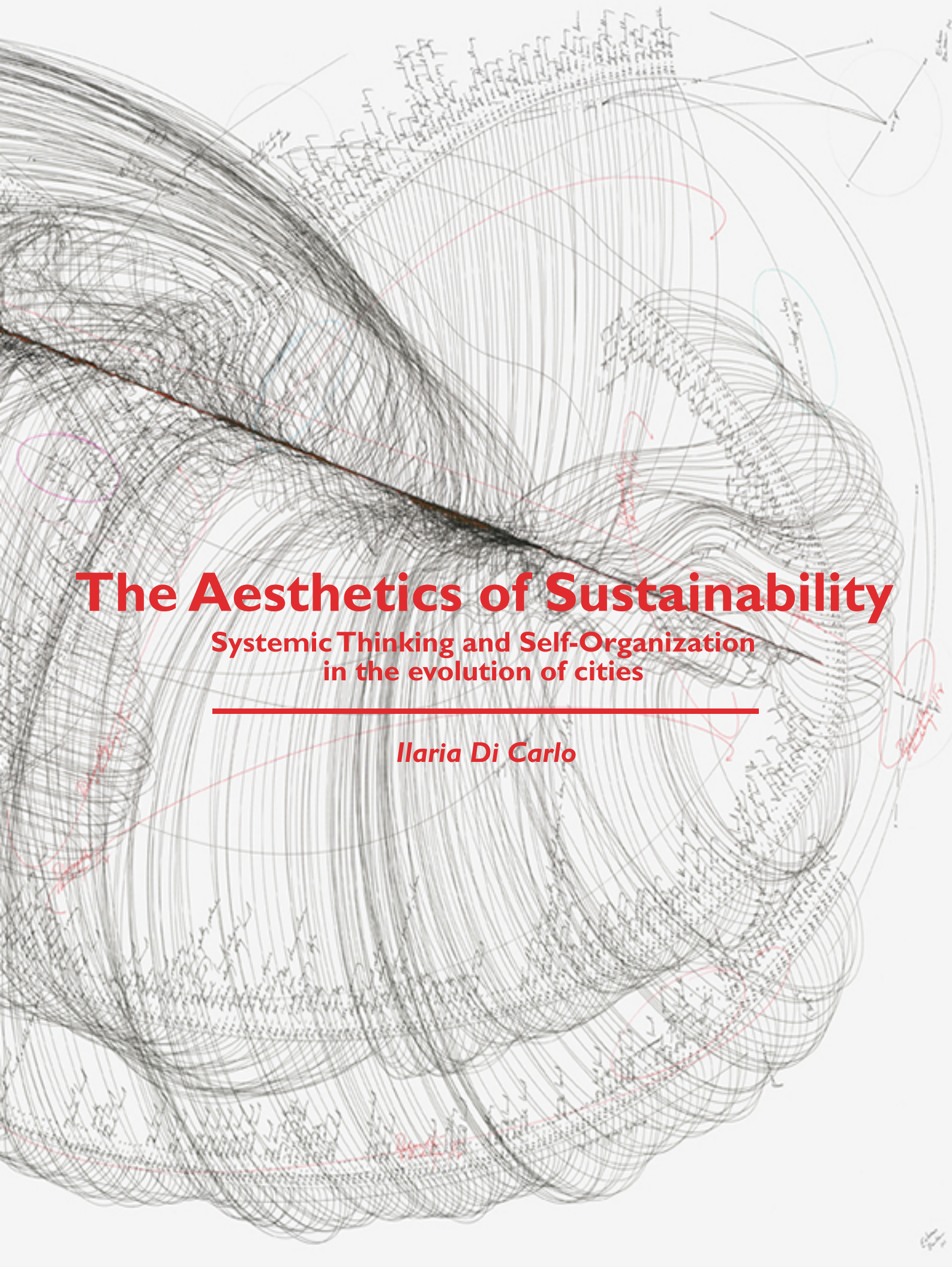

The Aesthetics of Sustainability

Systemic Thinking and Self-Organization in the evolution of cities

Ilaria Di Carlo

The Aesthetics of Sustainability.

Systemic thinking and self organization in the evolution of cities

Cover Image: Jorinde Voigt , Ludwig van Beethoven sonate 1-32

a Matteo Chubichu

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PREFACE

The issue: Aesthetics of Sustainability.

"It nonetheless remains the case that the immense crisis sweeping the planet – chronic unemployment, ecological devastation, deregulation of modes of valorisation, uniquely based on profit or State assistance – opens the field up to a different deployment of aesthetic components."
(F. Guattari, Chaosmosis: an ethico-aesthetic paradigm, 1992)

"We have made a lot of progress to empower the individual so now we have a network, and suddenly when you have a network, you have to look at things as systems, instead of objects."
(J. Ito, 9 Principle of the Media Lab, 2014)

At the moment on the international level there would not seem to be a clear and coded position in order to recognize a specific language and/or aesthetics in the sustainable design of city and territory.
In architecture the technological and plant design aspect of the artefact has become the favourite field of expression and experimentation in terms of sustainability. That same dimension which, during the '60s and '70s at the birth of the ecological movement, used to define buildings as '*performative machines*' evolved in more and more technologically advanced terms, although, tectonically, much less defined.
The urban and landscape scale, which had already introduced the concept of ecology between the 1890 and the First World War with the figure of Patrick Geddes[1], has developed a series of rules more similar to a 'best practice' approach, rather than a real and proactive solution with clearly recognizable aesthetic values.
Manifestos like the one of '*One Planet Living Community*' or the '*Triple Bottom Line*' and many others exist, but, apart from being too many, they just encode a series of points, a dogmatic and little seductive vision, from a morphological point of view, of a sustainability expressed more through new technological performance rather than through a new urban language.
Examples of urban development such as Masdar by Foster or Dongtan by Arup are examples of sustainable planning as necessary ethical action. However, apart from being too small, they are lacking of an innovative aesthetic language and they are just partly sustainable.

[1] Vidler A., *Whatever happened to Ecology?*, in AD EcoRedux n.208, November/December 2010, Wiley, London

Sustainability in fact, while being definitely a new form of humanity and more precisely the fourth human metabolic system[2], as it has been proposed and dealt with in many urban and landscape projects lacks often of an essential characteristic of the anthropic space: seduction.
Sustainability has to find its own power of seduction if it is to compete successfully with the ambiguous but established charms of the unsustainable city.
Talking about Sustainability as an *ethical* necessity is a given, but while dealing with this theme, we should also care about *aesthetics*, style and emotions, the essential elements of seduction that have historically made the city so attractive, particularly the capitalistic city, and have much to do, paradoxically, with excess and exuberance, with surplus production, conspicuous consumption and with waste.

This position is even more confirmed by recent studies in the field of neurosciences. Such researches propose a model of the mind as mapped through experience: offering disorganized maps creates confusion even down through different generations. A disorganized territory and, as such, disharmonic and anaesthetic, becomes the background of a consequently mapped society.
The mind is terrestrial, Jung said. The experience of 'beauty' is a generational one which we do know well but that can be easily forgotten.

In formal terms when we deal with Sustainability we deal as well with that sort of radicalization which is reminiscent of what already happened with modernism towards rationalism.
As Frédéric Migayrou[3] reminds us, subverting the classicist logic based on geometry, the humanist balance of proportions directly linked to the human body was substituted by the idea of a normative measurement.
Following the same path: a logic based on composition and tectonic-morphogenetic research has been replaced by one aesthetically impoverished and diminished, but normatively legitimated by an ethically performing technology.
Sustainability, as a matter of fact, contains in its performance some functional rigidity codified by a series of norms placing the ethic as the ultimate irreplaceable value. However functional rigidity tends towards chaos rather than complexity, while Excellency, understood

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[2] Meaning as first human metabolic system the hunters-gathers society, as second human metabolic system the agricultural society and as third one the industrial revolution.
[3] Migayrou F., *Non standard Planning*, in ArchiLab 2000

as the Greek value of *kalokagathìa* (an expression formed by the crasi of the two concepts of beautiful –*kalòs*- and –*kai*- good –*agathòs*-, one of Buber's Grundworte: words that have a meaning just if in couple) implies a certain degree of complexity.
In a society such as the contemporary one, oriented most of all in terms of efficiency, speed and economic gain, the aesthetic value which is often anti-functional and anti-economic, tends to be an obstacle exactly because it implies the acceptance of such complexity[4].

