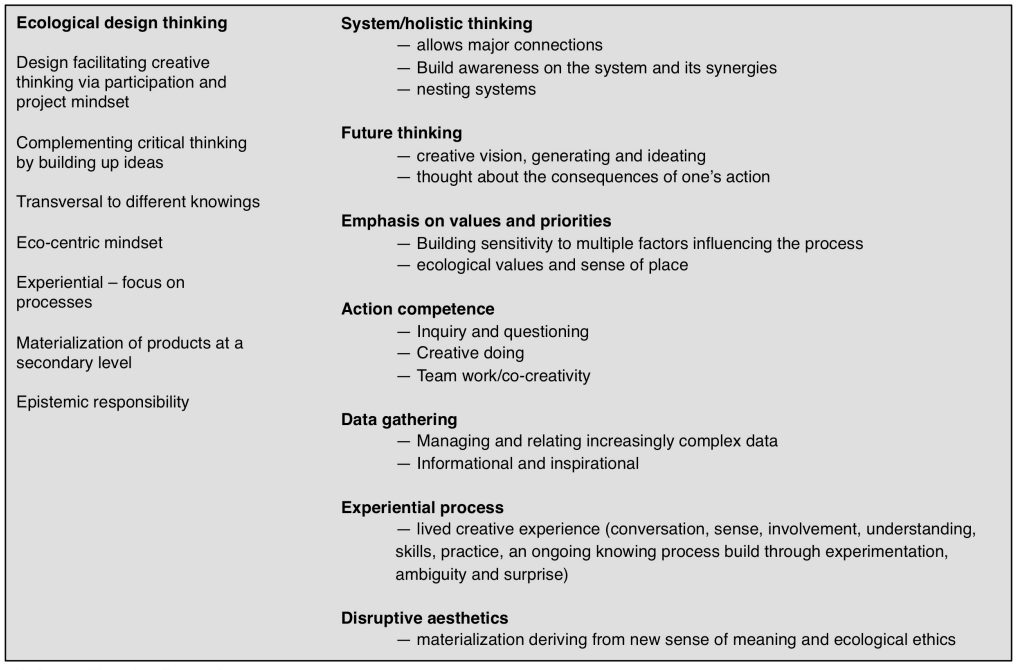


Figure 24 – Design thinking entering educational domains

According to all that has been exposed throughout this thesis and as in the Figure 24 above, I propose that design thinking can enter school domains to facilitate creative participation and a project mindset. From the workshops with the schools of Torres Novas it was possible to realize that the exercise has allowed the participants to build connections, to build awareness of the system and its synergies and the idea of

interdependence of our broader ecological dynamics, which also corresponds to the exercise of holistic thinking. When they were exercising future thinking they were disclosing the ability of visioning, to project, generating and ideating from a certain starting point, or information. This was also a way to reflect on the consequences of one's action. By building ecological awareness and interrelating different subjects they could contemplate several factors influencing processes. To ideate and generate ideas has also allowed the possibility to develop action competence and to experience teamwork. Furthermore, it can promote experiential processes of crafting and doing, as in the case of the small garden.

This brings the idea to be explored that design thinking can become part of the learning curricula, which opens an array of possibilities for designers — departing from platforms and to support the implementation of public policy. This as a matter of course would entail designers to construct further cooperation with educational domains.

Finally, in an attempt to situate design within an ecological perspective and its understanding as a relational domain does not end here. It is necessary to constitute other platforms for further reflection on how to set and maintain them. Or yet, to find out and put together similar activities that could build up a body of knowledge regarding the subject.

The end.
Thank you!

REFERENCES

2013. *O Inominável Encontro* [Online]. Torres Novas: Municipal Library Gustavo Pinto Lopes. Available: http://biblioteca.cm-torresnovas.pt/PortalWeb/LinkClick.aspx?fileticket=-fk0kqXmmKU%3d&tabid=168&language=pt-PT 2013].

AGAMBEN, G. 2005. *Infância e história: destruição da experiência e origem da história. From the original Infantzia e storia — distruzione dell´esperienza e origene dell storia. Translation Henrique Burigo,* Belo Horizonte, Editora UFMG.

AHMED, D. N. 2014. *Nasa-funded study: industrial civilisation headed for 'irreversible collapse'?* [Online]. London: The Guardian. Available: http://www.theguardian.com/environment/earth-insight/2014/mar/14/nasa-civilisation-irreversible-collapse-study-scientists [Accessed March 2014].

AITEKEN, C. & BAXTER, S. Nature's Academy: Experiments in Participatory Design. *In:* POGGENPOHL, S., ed. International Association of Societies of Design Research, 12th to 15th November 2007 Hong Kong. http://www.sd.polyu.edu.hk/iasdr/proceeding/papers/Natures Academy_Experiments in Participatory Design_Evaluation.pdf: School of Design, The Hong Kong Polythechnic University.