What the problem really is can be found in some of the following quotes, extrapolated from different sources: from general magazines, like Newsweek or the American Prospect, to opinions coming directly from professionals in the architectural and planning field:

"What bugs me the most about the fad for green architecture is the notion that virtue makes for better design. OK, an ugly green building is better than an ugly non-green building – but it's still ugly."
(C.Mc Guigan, in Newsweek)

"..much green architecture reflects a quality that Ford's Edsel possessed: it looks like the future, but it doesn't look good"
(K. Capps, in The American Prospect)

"if Green remains stuck in these aesthetic cliché, it won't last long."
(W.Maas, Green Dream. How future cities can outsmart nature)

"The sustainability of consultants and some architects has become to the eyes of the rest of professionals, and especially those of students, a parade of hi-tech drag-queens."
(I. Abalos, in Aesthetics & Sustainability: Alternatives)

"'Green' and 'Sustainable', in their current form, have made architecture a task rather than a desire."
(*JDS Architects, in Ecological Urbanism*)

From all the above it is clear the importance of the 'Aesthetics of Sustainability' as fundamental for the success of a **new model of green planning.** Not just from an environmental and economic point of view, but, perhaps and most importantly, from a social and mental one. It is the aesthetics as it is envisaged by Guattari and Foucault: 'a

[4] Zoja L., *Giustizia e Bellezza*, Bollati Boringhieri Editore, Torino, 2009

way to hint at the creative potential of expression and enunciation that has been silenced by the dominant force of signs and signifiers.'[5] It is an aesthetic paradigm interwoven with ethical and scientific paradigms: "The new aesthetic paradigm has ethico-political implications because to speak of creation is to speak of the responsibility of the creative instance with regard to the thing created […]"[6].

In the Ecosophical treatise *'The three Ecologies'* Felix Guattari was advocating quite a similar position: the increasingly deteriorating condition of human relationships with the socius, the psyche and the environment is due not only to the pollution and the objective damage that belongs to this, but to the most worrying praxis of regarding 'action on the psyche, the socius, and the environment as separate'[7]. Guattari condemns the notion of ecology simply related to the environment in a sort of synonymic equation as too reductive and too dangerous. He adds: "We need to apprehend the world through the interchangeable lenses of the three ecologies." Such ecologies are governed by a logic of intensities which 'concerns itself solely with the movement and intensity of EVOLUTIVE PROCESSES'.

This line of thought is important because advocating a sort of 'triplication' implies as well the overcoming of the binary system, the classic polarities and in general the oppositions with all their typical synthesis. Therefore it annihilates the dichotomy between ethic and aesthetic, or, in other words, **'aesthetics as an ethic'**, according to the transversal aspect of the three ecologies and the aesthetic paradigm always relating to modes of existence and life. [8]'

Equally important, this position introduces the idea of ecologies within the neo-Darwinian framework of Evolution. The passage is fundamental in creating a direct link between ecology and aesthetics within the evolutionary approach.

The content of this research is, as a matter of fact, an attempt to present a shift of perspective in the way we look at architecture, cities and territory. It is an urge to change the paradigm of urban structures and town planning in the light of evolutionary sciences.

The search for a new alliance between humans and nature proposed by Prigogine and Stengers calls for a new view of human systems and of

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[5] Brunner C., Nigro R., Raunig G., *Towards a New Aesthetic Paradigm. Ethico-aesthetics and Aesthetics of Existence in Foucault and Guattari*, available on web

[6] Brunner C., Nigro R., Raunig G., *Op. Cit.*

[7] *Guattari F., The three Ecologies*, Continuum International Publishing Group – Athlone, July 2000

[8] *Guattari F., Chaosmosis – an Ethico-Aesthetic Paradigm*, Indiana University Press, *1995*

the relations they establish with the environment[9]. These new relations should pursue Sustainability as an aim as well as defend the opportunities for a new hermeneutics of the city which will bring along a new language and aesthetics.

The key to such a challenge resides within the concept of *transdiciplinarity*, a synthesis between disciplines that destroys academic barriers and creates new disciplines in which everything is more than the sum of the parts and which has something to do with the complexity theory. Its essence lies in combining pre-existing elements to create new synapses.
We will look at how the evolutionary theory, the complexity theory, systemic thinking and the contemporary debate on Sustainability and Ecology have radically changed the approach to the design of city and territory. In particular we will focus on how they have challenged the historic dichotomy between Top Down versus Bottom Up models and how they are proposing the emergence of *the self-organized city* as possible morphogenetic process for sustainable city design.
In general terms we could argue that the point is a matter of *order versus chaos* whereby chaos we mean '*not a cult topic but a dynamic state, its potential revealed by science, that can indicate the way to a more subtle and flexible order than simplification and repetition*.' [10]

The research structure has been organized in three main areas.
The first one, *Ontology and Hermeneutics* (Chapters 1.1-1.4), is an effort to present the main subjects of the study (Sustainability, Aesthetics, Complexity Theory and Transdisciplinarity) within a specific philosophical and philological framework, the one of Systemic Thinking.
Themes are presented and analysed according to a consistent school of thought starting from the Evolutionary Theory all the way to the Complexity theory and self-organization. In this chapter it is set the stage for a new hermeneutics of the concepts of Sustainability and Aesthetics applied to urban processes and design. The existing status quo of a disciplinary structured top-down approach to planning is been challenged in favour of a more transdisciplinary bottom-up one.

The second, *Models and Tools* (Chapters 2.1-2.7), presents the output of a research aimed to discover a series of models for the self-organizing

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[9] Pulselli R.M & Tiezzi E., *Cities out of Chaos. Urban self-organization and Sustainability*. WIT Press, Southampton, UK, 2009
[10] Portoghesi P., Intro to, *Cities out of Chaos. Urban self-organization and Sustainability*. WIT Press, Southampton, UK, 2009

city borrowed by other disciplines such as biology, cybernetics, geology, statistics, mathematics and sociology applied to urban design and planning. It is an attempt to give a compendium, which, though possibly incomplete, should start to give some suggestions to a different promising path.
Since urban environments are artefacts or, as Stephen Read says, 'techno-constructions' which support specific urban societies and economies, models and tools have been analyzed according to both their technical performance as well as their material hermeneutics and aesthetics.
'Objects are not simplistically 'given' but are produced in a process that makes the context of the object's 'appearance part of the intentional or subjective side of the experiment.' [11]

The third and last chapter, *Evaluation Metrics* (Chapters 3.1-3.2), deals with the difficult question of the role of the architect and the notion of Style and Aesthetics within the specific framework formulated in Chapter 1 and pictured in Chapter 2.
It tries to give sense to the aesthetic discourse on Sustainability looking at the issue from another possibly more integrated perspective where the aesthetic act is conceived not only as a form of contemplation but most of all as a form of sensorial active participation.
This position, not new in the history of art and architecture, would, in the words of Guattari, 'organize a reinvention of social practices which would give back to humanity a sense of responsibility' towards the material and immaterial components of life.'
It would bring along a new concept of Style, Authorship and Aesthetics, as a form of ecology of mind, and would recuperate that '*flux of participation'* evoked by David Abram: 'Our senses are not for detached cognition but for participation, for sharing the metamorphic capacity of things that lure us[12].

Last but not least a quick inside about the modalities and contents of this thesis is due.
As the title of the work says, '*The Aesthetics of Sustainability. Systemic* ***thinking*** *and self-organization in the evolution of cities.*', the research carried out is of a theoretic type, it is intrinsically a 'map of paths' based on referential sequences recalling not only the

[11]Read S., '*Meaning and Material: Phenomenology, Complexity, Science and 'Adjacent Possible' Cities', in Complexity Theories of Cities have come of age*. Springer : Complexity, Berlin, 2012 .
[12]Abram D., as quoted in *Reclaiming Animism*, Stengers I., on line @ http://www.e-flux.com/journal/reclaiming-animism/

contemporary cultural imaginary but also a new conceptual apparatus sprung from the transdisciplinary union between thought-science-aesthetics, creating a cartography of resonances among different realms.
The possibility to build the thesis into the exploration of the theme through a 'case study', which would have turned the word *thinking* of the title into *praxis*, was initially launched and investigated but later dismissed.
The reason behind the impossibility was due to the sheer complexity of the models and tools required to handle the design process which entails indeed a very long and time consuming learning curve.
As a matter of fact, after two years of intense investigation needed to build up and support the theoretic backbone of the study, we were left with just one year to learn and become fluent and agile in the language (differential equations and computer scripting) needed to support the case and, just with these premises, to be able to embark in the selection of a proper subject with its subsequent design process.
This was retained an impracticable choice that would have mined conversely the credibility of the argumentation.
We have then opted to concentrate on the new theoretic and speculative aspect of the research, treating it in a form of an assay, leaving as an appendix the analysis of an externally bred 'case study', the *Relational Urban Models*, in order to illustrate in details the specific device of the *interface [i/f].*

It is important to explain with a bit more detail the argumentation of this particular choice of models.
When in May 2014 I was invited to give a lecture at the Bartlett School of Architecture in London (UCL), with the title '*In praise of Transdisciplinarity. From the death of typologies to the rise of cellular automata'* where I partially presented the work contained in this research, I was approached at the end of the talk by Eduardo Rico who was sitting among the audience.
Rico, who is design tutor at the Urban Design Master Course at the Bartlett, co-director of Landscape Urbanism at the Architectural Association, co-director of the practice GroundLAb, director of the practice Relational Urbanism and Associate for ARUP, revealed me that he was nicely shocked by my intervention because it was envisioning and quite literally describing in a *theoretic* manner what he and his wife, Enriqueta Llabres, co-director of Relational Urbanism and visiting professor at Harvard and the Berlage, had been developing for over two years on a *practical* level with the supervision of the technical expertise of ARUP and Charles Waldheim.

The project, called *Relational Urban Model*, at the time of the lecture was still covered by secrecy dictated by a non-disclosure agreement among the practices.
Obviously I was not, and could not have been, aware of the existence of that model.
This nice coincidence in terms of line of research brought us to collaborate in different occasions, exchanging thoughts and material, and when finally the project became of public domain, I got the privilege to write on it for the first time.
Now that the *Relational Urban Models* have been successfully tested in various occasions (competitions, private commissions, exhibitions, etc..), I thought that they would be the best complementary option to illustrate the *actual* aspects of my *virtual* 'map of paths', using Deleuze terminology.

1. THE SELF-ORGANIZED CITY: ONTOLOGY AND HERMENEUTICS

1.1 The theme of SUSTAINABILITY within the Complexity theories

"There is an ecology of bad ideas, just as there is an ecology of weeds."
(G. Bateson, Step towards en Ecology of mind, 1972)

"Urban sustainability needs to be planned, but more than that, it needs to be imagined."
(C. Hubert & I. Theocharopoulou, Design, Sustainability and the Global City, 2013)

"If there is one good thing about capitalism it is that under it, Mother Earth no longer exists."
(S. Žižek, on Molecular Red, 2015)

"Ecology.....the imagination and expression of an aesthetic of the world, free from folkloristic naiveties but rhizomatic in the consciousness of our cultures"
(E. Glissant, Poetics of Relation, 2007)

1.1.1 Sustainability today: a container of empty meanings or an empty container of meanings?

In the past recent years the term *Sustainability*, together with its other co-star, *Ecology*, has taken on a growing sense of urge, of immanence. It gained that sort of respect more similar to the one dedicated to 'religious aura' rather than the one more appropriate for a genuine global policy objective.
It has become what Slavoj Žižek calls 'the new opium for the masses'[1] and in doing so it has been emptied of a meaningful identity.
The reasons behind this unfortunate unfolding seem to be attributable mainly to three factors: first, its hyperinflationary use as a container of meanings; second, a sort of nostalgic, low tech, pseudo-bucolic notion of sustainability; and third its 'form of consumption', a reductionist approach to the complexity of reality.
On the one hand we encounter the abuse of the term Sustainability exploited in a paradoxical capitalistic mode in order to control consumptions where control is not used just with the meaning of 'decreasing consumptions' but it is rather employed in the more dodgy and manipulative form of 'directing consumptions', easily recognizable as a sort of *branding* (let's just think how many times we find this word in advertisement for selling anything from a car to a detergent).

[1] Žižek S., *On Ecology*, @ https://www.youtube.com/watch?v=iGCfiv1xtoU

In this case Sustainability flounders between a revisited form of metabolism and a green-washing performance.
On the other hand a very naïve idea of a reality worshipping Mother Nature as the only possible ethical choice in a world already condemned by the evil of Artificiality has pushed the notion of Sustainability and ecology in the very place where such a reactionary way of thinking belongs: demagogy.
Last but not least Sustainability has become trapped in a reductionist portrait that paralyzes its complexity.
The existing praxis got us used to think and relate to Sustainability as mainly related to economic, environmental and technical issues. Numbers, norms and technical apparata constitute its language and pseudo-scientific paradigms are borrowed to validate its essence, while mental and social aspects, that deal practically or theoretically with subjectivity and are so much part of the experience of reality, are somehow dismissed or worst forgotten.
'It is as if there were a scientistic super-ego which demanded that psychical entities be reified, understood only in terms of their extrinsic co-ordinates'[2]
In this case Sustainability is simplified/castrated/reduced to a bulimic use of restrictions and regulations and the asphyxiating legitimization of a techno-scientific paradigm.
As John Thackara says: "Our world is awash in eco-information, but starved for meaning." [3]
The problem about Sustainability is fundamentally a problem of *ecophenomenology*[4], in other words, of how environmental problems are framed: today the philosophical question about Nature, Ecology and their relationship with Culture and Humankind is almost entirely forgotten, possibly obscured by a reductive urge of *solving* environmental issues, but this environmental crisis 'existing as it does in the human world of value and significance[5]', is at heart a philosophical crisis.

The discourse about Sustainability will be invested of new credibility and meanings only reducing its applicability, embracing a more active and combatant concept of Ecology and dignifing its human,

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[2] Guattari F., *Chaosmosis – an Ethico-Aesthetic Paradigm,* Indiana University Press, *1995*
[3]Thackara J., Metrics or Aesthetics?, *in Green Dream. How future cities can outsmart Nature,* t?f The Why Factory, NAI Publishers, 2010
[4]The term ecophenomenology was coined by Ted Toadvine in 2009 when speculating on Merleau-Ponty's philosophy of Nature.
[5]Merleau-Ponty M., *La Natura. Lezioni al College de France 1956-1960,* Raffaello Cortina Ed., Milano 1996

philosophical, social and aesthetics aspects at the same level of the techno, scientific and ethic ones.
Within this research framework the thoughts of the philosophers Maurice Merleau–Ponty, Slavoj Žižek and, ultimately, Felix Guattari are of particular interest, exactly because in their speculations they envision an ecological anti-dialectic, anti-chiastic perspective on Nature and Humankind which is fundamental to overhaul the phenomenological problem of Sustainability.

Fig. 1.1: Examples of green-washing

1.1.2 Maurice Merleau-Ponty and the concept of Nature as the Primordial

In a series of courses held at the Collége de France between 1957 and 1960 Merleau-Ponty (Rochefort-sur-Mer, 1908 – Paris, 1961) decided to reflect and wonder on a subject that, for the time being, he considered an '*outdated theme'* but has much to do with the modern image of the world[6] *:* the concept of Nature.
Such fall into disuse of the philosophy of Nature was due, according to Merleau-Ponty, to the dichotomy that was to form between two different fields of knowledge: philosophy and the sciences of nature.
Nonetheless he was convinced that if philosophy does not encompass Nature as possible object, then the philosophical speculation on man is de-naturalised and therefore distorted: 'on one hand a dehumanised science, a-historical, a-spiritual, on the other, a disembodied spirit, an unnatural history and a man reduced to pure interiority. [7]'
His notes, collected in the volume '*Nature: Course Notes from the College de France'*, were meant to set out again an ontology of Nature and to negotiate the area between Nature's own self-unfolding and human subjectivity.
What interests us of Merleau-Ponty's thought within our framework are mainly two positions: the rejection of the dualism between Nature and Humankind, and therefore his ecological anti-dialectic perspective on Nature, and his concept of Artificiality as a component of Nature.