ALIER, J. M. 2004. *El Ecologismo de los Pobres. Conflictos Ambientales y Languajes de Valoración,* Barcelona, Icária Editorial, s.a.

ANTONOVSK, A. 1996. The salutogenic model as a theory to guide health promotion. *Oxford Journals* [Online], 11:1. Available: http://heapro.oxfordjournals.org/content/11/1/11.abstract [Accessed August, 18 2011].

APPADURAI, A. 2001. Grassroots Globalization and the Research Imagination *In:* APPADURAI, A. (ed.) *Globalization.* Duke University Press.

AQUINO, J. G. 2013. Sérgio Niza: A Brave Portuguese pedagogue. *Educação e Pesquisa São Paulo July/Sept. 2013,* vol.39**,** [online]. pp. 793-809. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1517-97022013000300015&lng=en&nrm=iso%3E. .

BAKAN, J. 2011. *Childhood Under Siege: How Big Business Ruthlessly Targets Children*, The Bodley Head, Random House.

BALL, P. 2004. *Critical Mass: How One Thing Leads to Another,* London, Willian Heinemann.

BANERJEE, B. Designer as Agent of Change: A Vision for Catalyzing Rapid Change. *In:* CIPOLLA, C. & PERUCCIO, P. P., eds. Changing the Change Design, Visions, Proposals and Tools, 2008 Turin, Italy. Umberto Allemandi & C.

BATES, B. C., KUNDZEWICZ, Z. W. & WU, S. 2008. Climate Change and Water. Technical

Paper of the Intergovernmental Panel on Climate Change. J.P. Palutikof ed. Geneva.

BATESON, G. 2000a. *Steps to an Ecology of Mind,* Chicago, University of Chicago Press - originally published in 1972.

BATESON, M. C. 2000b. Foreword to this Edition. *in Steps to an Ecology of Mind.* Chicago: The University of Chicago Press.

BAXTER, S. 2005. Deep Design and the Engineers Conscience: A Global Primer for Design Education - S. Baxter, Centre for the Study of Natural Design, University of Dundee, Scotland, UK. *In:* RODGERS, P., BRODHURST, L. &

HEPBURN, D. (eds.) *Crossing Design Boundaries: Proceedings of the 3rd Engineering & Product Design Education International Conference, 15-16 September 2005, Edinburgh, UK.* Routledge.

BAXTER, S. Deep design and the engineers conscience: A global primer for design education. *In:* DAHLE, B. & JENSEN, A., eds. Being in Nature - Experimental Learning and Teaching, 2007a Nord-Tondelag University College - Steinkjer. pp 151 - 158.

BAXTER, S. The Way to Natural Design: Learning to See and Confront the Bigger Design Question. *In:* DAHLE, B. & JENSEN, A., eds. Being in Nature - Experimental Learning and Teaching, 2007b Nord-Tondelag University College - Steinkjer. pp 84 - 90.

BECKER, C. M., GLASCOFF, M. A. & FELTS, W. M. 2010. Salutogenesis 30 Years Later: Where do we go from here? *International Electronic Journal of Health Education, 2010; 13: 25-32,* available online: http://www.aahperd.org/aahe/publications/iejhe/upload/10_C_Becker.pdf.

BELL, D. 1974. *The comming of post-industrial society,* New York Basic Book.

Dirt, The Movie, 2012. Directed by BENENSON, B. & ROSOW, G.

BEST, K. 2009. *The Fundamentals of Design Management*, AVA Publishing http://books.google.pt/books?id=OY1FPgAACAAJ.

BOHM, D. 1980. *Wholeness and the Implicate Order,* London, Routledge & Kegan Paul.

BRAUNGART, M. & MCDONOUGH, W. 2009. *Cradle to Cradle: Re-making the Way we Make Things,* London (Third Edition), Vintage (First published in United States of America in 2002 by North Point Press).

BROGAN, S. & BAXTER, S. 2010. Food Orbits: A novel design tool for complex systems.

BROGAN, S. K. 2011. *Health , Food and Design Thinking: .* Doctor of Philosophy University of Dundee.

BROWN, K. H. & CARTER, A. 2003. Urban Agriculture and Community Food Security in the United States: Farming from the City Center to the Urban Fringe. *In:* CARTER, A., MANN, P. & SMIT, J. (eds.). Venice: Urban Agriculture Committee.

BUCHANAN, R. 1995. Wicked Problems in Design. *In:* MARGOLIN, V. & BUCHANAN, R. (eds.) *The idea of Design: A Design Issues Reader.* Cambridge: MIT Press.

BUSH, M. 2011. *The Practical Beekeeper Volume 1, 2, 3 Beekeeping Naturally*, X-Star Publishing Company.

CAMPBELL, C. & JOVCHELOVITCH, S. 2000. Health, community and development : towards a social psychology of participation [online]. *LSE Research Online. Available at:* http://eprints.lse.ac.uk/2587 *and Originally published in Journal of community and applied social psychology, 10 (4). Pp. 255-270 © 2000 John Wiley & Sons.*

CAPRA, F. 2002. *The Hidden Connections* London, Flamingo - Harper Collins Publishers.