For Merleau-Ponty Nature is the *primordial, the nonconstructed, the noninstitueted* but at the same time Nature is 'what makes sense, without this meaning had been put by the thought. *It is the self-production of sense*[8].'
In saying so and in other passages ('Nature is not only the object, [...] it is an object from which we ourselves have risen[9]'), he reunifies the traditional dichotomy between Nature and what is not considered Nature, since Nature is not the object of our knowledge, which is separated from us and from our embodied subjectivity, but it is rather the whole from which opposition itself is born.
That is why Nature is primordial, because it comes before the dualism, the epistemological separation between subject and object, that same separation that we, men, encompass in order to know.

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[6]D'Angelo D., *Maurice Merleau-Ponty e la verità del naturalismo*, available on line @ www.metodo-rivista.eu/index.php/metodo/article/download/33/38+&cd=4&hl=it&ct=clnk&gl=it
[7]D'Angelo D., *Op. Cit.*
[8] Merleau-Ponty M., *La Natura. Lezioni al College de France 1956-1960*, Raffaello Cortina Ed., Milano 1996
[9] Merleau-Ponty M., *Op.Cit.*

That is also why Nature cannot be subtracted from the philosophical investigation and be confined just within the 'hard sciences', since, being a whole, cannot be comprehended through a separation of knowledge (hard sciences vs human sciences), discarding later on one of them (human sciences).
Everything is one and can be observed by different perspectives/disciplines.
For Merleau-Ponty object and subject are nothing but *planes of signification,* 'structures of meaningful relationships which explicate themselves first and foremost in action and correlation [...], we could then say that if Nature is nothing but a way to be in the world, it is nothing but a meaning, since 'the way to be in the world' indicate a particular way to be actively in relationship with things, that is to give meaning to things. [10]'
This relational logic applied to processes of signification unveils a deep ecological dimension as ecology is actually based on dynamical interactions/inter-relations between organisms and their environment.

Within this philosophical structure where any Cartesian dichotomy between Nature and the other self has been dismantled, even the concept of Artificiality as opposed to Nature ceases to exist. In fact Nature, 'absorbing artificial matter as its own component, eliminating the anaemic categories of belonging and aiming to that wonderful regenerative fluidity that elides opposites and makes them its own[11]', is capable to overcome any sort of symbolic reductionism and self-unfolds, as its own evolution, in Artificiality.
'What might seem the result of a hybridization between natural and its opposite, the artificial, is instead an alternated interpenetration that makes us interpret the transformative reality of Nature. It is, more simply, the very concept of Nature that has been perverting the secular fixity producing one of the most revolutionary changes that have ever occurred in history, [ie], it frees itself from the immanentistic hibernation which has always persecute it.[12]'
This idea of Artificiality as transfiguration of Nature dissolves at once any reactionary claim of Sustainability as a 'restorative system' and any ecological thinking as a merely 'protective apparata'.

[10]D'Angelo D., *Op. Cit.*
[11] Merleau-Ponty M., *Op. Cit.*
[12] Merleau-Ponty M., *Op. Cit.*

1.1.3 Slavoj Žižek and Ecology against Mother Nature

The idea that Ecology should be based on a 'timid, merely defensive-resistant- and non-interventionist[13]' attitude appears today as totally anachronistic.

As Frédéric Migayrou points out: "the attempt to institute a right of nature, a right of ecosystems, is illusory, not because it would involve reinstating the old Kantian debate about humanist right, but because the right has been replaced by patent - patents that the big global foodstuffs, chemical and pharmaceutical companies register in order to appropriate for themselves and commercialize nature's authentic capacity for production: its capacity for reproduction. The myth of green architecture, 'green worship' no longer represents any other alternative but [...] the return in strength of a demagogy of the 'low-tech'[14].

The alternative is a more *active* or *bold ecology*[15] based upon the conviction that Sustainability is basically interaction, intervention, qualification and evolution through an appropriate use of technology and artificiality.

It is not, by any means, conservation and contemplation; it cannot be a 'mere defence of nature', we rather urge 'to go on the offensive[16]', creating 'additionality' according to the *cradle to cradle*[17] approach , forging though an appropriate ethics, aesthetics and politics for the general destiny of humanity.

The thinking and reflections of Slavoj Žižek (Ljubljana, 1949) on this line are even more radical. In a mainstream society where the fundamental aspect of an ecological and sustainable debate seems to be a romantic return back to a good harmonious, organic and balanced Mother Nature, where we should somehow 'dilute' our human dimension in front of Nature, the position of Žižek and other contemporary thinkers has the power and the inconvenience of a blasphemy: the desiderability of an even more abstract Artificiality.

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[13] Gausa M. et al., *Ecology, active (or bold), definition,* in The Metapolis Dictionary of Advanced Architecture. City, technology and society in the information age, ACTAR, Barcelona, 2003

[14]Migayrou F., *Ecology, active (or bold), definition,* in The Metapolis Dictionary of Advanced Architecture. City, technology and society in the information age, ACTAR, Barcelona, 2003

[15] Gausa M. et al., *Op. Cit.*

[16]Guattari F., *The three Ecologies,* Continuum International Publishing Group – Athlone, July 2000

[17]For more on the concepts of 'additionality' and 'cradle to cradle' see Mc Donough W. and Braungart M., *'Cradle to Cradle. Remaking the way we make things',* North Point Press, 2002

Indeed the questions of resource, scarcity and sustainability are questions of design[18].
The roots of this modality of thought lie in the humankind's somehow deep awareness of a certain condition of familiarity and ease towards Artificiality and, conversely, a growing sense of tension and disquiet towards Nature as the poet Fernando Pessoa lyrically discloses in his philosophic diary/notebook, 'The book of Disquiet',:

"Perhaps it does not happen only to me,
but also to all those that civilization has given birth for the second time. Yet I feel that for me, or for those who feel like me, Artificiality has become a natural thing, and it is Natural which seems odd.
I correct myself:
Artificiality has not become natural:
Natural has become different.[19]"

As a matter of fact, 'though humans can probably never escape entirely from a godlike differentiation of self from nature-other, our power lies not in 'sparing' nature but rather in moving purposefully within the realm of its power[20]' because 'Artificiality is the way for the approach to the natural.[21]'

1.1.4 The question of the Eco-Modernist and the 'good Anthropocene'

The same trend irreverently promoted by Žižek in 2009 is now at the core of the newest ecologic manifesto published very recently in April 2015 which is enjoying at the moment a lot of mediatic success: the so called *Ecomodernist Manifesto* by a group of researchers and practitioners in different fields.

Despite the disgraceful choice of name which wrongly reminds us of the modernist period, an era totally *decoupled* (to use the flagship word of the ecomodernists) from the concept of ecology, the content of the document is worth reading.
It distances itself in a very direct way from the school of a good balanced Mother Nature and the call for a Happy Degrowth (MDF) to promote instead a vision of Ecology and Sustainability linking

[18]Mc Donough W. and Braungart M., *The Upcycle: beyond Sustainability. Designing for Abundance*, North Point Press, 2013
[19]Pessoa F., *Il libro dell'inquitudine*, Feltrinelli ed., Milano, 2000
[20]Smaje C. *'Dark thoughts on Ecomodernism'* available on line @ http://dark-mountain.net/blog/dark-thoughts-on-ecomodernism-2/
[21]Pessoa F., *Op. Cit.*

environmental protection, progress, production and human well being with technological development, using 'humanity's extraordinary powers in service of creating a good *Anthropocene*.[22]'
"[...]we affirm one long-standing environmental ideal, that humanity must shrink its impacts on the environment to make more room for nature, while we reject another, that human societies must harmonize with nature to avoid economic and ecological collapse. These two ideals can no longer be reconciled.[23]"

The core concepts of the Manifesto are strangely not expressly listed as they would be in a typical Manifesto formula (although there being 7 sections, they do not coincide with the number of concepts), but are rather recounted in a more 'story telling' model, maybe a smart move away from all the other previous dogmatic versions of similar documents (just think to the One Planet's living community, the Copenhagen Manifesto, the Hannover principles, etc...).
Its principal ideas can be summarised as follows:

1. Intensifying many human activities – particularly farming, energy extraction, forestry and settlement - so that they use less land and interfere less with the natural world
2. Ecosystems around the world are threatened today because people over rely on them: it is the continued dependence of humans on natural environments that is the problem for the conservation of nature
3. Human technologies have made humans less reliant upon the many ecosystems that once provided their only sustenance. By using natural ecosystem flows and services more efficiently modern technologies offer a real chance of reducing the totality of human impacts on the biosphere.
4. *Decoupling* human well-being from the destruction of nature requires the conscious acceleration of emergent *decoupling* processes.
5. *Decoupling* raises the possibility that societies might achieve peak human impact without intruding much further on relatively untouched areas. Nature unused is nature spared.
6. Cities both drive and symbolize the decoupling of humanity from nature, performing far better than rural economies in providing efficiently for material needs while reducing environmental impacts

[22]Ecomodernist Manifesto, April 2015, available on line @ http://www.ecomodernism.org/
[23]Ecomodernist Manifesto, *Op. Cit*

7. Human should seek to liberate the environment from the economy
8. Plentiful access to modern energy is an essential prerequisite for human development and for decoupling development from nature
9. Meaningful climate mitigation is fundamentally a technological challenge: in the long run, next generation solar, advanced nuclear fission, and nuclear fusion represent the most plausible pathways toward the joint goals of climate stabilization and radical decoupling of humans from nature
10. The document is written out of deep love and emotional connection to the natural world. By appreciating, exploring, seeking to understand, and cultivating nature, many people get outside themselves. They connect with their deep evolutionary history
11. Humans will always materially depend on nature to some degree. What decoupling offers is the possibility that humanity's material dependence upon nature might be less destructive.
    The case for a more active, conscious, accelerated decoupling to spare nature draws more on spiritual or aesthetic than on material or utilitarian arguments.
12. Environments will be shaped by different local, historical and cultural preferences. **Along with decoupling humankind's material needs from nature**, establishing an enduring commitment **to preserve wilderness**, biodiversity, and a mosaic of beautiful landscapes **will require a deeper emotional connection to them.**
13. Decoupling of human welfare from environmental impacts will require a sustained commitment to technological progress and the continuing evolution of social, economic, and political institutions alongside those changes
14. This statement [ed: the Ecomodernist Manifesto itself] is offered in the belief that both human prosperity and an ecologically vibrant planet are not only possible but also inseparable
15. Too often discussions about the environment have been dominated by extremes, and plagued by dogmatism, which in turn fuels intolerance. What is valued here instead are the liberal principles of democracy, tolerance, and pluralism in themselves

Now, many of their ideas and concepts are criticisable and fallacious as still locked in an eco-ideology.

They portray the sham idea of a necessary division between the city and the agrarian productive land, while we should be thinking about re-engineering the city to make it productive, re-coding the city landscape as farming terrain, an advanced form of biotechnological and networked model of urban farming.
Again, their call to decouple the human beings from their lands through a massive rapid urbanization is simply dramatic.
They fall short also in demonstrating that smallholders, working in large numbers, produce lower yields than large farms.[24]
And last but not least, they seem to have forgotten in their list the word *inequality,* as Chris Smaje rightly points out.[25]
However, even though we are normally not very prone on embracing manifestos, this particular one has few links to the mental and scientific framework of this specific research which is the main reason we have been dwelling on it so far.

One of the most interesting points of the debate to us is not just the accent on the power of DECOUPLING, technology, progress and faith in human capacity but, more important for our line of research, the link between Ecology and Aesthetics: "These patterns [ed: processes that reduce human demands on the environments, allowing more room for non-human species] suggest that humans are likely to spare nature because it is not needed to meet their needs as they are to spare it for explicit *aesthetic and spiritual reasons*." [26]
This statement together with the ones mentioned on points 11 and 12 of the above list are very strong and bold assertions: the aesthetic and spiritual/mental experiences have not only the capacity to convey and empower ecological messages but they are also capable of questioning 'any conflict between climate mitigation and the continuing development process through which billions of people around the world are achieving modern living standards (and that) will continue to be resolved resoundingly in favour of the latter. [27]"

Another interesting aspect of this Manifesto is the connection with the work of Felix Guattari and in specific with his call for an holistic approach to the concept of Ecology (point 14) as well as his interest in

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[24]For more on this topic please see the article by G. Monbiot '*Meet the ecomodernist: ignorant of history and paradoxically old-fashioned'* available on line @ http://www.theguardian.com/environment/georgemonbiot/2015/sep/24/meet-the-ecomodernists-ignorant-of-history-and-paradoxically-old-fashioned
[25]For more on this topic please see the article by C. Smaje '*Dark thoughts on Ecomodernism'* available on line @ http://dark-mountain.net/blog/dark-thoughts-on-ecomodernism-2/
[26]Ecomodernist Manifesto, *Op. Cit*
[27]Ecomodernist Manifesto, *Op. Cit*

the evolutionary theories (point 10), which is of paramount importance for understanding the conceptual structure of this study.

1.1.5 The concept of ecology for Guattari

The work of Felix Guattari (Villeneuve-les-Sablons,1930–Paris,1992): 'My perspective involves shifting the human and social sciences from scientific paradigms towards ethico-aesthetic paradigms.'[28]
In the Ecosophical treatise 'The three Ecologies' Guattari was advocating quite a similar position: the increasingly deteriorating condition of human relationships with the socius, the psyche and the environment is due not only to the pollution and the objective damage that belongs to this, but to the most worrying praxes of regarding 'action on the *psyche*, the *socius*, and the *environment* as separate'[29]. Guattari condemns the notion of Ecology simply related to the environment in a sort of synonymic equation as too reductive and too dangerous. He adds: 'We need to apprehend the world through the interchangeable lenses of *the three ecologies'*, governed by *a logic of intensities* - the **eco-logic** - which "concerns itself solely with the movement and intensity of EVOLUTIVE PROCESSES[30]".

This line of thought is important as it advocates for a 'triplication' i.e. implying the overcoming of the binary system, the classic polarities and in general the oppositions with all their typical synthesis. This system therefore utterly eradicates the dichotomy between Ethics and Aesthetics (For more on this topic see also Chapter 1.2.2).

Of equal importance this position introduces us to the idea of ecologies within the neo-Darwinian framework of Evolution, creating a direct link between Ecology and Aesthetics within the evolutionary framework approach[31].
In fact, what becomes crucial in terms of the bond between the guattarian concept of Ecology and the enunciation of *Subjectivity*, which for Guattari is synonym of both a form of knowledge and a tool for aesthetic creation, is the awareness that the necessary precondition for any REGENERATION is the acknowledgment of the general principle that 'both individual and collective subjective assemblages

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[28] Guattari F., *Op. Cit.*
[29] Guattari F., *The three Ecologies,* Continuum International Publishing Group – Athlone, July 2000
[30] Guattari F., *Op. Cit.*
[31] For a deeper understanding of the issue of Aesthetics in the Evolutionary Theory see also Chapter 1.2 of this volume.

have the potential to develop and proliferate far beyond their ordinary state of equilibrium[32]'.
That is to say that the possibility to heal the social, economic and environmental degeneration of the world we live in can be achieved just by a conscious reading of reality through the lenses of an evolutionary complex approach ('far from equilibrium').
Such an approach, in turn, underlines the significance of narrative, subjective elements of which emotions and affections are part of.

A mental framework, the one of evolutionary sciences, which does not try to simplify reality but on the contrary embraces complexity: 'The decisive factor [for the failure of any ecological discourse] is a widespread incapacity to perceive the erroneousness of partitioning off the real into a number of separate fields. [33]'
Possibly the worst consequence grown out from this logic of separation, simplification and reduction is the notion that culture is by some means something alienated from nature, while 'more than ever today, nature has become inseparable from culture. [34]'
For Guattari the only way to deal with what has been acknowledged as a 'de facto situation' is to reorient it, through a 'redefinition of *contemporary conditions* of the objectives and the methods [ed. models and tools] of each and every form of movement of the social[35].'
And the construction and development of cities is ultimately the biggest, most complex, most complete and articulated movement of the social.
In order to address this redefinition through the development of the three types of ecological praxis, our activity will need to 'focus more centrally on new modes of production of subjectivity: that is to say, on modes of knowledge, culture, sensibility and sociability, the future foundations of new productive assemblages –whose source lies in incorporeal systems of value.[36]'

This notion of the triple ecology has been recently recalled also by Sanford Kwinter in his attempt to describe the necessary disciplinary updating architecture must face in its passage from the mechanical to the digital era and in particular the idea of the three ecologies applied to the word *environment*.