CHANDLER, P. 2012a. The Beatrix Potter Syndrome. *2012 UK Natural Beekeeping Conference.* Emerson College, East Sussex from 10-12 August: Ezine Articles.

CHANDLER, P. 2012b. The Future of Natural Beekeeping. *2012 UK Natural Beekeeping Conference.* Emerson College, East Sussex from 10-12 August.: Ezine Articles.

CHESTNEY, N. 2014. *100 million to die by 2030 if world fails to act on climate* [Online]. New York: Thomson Reuters Available:

http://www.reuters.com/article/2012/09/27/us-climate-inaction-idUSBRE88Q0ZJ20120927 [Accessed March 2014].
CLEVELAND, C. 2008. *Energy return on investment (EROI)* [Online]. The Encyclopedia of Earth (EoE). Available: http://www.eoearth.org/article/Energy_return_on_investment_(EROI) [Accessed June 2012].
COMMISSION, E. 2007. A Sustainable Future in Our Hands - A Guide to the EU's Sustainable Development Strategy. Brussels.
CORBETT, J. 2013. *Fukushima Update: Nuclear News From Japan* [Online]. Corbett Report. Available: http://fukushimaupdate.com/about/ 2013].
CRANE, E. 1999. *The World History of Beekeeping and Honey Hunting,* New York, Routledge.
CRAWFORD, M. 2010. *Creating a Forest Graden: Working With Nature to Grow Edible Crops,* Dartington, Green Books.
CROSS, N. 2005. *Engineering Design Methods: Strategies for Product Design,* Chichester, West Sussex, England, John Wiley & Sons Ltd.
CSIS. 2010. Rare Earth Elements: A Wrench in the Supply Chain? *Center for Strategic and International Studies* [Online]. Available: http://csis.org/files/publication/101005_DIIG_Current_Issues_no22_Rare_earth_elements.pdf.
DAMASIO, A. 2010. *What role do emotions play in consciusness?* [Online]. Available: http://www.youtube.com/watch?v=Aw2yaozi0Gg&feature=share [Accessed May 2013].
DAWSON, C. 2002. *Practical Research Methods,* Oxford, How to Books Ltd.
DELUCHI, M. A. & JACOBSON, M. Z. 2011. Providing all global energy with wind, water, and sola power, part II: Reliability, system and transmission, costs and policies. *Energy Policy,* 39.
DRENGSON, A. 2008. The Life and Work of Arne Naess: An appreciative Overview by Alan Drengson. *In:* DRENGSON, A. & DEVALL, B. (eds.) *Ecology of Wisdom: Writings by Arne Naess / Edited by Alan Drengson and Bill Devall.* Berkley: Counterpoint Press.
EBLEN, R. A. & EBLEN, W. R. 1994. Ecosystems. *The Encyclopedia of the Environment.* Boston: Houghton Mifflin Company.
EISENSTEIN, C. 2011. *Sacred economics: money, gift, and society in the age of transition,* Berkley, Evolver Editions.
EXTRAENVIRONMENTALIST 2011. Bill Rees // Why We're in Denial.
FERRY, L. 2010. *A revolução do amor: Por uma espiritualidade laica - Translation from the original: La révolution de l'amour,* tradução Véra Lucia Reis, Rio de Janeiro 2012, Objetiva, LTDA.
FERRY, L. 2011a. *A Brief History of Thought,* New York, Harper Collins Publishers.
FERRY, L. 2011b. *A Brief History of Thought: A philosophical guide to living,* New York, Harper Collins
FOLKE, C. 2006. Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change,* 16**,** 253-267.
FOSTER, J. B. 2001. *The Vulnerable Planet: A Short Economic History of the Environment*.
FULLER, R. B. & KUROMIYA, K. 1981. *Critical path,* London, Hutchinson, 1983.
GALLOPIN, G., HAMMOND, A. & SWART, P. R. A. R. 1997. Branch Points: Global Scenarios and Human Choice *PoleStar Project* [Online]. Available: http://www.tellus.org/publications/files/branchpt.pdf [Accessed Jun 2010].

GATTO, J. T. 2009. *Weapons of mass instruction,* Gabrila Island, Canada, New Society Publishers.

GEN, G. E. N. 2014. *Global Ecovillage Network* [Online]. Sieben Linden, Beetzendorf: Global Ecovillage Network. Available: http://gen-europe.org/home/home/index.htm [Accessed February 2014].

GFN. 2013. *Earth Overshoot Day* [Online]. Oakland: Global Footprint Network. [Accessed June, 2013 2013].

GIACCARDI, E. & FISCHER, G. 2008. Creativity and evolution: a metadesign perspective. *Digital Creativity,* 19**,** 19-32

GIBSONE, C. & BUCKINGHAM, J. 2013. *Applied Ecovillage Living* [Online]. Findhorn: Findhorn Foundation. Available: http://www.findhorn.org/programmes/53/ -.UxGwsv2HvGA [Accessed January 2013].