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[32] Guattari F., *Op. Cit*
[33] Guattari F., *Op. Cit*
[34] Guattari F., *Op. Cit*
[35] Guattari F., *Op. Cit*
[36] Guattari F., *Op. Cit*

Kwinter affirms that in order to properly revise the discipline, *experience* must be the 'legitimate scope of operation' for architecture and urban design. One of the main implications of this operation is to reconsider a more appropriate reading of the concept of environment 'on one hand as the process around us that we virtually call nature but which can simply be described for the 'nature deniers' among us as those processes that unfold independently and indifferently to us but whose fate we necessarily share. We must aspire to a new kind of environmental phenomenology in which our nervous systems are seen as deeply bound up with the organizational cues around us and subject even to flamboyant transformations and reinvigorations by design.
On another hand as a sincere engagement with the broader surround in which we are embedded and which is and is not merely masquered as a living, transforming, metabolic entity: the natural world and the manifold interactions of its *triple ecology*. [37],

[37]Kwinter S., in *Organization or design*? Architecture symposium at Harvard GSD, October 2015 available on web @ https://www.youtube.com/watch?v=xRRYDzNg8hA

1.2 The agency of AESTHETICS as ecological category and adaptive system

Beauty is the symbol of moral good
(I.Kant)

Beauty is a manifestation of arcane laws of nature, without the appearance of which, it would remain forever hidden from us.
(J.W. Göethe)

1.2.1. The Aesthetics of Sustainability today

As we have previously mentioned in the preface, one of the most worrying and unattended problems that Sustainability is facing today in terms of urban and landscape projects is the lack of one of the crucial and indispensable characteristics of any anthropic space: seduction.
It seems that while its *ethical* dimension has been incorporated within the concept itself, its *aesthetic* dimension went somehow forgotten.
Is there any chance to come across a new aesthetic language or style behind the hyper inflated concept of Sustainability or it is rather the case of being confronted with 'various aesthetic manifestations'?
What is today the Aesthetics of Sustainability?

We believe that in the current panorama various aesthetic manifestations of Sustainability make up for the lack of a new aesthetic language and they could perhaps be summarized in six macro groups of expression:

-The *Baroque Supermanierism*: the aesthetics of excess and redundancy
-The *Bio-Mimeticism*: the aesthetics of artificial naturalism,
-The *Analytic*: the vectorized aesthetics of processes,
-The *Hyper-Technologic*: the additive aesthetics of high-tech,
-The *Regulatory*: the an-aesthetic,
-The *Eclectic* that embodies all of the above in different degrees of intensity.

The first group, the *Baroque Supermanierism,* includes all those projects whose fluid tectonics, born from the masterly use of morphogenetic algorithms, are characterized by excess and exuberance[1], overabundance and profusion along with a pseudo-organic

[1]AD n°204, *Exuberance: new virtuosity in contemporary architecture*, 02:2010, Wiley, London

reference, repetitive but incrementally modified. It is an aesthetic that embodies the link to processes of growth and of physiological evolution, adaptation and multiplication, which tells of growths and blooms where the programmatic and material convolutions are expression of self-generation and where redundancy in the digital scenario is a productive value, not contrary to efficiency, which represents instead multiplicity and simultaneity. These include, for example, the work of Kokkugia (Roland Snooks + Robert Stuart-Smith), Ali Rahim, Xefirotarch (Hernan Diaz Alonso), CJ Lim, Marjan Colletti and many others.

Fig.1.2: Baroque Supermanierism: marcosandmarjan, Self-sufficient City: Khataba (Al Jadida) Agropolis, Egypt, 2009

The *Bio-Mimeticism* is a macro-set containing two sub-groups which differ as to the particular aspect of nature they tend to camouflage.
A first group, to which belong the research that Frei Otto led or the more contemporary ones of Ocean (Michael Hensel), Tom Wiscombe, R&Sie architects (François Roche and Stéphanie Lavaux), etc .., aims to study and rehabilitate the performances and the metabolic processes of biological systems in a particular environment, examining questions of cause-effect.
A second group instead, limits itself to simply copy forms in a very superficial way; a sort of 'return to naturalism', where Sustainability becomes pure branding, to the extent to be just graphism.

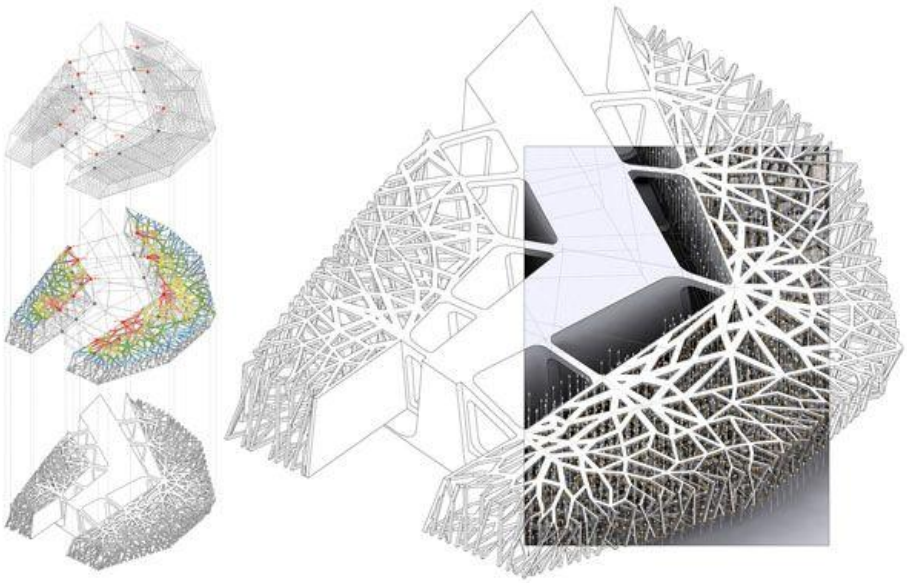

Fig.1.3: Bio-mimeticism: OCEAN, New Czech National Library in Prague, 2006

The urban, social, economic and ecological performances and processes expressed through the vectorization of space are the basis of the formal research of *Analytic* groups such as GroundLab and Ecologic studio. The scale becoming the object of research are the urban and regional ones: flows, meshes, paths, and density mappings are at the core of a fluid and diagrammatic aesthetics where prototypes capable to adapt and change to the different local conditions become incremental elements, the aesthetic essence of which lies in being part of an indissoluble whole within a topological continuity.

Fig.1.4: Analytic: EcoLogic studio, Regional Algae Plant, Simrishamm, 2011

The *High-Tech* aesthetic solution is perhaps the most accommodating when dealing with Sustainability. His acknowledged, declared, additive and little synthetic logic is still a reassuring and understandable expression of the saving power of technocracy. It is the aesthetics of the Super-tech: very little sensual, very much cerebral. It is the aesthetics of specialized elements, components, of the hyper-trophic green in the form of roof gardens, green roofs, green facades and urban gardens. The cliché of Sustainability where virtue makes up for beauty and the development of techniques has sacrificed a certain sophistication and aesthetic sensibility.

Fig.1.5: High – Tech : ARUP, Dongtan eco-city , China, 2009

The *Normative*, transfigured into a set of numerous and often redundant prescriptive rules, is the an-aesthetic of Sustainability. Rules will never acquire the emotional, mediatic, persuasive and seductive power of design, they will only have the effect of making more dogmatic and boring the concept of Sustainability.

These five 'pure' morphological expressions have a tendency to hybridize with each other in a series of *eclectic* solutions that do nothing but increase the lack of clarity of an already maturely limited language.

However, examining in specific the relationship between these aesthetic expressions and the concept of Sustainability, one must add a note.

In the first three cases, Sustainability is mainly a container of meanings rather than a content, but it does generate emotional responses, feelings,

those that Yael Reisner called 'depth-scapes'[2], expressions that offer remarkable qualities that go beyond what is purely practical or required, something that is therefore approaching the aesthetic act as it was understood by the ancient Greeks: the aspect of knowledge concerning the use of the senses, *the Sensible.*

Fig.1.6: Normative : Dunster, Bed Zed ,Lonodn, UK, 2001

In the last three cases, instead, the concept of Sustainability becomes content and paradigm of the project and the concept of aesthetics is diminished and suffocated.
This seems to confirm the initial hypothesis of a schism between ethics and aesthetics of sustainable design.
Such position must be refuted.
The concept of Sustainability, in fact, if properly interpreted, implies an increase in the quality of life and of the environment and Aesthetics, in turn, is "wherever the qualitative processes of reception and production, of pleasure and doing are examined[3]". And while it is true that the aesthetic standards are always evolving, the social component contained in the concept of Aesthetics is very specific, and it is to this that we must turn to find a new language with all the variations that the specificity of the places will give it.

The answer may lie in a new hermeneutics. How would we interpret architecture, the territory and contemporary landscapes? A landscape

[2]Reisner Y., *Diving into the Depth-scape exuberance and personalities*, in AD n°204, Exuberance: new virtuosity in contemporary architecture, 02:2010, Wiley, London
[3]Franzini E. & Mazzocut-Mis M., *Estetica*, Mondadori, Milano 1996

and all that is contained therein is altogether ecologies, metabolism, synergies and disclosure through their processes. A landscape is also energy flows as already said by Christopher Alexander in his 'Notes on the synthesis of Form' of 1964. A very complex and therefore excellent vision: to perceive not only shapes and performances of the world but also the embodied represented energy, and especially antagonism instead of uniformity and predictability, because, as the Darwinian studies remind us, the real change occurs through confrontation and opposition[4].
The challenge here is the following: transforming the socio-economic-environmental model in a distinct and recognizable spatial reality. Paraphrasing the Doorn Manifesto of 1954 you could say: "The appropriateness of any solution may lie in the field of architectural invention rather than social anthropology nor technological technocracy."
The risk otherwise is to slump in positions of an artificial naturalism, superficially mimetic, or a fake and disenchanting eco-mannerism, what Iñaki Abalos defines as 'a parade of high-tech drag queens[5]', or even, and perhaps worse, a mass market phenomenon of green washing.

In short, the danger is so fierce eclecticism as an-aesthetic.
Therefore, if we want to disengage with this pattern, it is necessary to look at the issue through a different perspective, a less specific and more holistic one, possibly the same that was at the birth of the sustainable agenda in 1915: an evolutionary one.

1.2.2. The three ecologies and the importance of the evolutionary approach: aesthetics as *an ethic*

In order then to look at Aesthetics and its association with Sustainability in this light, let's recall one of Guattari's points on Ecology (see chapter 1.1.4.): the increasingly deteriorating condition of human relationships with the socius, the psyche and the environment is due not only to the pollution and the objective damage that belongs to this, but to the most worrying praxes of regarding 'action on the *psyche*, the *socius*, and *the environment* as separate'[6].
Guattari fiercely criticizes the belief of an Ecology solely related to the environment. Instead he resolutely promotes the notion of apprehending

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[4]Lopez Duran F. & Moore N., *(Ut)opiates Rethinking Nature*, in AD EcoRedux n.208, November/December 2010, Wiley, London

[5] Abalos I., *Aesthetics and Sustainability: Alternatives*, available on line

[6] Guattari F., *The three Ecologies*, Continuum International Publishing Group – Athlone, July 2000

the world 'through the interchangeable lenses of the three ecologies.' Such ecologies are governed by a *logic of intensities* - the eco-logic - which "concerns itself solely with the movement and intensity of EVOLUTIVE PROCESSES". This line of thought is important because advocating a sort of 'triplication' implies as well the overcoming of the binary system, the classic polarities and in general the oppositions with all their typical synthesis, therefore it annihilates the dichotomy between ethics and aesthetics, nature and culture, science and humanities.

Following the considerations above, we could also convey that annihilating the dichotomy between ethics and aesthetics, Guattari declares *aesthetics as an ethic* according to the transversal aspect of the three ecologies and the aesthetic paradigm always relating to modes of existence and life[7]'.

Guattari points out that the link between the evolutionary theory and the need for a mental-aesthetic element has been introduced for the first time, 'paradoxically', exactly in the 'hard sciences' and more in specific, in physics.

Prigogine and Stengers in fact in their *Entre le temps et l'Éternité* brought up the necessity for a 'narrative element', meaning the enunciation of *Subjectivity*, as indispensable for a theorization of evolutionary irreversibility[8].

For Guattari the concept of subjectivity is not just a synonym of individuality and personality, but it is mostly a form of knowledge and a tool for aesthetic creation.

It is a form of knowledge through two complementary modes of apprehension of pascalian origin: via the concept (*l'esprit de geometriè*) and via the affect or percept (*l'esprit de finesse*); and it is a tool for aesthetic creation in the hands of the *cartographers of subjectivity*[9] capable of conceiving and designing new perspectives 'without prior recourse to assured theoretical foundations or the authority of a group, school, conservatory or academy…[10]'

Any ecologic discourse must be aesthetic as well as ethic in order to be meaningful.

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[7] Guattari F., *Op. Cit.*
[8] Prigogine I. and Stengers I., *Entre le temps et l'Éternité*, Fayard, Paris, 1988
[9] For a further evaluation on this concept see Chapter 3.1.2. of this volume
[10] Guattari F., *Op. Cit*

1.2.3. The three ecologies and the importance of the evolutionary approach: *aesthetics as adaptive system*

But what does it mean and what does it imply to look into Aesthetics through an evolutionary approach?
Evolutionary Aesthetics (EA) is today a burgeoning sub-field of Aesthetics, the main aim of which is the "importation of aesthetics into natural sciences, and especially its integration into the heuristic of Darwin's evolutionary theory[11]".
According to Orians, Professor Emeritus of Biology at the University of Washington, results from existing studies have undoubtedly demonstrated the power of an evolutionary approach to aesthetics: 'Humans have strong emotional responses to living organisms and to natural and human-modified environments. […] These powerful emotions, which are the foundations of aesthetics, […] have been designed by evolutionary processes'. He specifies that 'aesthetic emotions are a major component of how humans solve problems[12]'
Appleton, Emeritus Professor of Geography at Hull University, on the same subject gives an interesting definition of Beauty as 'the product of interactions between traits of objects and the human nervous system that evolved so that objects we consider beautiful have properties that result in improved performance in some aspect of living if we respond positively to them[13].'
The emotional power of beauty in the decision making process is something that was already recorded in the ancient myth of Paris, and his choice of Beauty, both in the ideal of Aphrodite and in the real person of Helena, over invincibility or immense power.

As a Senior Scientist at the International Institute for Applied Systems Analysis in Laxenburg, Marchetti seems to share with the people cited above the idea that aesthetic responses are 'fundamental to the ways in which organisms know about and adapt to the world[14]'.
The hypothesis here is - both in the area of "natural beauty" and in sexuality, with regard to landscape preferences, but also in the area of

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[11] Portera MG., *Evolutionary Aesthetics. A bridging discipline between the life and the human sciences*, available @ http://cas.uniri.hr/tag/evolutionary-aesthetics/
[12]Orians G. H., *An evolutionary prospective on aesthetics*, on line http://www.apa.org/divisions/div10/articles/orians.html
[13] Appleton J., *The experience of landscape.* NY: John Wiley & Sons, 1975
[14] Marchetti C., *Notes on the limits of knowledge explored with Darwinian logic*. Complexity 3, pp.22-35, 1998

"artificial beauty" (i.e. in art and design) - that beauty opens up fitness opportunities, while ugliness holds fitness risks[15].
If aesthetic responses evolved because they enabled people to better solve life's problems, exposure to high quality environments should, at least, be restorative and this brings us back to the link between aesthetics and ecologies.
Hence, within the evolutionary approach, it seems to be possible to define *Aesthetics as an adaptive system* and, as such, it 'can function (or continue to exist) only if it makes a continued adaptation to an environment that exhibits perpetual novelty[16],.