GOLDSMITH, E. 1998. *The Way,* Athens, Georgia, University of Georgia Press.

GOTTRON, F. 2001. RS20981: Energy Efficiency and the Rebound Effect:

Does Increasing Efficiency Decrease Demand? *National Library for the Environment* [Online]. Available: http://www.ncseonline.org/nle/crsreports/energy/eng-80.cfm?&CFID=11262148&CFTOKEN=7028302.

GRATTON, L. 2011. *The Shift: The future of the work is already here,* London, Harper Collins Publishers.

GREER, J. M. 2008. *Long Descent: A User's Guide to the End of the Industrial Age*, New Society Publishers.

GREER, J. M. 2009. *Ecotechnic Future: Envisioning a Post-Peak World*.

GUINOTE, P. 2014. *A Educação do Meu Umbigo: Textos sobre Educação* [Online]. Paulo Guinote. 2013].

HEAF, D. 2008. Towards Sustainable Beekeeping Part 4. *Beekeepers Quarterly*.

HEINBERG, R. 2011. *The End of Growth: Adapting to Our New Economic Reality*, Clairview Books.

HOLLICK, M. 2006. *The Science of Oneness: A Worldview for the Twenty-first Century,* Winchester, U.K., Books.

HOLMGREN, D. 2009a. *Future Scenarios: How Communities can Adapt to Peak Oil and Climate Change,* Totnes, Green Books.

HOLMGREN, D. 2009b. *Permaculture: Principles and Pathways Beyond Sustainability,* Hapburn, Australia, Holmegren Design Services. First published in 2002.

HOLT, J. 2004. *Instead of Education: Ways to help people do things better,* Boulder, Sentient Publications - First edition 1976, E.P. Dutton & Co.

HOLZER, S. 2010. *Sepp Holzer's Permaculture: A practical guide for farmers, smallholders and gardeners,* Hampshire, Permanet publicaions.

HOPKINS, R. 2008. *The Transition Handbook: from oil dependency to local resilience*, Green Books Ltd.

HOPKINS, R. 2011. *The Transition Companion: Making Your Community More Resilient in Uncertain Times,* Totnes, Green Books.

HOPKINS, R. 2014. *Rob Hopkins' Letter to BBC Slams Climate Denier Nigel Lawson* [Online]. Hampshire: Permanent Publications via Permaculture Magazine. Available: http://www.permaculture.co.uk/news/1402144366/rob-hopkins-letter-bbc-slams-climate-denier-nigel-lawson [Accessed February 2014].

HORSBURGH, M. E. 2000. Salutogenesis: "Origins of health" and sense of coherence *In:* RICE, D. V. H. (ed.) *Handbook of Stress, Coping, and Health: Implications for Nursing Research, Theory, and Practice.* Thousand Oaks, CA: Sage Publications.

HULME, M. 2009. *Why we disagree about climate change: understanding controversy, inaction and opportunity,* Cambridge, Cambridge University Press.

ILLICH, I. 1970. *Deschooling Society,* London, Marion Boyars.

INDEPENDENT, T. 2006. *Why London's beekeepers are a growing band* [Online]. London: The Independent. Available: http://www.independent.co.uk/environment/why-londons-beekeepers-are-a-growing-band-476750.html [Accessed March 2013].

IPCC 2007. Issues Related to Mitigation in the Long Term Context, In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Inter-governmental Panel on Climate Change. *In:* METZ, B., DAVIDSON, O. R., BOSCH, P. R., DAVE, R. & MEYER, L. A. (eds.). Cambridge: Inter-governmental Panel on Climate Change. Available in http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter3.pdf.

IPCC. 2014. *Intergovernmental Panel on Climate Change* [Online]. IPCC. Available: http://www.ipcc.ch [Accessed May 2014].

ISEOF. 2012. *The Oil Drum: Discussions About Energy And Our Future* [Online]. Fort Collins: Institute for the Study of Energy and Our Future. Available: http://www.theoildrum.com/ 2011].

JACKSON, T. 2009. *Prosperity without growth : economics for a finite planet,* London ; Sterling, VA, Earthscan.

JACOBSON, M. Z. & DELUCCHI, M. A. 2009. A Plan for a Sustainable Future: How to get all teh energy from wind, water and solar power. *Scientific American.* Nature America, Inc.

JOVCHELOVITCH, S. 1995. Social representations in and of the public sphere: towards a theoretical articulation *LSE Research Online. Available online at* http://eprints.lse.ac.uk/2650 *since 2007. Originally published in Journal for the theory of social behaviour, 25 (1). Pp. 81-102 © 1995 Blackwell Publishing.* London.

JOVCHELOVITCH, S. 2007. *Knowledge in context : representations, community and culture,* London, Routledge Publications.

KENNER, R. 2008. Food, Inc. .

KUNSTLER, J. H. 2006. *The Long Emergency: Surviving the Converging Catastrophes of the 21st Century*.

LEGAN, L. 2009. *A Escola Sustentável: Ecoalfabetizando Pelo Ambiente,* São Paulo, Imprensa Oficial do Estado de São Paulo e Ecocentro IPEC - Instituto de Ecovilas e Permacultura do Serrado, Pirenópolis, Goiás.

LLOYD, Z. A., WHITE, R. M. & BAXTER, S. 2010. Curriculum Development in Scotland and a Strategy for Reform. *Teaching and Learning 2010.* Seville, Spain: International Association for Scientific Knowledge.

LOOV, R. 2005. *Last Child in the Woods: Saving our Children from Nature-Deficit Disorder,* New York, Atlantic Books.

LOVE, T. 2005. A Unified Basis for Research and Theory - *International Design Congress - IASDR 2005: New Design Paradigms.* Taiwan: International Association of Societies of Design Research.

LOVINS, L. H. & LOVINS, A. B. 1999. NATURAL CAPITALISM: PATH TO SUSTAINABILITY? *Rocky Mountain Institute* [Online]. Available: http://www.natcap.org [Accessed 05 de Setembro de 2008].

MARGOLIN, V. 2007. Design, the Future and the Human Spirit. *Design Issues,* Volume 23, Number 3.

MARKUSSEN, T. 2012. The Disruptive Aesthetics of Design Activism: Enacting Design Between Art and Politics. *DesignIssues,* Volume 29.

MARTINS, C. F. 2013. Quando a Escola Deixar de Ser uma Fábrica de Alunos. *Jornal o Público* [Online]. Available: http://www.publico.pt/temas/jornal/quando-a-escola-deixar-de-ser-uma-fabrica-de-alunos-27008265.

MASER, C. & MASER, Z. 2000. *The World in my Garden,* London, Polair Publishing.

MATURANA, H. 1988. Ontology of Observing - The Biological Foundations of Self Consciousness and the Physical Domain of Existence. Available: http://ada.evergreen.edu/~arunc/texts/cybernetics/oo/oo3.pdf [Accessed April 2011].

MATURANA, H. 1997. METADESIGN. *Instituto de Terapia Cognitiva INTECO* [Online]. Available: http://www.inteco.cl/articulos/006/doc_ing5.htm [Accessed April 2011].

MATURANA, H. 1999. *Emoções e linguagem na educação e na política,* Belo Horizonte, Editora UFMG - Original title: Emociones y lenguaje en educadón y política.

MATURANA, H. 2002. Autopoiesis, Structural Coupling and Cognition: A history of this and other notions in the biology of cognition. *Cybernetics and Human Knowing,* 09**,** pp 5 - 34.

MATURANA, H. & DAVILA, X. 2012. Um Diálogo sobre Infância, Ética e Amor. São Paulo: Instituto Alana - online http://www.youtube.com/watch?v=bhkrB8WntNA.

MATURANA, H. & VARELA, F. J. 1984. *A Árvore do Conhecimento: As Bases Biológicas da Compreensão Humana,* São Paulo, Palas Athenas Editora.

MATURANA, H. & VERDEN-ZOLLER, G. 1996. Biology of Love. G.: Peterander,F. (Hrsg.): Focus Heilpadagogik, Ernst Reinhardt, Munchen/Basel 1996. in http://www.lifesnaturalsolutions.com.au/documents/biology-of-love.pdf.

MEADOWS, D. H. 2009. *Thinking in Systems,* London, Earthscan

MEC. 2013. *Sobre o Ministério da Educação e Ciência* [Online]. Lisboa: Ministério da Educação e Ciência. Available: http://www.portugal.gov.pt/pt/os-ministerios/ministerio-da-educacao-e-ciencia/sobre-o-ministerio-da-educacao-e-ciencia.aspx 2013].

MOTESHARREI, S., RIVAS, J. & KALNAY, E. 2014. *Human and Nature Dynamics (HANDY): Modeling Inequality and the Use of Resources in the Collapse or Sustainability of Societies* [Online]. College Park: University of Maryland. Available: http://www.atmos.umd.edu/~ekalnay/pubs/2014-03-18-handy1-paper-draft-safa-motesharrei-rivas-kalnay.pdf 2014].

NAESS, A. 2008. *Ecology of Wisdom: Writings by Arne Naess / Edited by Alan Drengson and Bill Devall,* Berkley, Counterpoint Press.

Climate Refugees 2010. Directed by NASH, M. USA: LA Think Tank.

NEF. 2012. *The New Economics Foundation* [Online]. London. 2011].

NETWORK, T. 2013. *Transition Initiatives Map* [Online]. Totnes: Transition Network. Available: http://www.transitionnetwork.org/initiatives/map [Accessed January 2013].

NIZA, S. 2012. *Escritos Sobre Educação,* Lisboa, Tinta da China.

NOVAK, P. 1998. Coping with Existential Threats and the Inevitability of Asking for Meaningfulness. *In:* DAWSON, S. (ed.) *Twentieth World Congress of Philosophy.* Boston, Massachusetts from August 10-15: Boston University. Available online: http://www.bu.edu/wcp/Papers/Bioe/BioeNova.htm.

ODAC. 2011. *The Oil Depletion Analysis Centre (ODAC)* [Online]. NEF (The New Economics Foundation). 2012].

ORR, D. 2001. Foreword to Stephen Sterling's Sustainable Education. *Sustainable Education: Re-visioning Learning and Change.* Totnes: Green Books.
ORR, D. 2002. *The Nature of Design,* New York, Oxford University Press.
ORR, D. 2005a. Forewords. *In:* STONE, M. K. & BARLOW, Z. (eds.) *Ecological Literacy: Educating our Children for a Sustainable World.* San Francisco: Sierra Club Books.
ORR, D. 2005b. Place and Pedagogy *In:* STONE, M. K. & BARLOW, Z. (eds.) *Ecological Literacy: Educating our Children for a Sustainable World.* San Francisco: Sierra Books.
ORR, D. W. 2010. Foreword of The Third Teacher. *The Third Teacher: 79 Ways You Can Use Design to Transform Teaching & Learning.* Abrams.
OWEN, C. 2006. Design Thinking: Notes on its Nature and Use. *Design Research Quaterly - The Design Research Society,* V. 2:1.
PAPANEK, V. 1985. *Design for the Real World: Human Ecology and Social Change,* London, Thames and Hudson - 2nd Edition. First published in United Kingdon in 1985 and reprinted in 2009.
PCI. 2010. *Post Carbon Institute* [Online]. Available: http://www.postcarbon.org/.
PERROW, C. 2011a. Fukushima and the inevitability of accidents. *Bulletin of the Atomic Scientists* [Online]. Available: http://thebulletin.org/2011/november/fukushima-and-inevitability-accidents.
PERROW, C. 2011b. Fukushima, risk, and probability: Expect the unexpected. *Bulletin of Atomic Scientists* [Online]. Available: http://thebulletin.org/fukushima-risk-and-probability-expect-unexpected.
PERROW, C. 2013. Nuclear denial: From Hiroshima to Fukushima. *Bulletin of the Atomic Scientists* [Online]. Available: http://thebulletin.org/2013/september/nuclear-denial-hiroshima-fukushima.
PINKERTON, T. & HOPKINS, R. 2009. *Local food: How to make it happen in your community,* Totnes, Transition Books.
PREECE, G. S. 2011. *Co-Designing in Love: Towards the Emergence and Conservation of Human Sustainable Communities.* Doctor of Phylosophy, University of Dundee.
QUIVY, R. & CAMPENHOUDT, L. V. 1995. *Manual de Investigação em Ciências Sociais,* Lisboa, Gradiva Publicações, S.A.
RESALLIANCE. 2004a. *Ecosystems Services* [Online]. Resilience Alliance (online). Available: http://www.resalliance.org/index.php/index.php?id=1289&sr=1&type=pop [Accessed July 2013].
RESALLIANCE. 2004b. *Thresholds and alternate states in ecological and social-ecological systems* [Online]. Resilience Alliance (Online). Available: http://www.resalliance.org/183.php [Accessed August 25th 2010].
ROBIN, M.-M. 2010. *The World According to Monsanto: Pollution, Corruption, and the Control of the World's Food Supply,* New York, The New Press.
ROSA, C. 2012. *Ser Professor é um Inferno: Entrevista com Sérgio Niza* [Online]. Lisboa: Jornal de Notícias. Available: http://www.jn.pt/revistas/nm/Interior.aspx?content_id=2772827.
SANDERS, E. 2005a. Design Serving People. *In:* SOTAMAA, Y., SALMI, E. & ANUSIONWU, L. (eds.) *Proceedings Cumulus conference on Future Design and Innovation.* Danmarks Designskole, Copenhagen, Denmark, 23-25 September 2005: University of Art and Design. Available online in

http://www.cumulusassociation.org/images/stories/Working_papers/WP_Copenhagen_15_05.pdf.

SANDERS, E. 2008. An Evolving Map of Design Practice and Design Research. *Interactions* XV.06.

SANDERS, E. B.-N. 2005b. Information, Inspiration and Co-creation. *The 6th International Conference of the European Academy of Design, March 29-31 2005.* University of the Arts, Bremen, Germany. Available online in http://www.maketools.com/articles-papers/InformationInspirationandCocreation_Sanders_05.pdf.

SANDERS, E. B.-N. 2006. Design Research in 2006. *Design Research Quaterly - The Design Research Society,* V.1:1 September 2006.

SANDERS, E. B.-N. 2009. Contextmapping / Exploring Co-creation on a Large Scale. *Collegerama.* Delft: Technical University of Delft. Avilable online: http://collegerama.tudelft.nl/mediasite/SilverlightPlayer/Default.aspx?peid=35a0ffdf188342f7a7b39c0e212d531d.

SANDERS, E. B.-N., BRANDT, E. & BINDER, T. 2010. A Framework for Organizing the Tools and Techniques of Participatory Design. *PDC '10 Proceedings of the 11th Biennial Participatory Design Conference*. Sidney ACM New York, NY, USA ©2010. Available online in http://dl.acm.org/citation.cfm?id=1900476&dl=ACM&coll=DL&CFID=72850900&CFTOKEN=41918960.

SANDERS, E. B.-N. & CHAN, P. K. 2006. Emerging Trends in Design Research: Changes over time in the landscape of design research. *Make Tools* [Online], Department of Industrial, Interior and Visual Communication Design, The Ohio State University,. Available: http://www.maketools.com/articles-papers/EmergingTrends1_Sanders_Chan_07.pdf.

SANDERS, E. B.-N. & STAPPERS, P. J. 2008. Co-creation and the new landscapes of design. *CoDesign: International Journal of CoCreation in Design and the Arts Published By: Taylor & Francis.,* Vol - 7. Available online http://www.maketools.com/articles-papers/CoCreation_Sanders_Stappers_08_preprint.pdf.

SANDERS, E. B.-N. & WESTERLUND, B. Experiencing, Exploring and Experimenting in and with Co-design Spaces. 4th Nordic Design Research Conference - Making Design Matter!, May 29th - 31st, 2011 2011 School of Art and Design, Aalto University, Helsinki, Finland. Nordes. Available online on http://designresearch.fi/nordes2011/docs/Nordes2011-Proceedings.pdf.

SANDERS, E. B.-N. & WILLIAM, C. T. 2003. Harnessing People's Creativity: Ideation and Expression through Visual Communication. *In:* LANGFORD, J. & MCDONAGH, D. (eds.) *Focus Groups: Supporting Effective Product Development.* New York: Taylor and Francis.

SANDERS, E. B. N. 2000. Generative tools for CoDesigning. *In:* SCRIVENER, S. A. R., BALL, L. J. & WOODCOCK, A. (eds.) *Proceedings of CoDesigning 2000, pages 3–12,.* London: Springer.

SANDERS, E. B. N. 2002. From User-Centered to Participatory Design Approaches. *In:* FRASCARA, J. (ed.) *Design and the Social Sciences.* London: Taylor & Francis Books Limited.

SCHUMACHER, E. F. 1973. *Small is beautiful : economics as if people mattered*, Harper & Row.

SCOTT, J. 2010. *Arafura in Funding Talks for $964 Million Rare Earths Project* [Online]. New York: Bloomberg News. Available:

http://www.bloomberg.com/news/2010-09-30/arafura-in-funding-talks-for-964-million-australian-rare-earths-project.html 2013].

SDSN 2013. An Action Agenda for Sustainable Development. 07 May 2013 ed.: Sustainable Development Solutions Network (SDSN), a global initiative for the United nations.

SERRANO, G. P. 2008. *Elaboração de Projectos Socias: Casos Práticos,* Porto, Porto Editora, LDA.

The Quen of The Sun: What Are Bees Telling Us? , 2011. Directed by SIEGEL, T.

SNODGRASS, A. & COYNE, R. 1997. Is Design Hermeneutical? *Architectural Theory Review, Journal of the Department of Architecture, The University of Sidney,* Vol 1**,** pp 65-97.

SONDEIJKER, SAARTJE, GEURTS, JAC, ROTMANS, JAN, TUKKER & ARNOLD 2006. Imagining sustainability: the added value of transition scenarios in transition management. *Foresight - The journal of future studies, strategic thinking and policy,* 8**,** 15-30.

SRC. 2007. *Stockholm Resilience Centre - what is resilience?* [Online]. Stockholm: Stockholm University. Available: http://www.stockholmresilience.org/research/whatisresilience.4.aeea46911a3127427980004249.html [Accessed june 2010].

STERLING, S. 2001. *Sustainable Education: Revisioning Learning and Change,* Totnes, Green Books Ltd.

STERMAN, J. D. & SWEENEY, L. B. 2007. Understanding public complacency about climate change: adults' mental models of climate change violate conservation of matter. *Springer Science+Business Media* [Online]. Available: http://www.springerlink.com/content/f367413412565006/fulltext.pdf [Accessed December 2011].

STIBBE, A. 2009. *The Handbook Of Sustainability Literacy: Skills For A Changing World,* Totnes, Green Books.

STOLL-KLEEMANN, S., O,ÄÔRIORDAN, T. & JAEGER, C. C. 2001. The psychology of denial concerning climate mitigation measures: evidence from Swiss focus groups. *Global Environmental Change,* 11**,** 107-117.

STONE, M. S. & BARLOW, Z. 2005. *Ecological Literacy: Educating OUr Children For A Sustainable World,* San Francisco, Sierra Club Books.

STORCH, H. 1985. *At the Hive Entrance,* Brussels, European Apicultural Editions.

TAMERA. 2014. *Tamera* [Online]. Monte do Cerro, Colos: Tamera. Available: http://www.tamera.org/index.html.

UB. 2013. *Urban Bees* [Online]. London: Urban Bees. Available: http://www.urbanbees.co.uk [Accessed March 2013].

UN 1972. REPORT OF THE UNITED NATIONS CONFERENCE ON THE HUMAN ENVIRONMENT. *In:* UNEP (ed.). Stockholm: United Nations.

UNDP 2005. Human Development Report *International Cooperation at a Crossroads: Aid, Trade and security in unequal world* New York: Published for the United Nations Development Programme (UNDP). Available online at http://hdr.undp.org/en/media/HDR05_complete.pdf.

USDA. 2013. *Honey Bees and Colony Collapse Disorder* [Online]. USDA, United States Department of Agriculture. Available: http://www.ars.usda.gov/News/docs.htm?docid=15572 [Accessed March 2013].

WAHL, D. C. Eco-literacy, Ethics, and Aesthetics in Natural Design. EAD 06 - 6th international conference of the European Academy of Design, March 29-31

2005 University of the Arts, Bremen, Germany. http://ead.verhaag.net/fullpapers/ead06_id98_2.pdf.

WAHL, D. C. 2006a. *Design for Human and Planetary Health: A Holistic/Integral Approach to Complexity and Sustainability.* PhD, University of Dundee.

WAHL, D. C. 2006b. Design for Human and Planetary Health: a Transdisciplinary Approach to Sustainability. *WIT Transactions on Ecology and the Environment,* Vol 99 WIT Press http://www.witpress.com, ISSN 1743-3541 (on-line).

WAHL, D. C. 2007. SCALE-LINKING DESIGN FOR SYSTEMIC HEALTH: SUSTAINABLE COMMUNITIES AND CITIES IN CONTEXT. *International Journal of Ecodynamics,* Vol. 2**,** 57–72.

WAHL, D. C. 2009. Beyond Sustainability: Natural Design and Resilience. *In:* CONNEXITY, D. (ed.) *8th European Academy of Design Conference.* Aberdeen, Scotland: Design Connexity.

WAHL, D. C. & BAXTER, S. 2008. The Designer's Role in Facilitating Sustainable Solutions. *Design Issues,* 24**,** 72-83.

WARRÉ, A. 2007. *Beekeeping For All*, Translated from the original French version of L'Apiculture Pour Tous (12th edition - reproduction of the 1948 edition) by Patricia and David Heaf. Sixth electronic English edition thoroughly revised February 2010.

WCED 1987. Our Common Future: Report of the World Commission on Environment and Development. USA.

WHO. Ottawa Charter for Health Promotion. *In:* ORGANIZATION, W. W. H., ed. First International Conference on Health Promotion, 1986 Ottawa. WHO, 4.

WIEK, A., BINDER, C. & SCHOLZ, R. 2006. Functions of scenarios in transition processes. *Futures,* 38**,** 740-766.

WILLIAMS, A. 2008. *The Enemies Of Progress,* Exeter, UK, Imprint Academic.

WILLIAMS, D. R. & STEWART, S. L. 1998. Sense of Place: An Elusive Concept that is Finding a Home in Ecossystem Management *Journal od Forestry,* **,** 18-23.

WOLF, A. 2002. *Does education matter? Myths about education and economic growth,* London, Penguin Books

WOOD, F., BAXTER, S. & BRUCE, F. The Design of Children's Outdoor Activities: Sustainability and Early Learning Experiences *In:* UNIVERSITY, T. R. G., ed. 8th European Academy Of Design Conference, 1st, 2nd & 3rd April 2009 The Robert Gordon University, Aberdeen, Scotland. The Robert Gordon University, 5 pp.

WOOD, J. Changing the Change: A Fractal Framework for Metadesign. *In:* CIPOLLA, C. & PERUCCIO, P. P., eds. Changing the Change Design, Visions, Proposals and Tools, 2008a Turin, Italy. Umberto Allemandi & C, 8.

WOOD, J. 2008b. Co-designing within Metadesign; synergies of collaboration that inform responsible practice. *to be published in CoDesign International, Journal of CoCreation in Design and the Arts* [Online], (accepted, but no date set for publication). Available: http://attainable-utopias.org/tiki/tiki-download_file.php?fileId=85.

WRIGHT, J. T. C. & SPERS, R. G. 2006. O País no Futuro: Aspectos Metodológicos e Cenários. *Revista Estudos Avançados. Publicação Quadrimestral do Instituto de Estudos Avançados da USP,* 20**,** 56: 13-18. Available online: http://www.scielo.br/pdf/ea/v20n56/28624.pdf.