Fig.1.7: The Judgement of Paris, P.P. Rubens

Having said that, we also know that most of the preferences that lead us in our everyday life (food, music, dress preferences, etc..) are the result of processes of social learning and of the exposure to cultural models[17].
This is one of the greatest challenges for today's philosophers of art: how to clarify the conceptualization of the relationship and interactions between *nature* and *culture*.
On this topic Darwin introduced an evolutionary relationship between 'authentic taste – that which obeys the instinct acquired during evolution – and "fashion" – that which depends on cultural habits developed during life and the natural tendency of any animal species to

[15]Voland E. and Grammer K., edited by, *Evolutionary Aesthetics*, Springer-Verlag Berlin Heidelberg, 2003
[16]Holland J., Complex adaptive systems: a Primer, available on web @ http://www.santafe.edu/media/bulletin_articles/summer_fall1987v2n1.pdf
[17]Jablonka E., Lamb M., *Evolution in four dimensions: genetic, epigenetic, behavioral and symbolic variations in the history of life*, MIT Press, Cambridge, (MA), 2005

look for novelty. It is only in the relationship between these two moments of taste that Darwin sees the evolutionary law of aesthetic ideals.[18]'

Darwin's position on aesthetic ideals constituted, at the really beginning of the origin of Systemic Thinking and the Complexity theories, the basis of yet another historical philosophy on the issue: *The Tacit Knowledge.*

Fig.1.8: Aesthetics as Adaptive System

1.2.4. 'We know more than we can tell': aesthetics as a form of *tacit knowledge*

The concept of aesthetics as a form of knowledge based on the perception of the world and the importance that such knowledge has in the everyday life of humans was reiterated in the 60's by the philosopher and polymath Michael Polanyi.

In 1958 Polanyi, in his work *Personal Knowledge* first introduced the idea of the *tacit knowledge*, (later better summarized in the book *The Tacit Dimension*), as opposed to the *explicit* knowledge, the formal, codified and accepted form of knowledge: "I shall reconsider human knowledge by starting from the fact that *we can know more than we can tell*[19]".

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[18] Portera MG., Bartalesi L., *beyond the nature-culture dichotomy: a proposal for Evolutionary Aesthetics,* available on web @ http://www.fupress.net/index.php/aisthesis/article/viewFile/16209/15161

[19]Polanyi M, *the Tacit Dimension*, University Of Chicago Press, Reissue edition, 2009

Initially referring to the production in creative arts, Polanyi not only described a type of knowledge characterized by the possibility of being conceptualised and transmitted before it could be explicitly rationalized, but also that all knowledge is rooted in tacit knowledge in the strong sense of that term.

Tacit knowledge is contained within the individual and his or her involvement in a specific context; it is rooted in action and centred in experience and skills, rather than codified in language and conventions[20]. This type of knowledge is based on processes of Gestalt formation that enable us to grasp unified wholes through their constituting elements without still being aware of the latter.

Such 'un-conscious knowing' has only recently come to be explored by psychology under the heading of 'implicit' or 'procedural memory': '[…] It is mainly based on the neuronal coupling of single sensory-motor units by repeated perception or action. […] It contains familiar styles or 'melodies' of moving, perceiving and being-with-others in which our whole bodily and emotional experience is engaged. There is an atmospheric, 'felt' quality about them that cannot be analyzed into single elements.'[21] (See also Chapter 1.2.6. for a deeper understanding of this issue)

Examples of tacit knowledge are aesthetic sense, leadership, innovation, body language, intuition, humour, emotional intelligence.....

Values, beliefs, ideals and mental as much as aesthetic models are all part of the tacit cognitive dimension described by Polanyi: they establish the way we perceive the world.

They are of paramount importance to us and our knowledge, even with their immeasurable, intuitive and ineffable dimension: 'Deprived of their tacit context, all spoken words, all formula, all maps and graphs, are strictly meaningless. [22]'

As a matter of fact, as Fuchs makes us notice, the designation of *homo sapiens* that we give to ourselves is derived from the Latin *sapere* (to taste/to know), and thus shows that the knowledge characteristic for man is not an explicit one, but intuitive, implicit knowing or "feel" for his surroundings, or as Kant says, an 'aesthetic rather than intellectual judgment'[23].

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[20]Nonaka, I., *A dynamic theory of organizational knowledge creation'*. In: Organization Science, Vol 5 (1), 1994, p.14-37.

[21]Fuchs T., *The Tacit Dimension*, in PPP, Vol.8, No.4, The John Hopkins University Press, December 2001, pp.323-326

[22]Polanyi M, *the Tacit Dimension*, University Of Chicago Press, Reissue edition, 2009

[23]Fuchs T., *Op. Cit.*

Fig.1.9: Example of spaces with a strong Tacit Dimension. ©Anat Stern

For that same reason Polanyi, examining how individuals gain knowledge and share it, was stating: "Into every act of knowing there enters a passionate contribution of the person knowing what is being known and that this coefficient is no mere imperfection but a vital component of his knowledge" [24].

Another characteristic of the tacit knowledge is that it can only be revealed through practice in a particular context and transmitted through social networks[25].

The importance of the distribution network, the social network, is related to the significance of enabling the incorporation of an external component, 'the others', into the validation of any semantic process of investiture of meaning: "Meanings are not reducible to rules. They arise within the context of interactions between embodied points of view and external realities.[26]"

However, in the case of the tacit knowledge, 'the others' are not just 'any others' but they must be part of a community of practice[27], people with a common interest in a particular domain or area.

On this issue, during an interesting debate in 1948 between Turing and Polanyi, friends and colleagues at Manchester University, about the

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[24]Polanyi M, *the Tacit Dimension*, University Of Chicago Press, Reissue edition, 2009

[25]Schmidt, F. L.& Hunter, J. E, *Tacit Knowledge, Practical Intelligence, General Mental Ability, and Job Knowledge Current Directions* in Psychological Science, February 1993, 2, pp. 8-9,

[26]Goodman C.P., *The Tacit Dimension*, in Polanyiana 2003/1-2, pp133-157, available on line @ http://polanyi.bme.hu/folyoirat/2003/2003-14-the_tacit_dimension.pdf

[27]Goffin, K.; Koners, U., *Tacit Knowledge, Lessons Learnt, and New Product Development*, Journal of Product Innovation Management **28** (2), 2011.pp. 300–318.

potentials and limits of a machine that Turing was developing (the *Turing machine* precisely), Polanyi declared that 'in order for a symbol to be meaningful, it is not enough for them to be manipulated in accordance with algorithms. A symbol becomes meaningful when it is used within the context of a tacit awareness. The informal dimension that supplements the operations of the formal system instantiated by a Turing machine is brought to it by its users.' [28]

In saying that Polanyi wanted to mark the importance the users, with all their informal values, interests and background, have in the production of a successful and meaningful output of any formal process, including an algorithmic one.

Being Aesthetics part of this informal, tacit dimension, their more or less successful inclusion in every formal, codified process determines the degree of the process failure or achievement.

Starting from this basis, in 1991 Nonaka and Takeuchi in their pivotal work *The Knowledge Creating Company*[29] proposed a new description of knowledge in organizational practices which would promote the role of the tacit knowledge as primary in the process of creation: successful innovation comes from the mobilisation and conversion of tacit knowledge through four modes of knowledge conversion -- Socialisation, Externalisation, Combination and Internalisation (the 'SECI' model) [30].

This study, without going to much into details, contextualises the creative role of the tacit dimension, with all its ineffable values, within organised, collective environments, as cities are, introducing a direct link between *Aesthetics* (and therefore *Ecology* following Guattari and the evolutionary thinking), *collective environments* and *participation* (we will see how this last subject will acquire paramount importance in the last chapter 3.1.1).

1.2.5. Relational Aesthetics and the intersubjectivity issue: aesthetics as *social interstice*

Collective environments and participation are also at the core of yet another important concept of aesthetics and values within the systemic thinking and the contemporary discourse about the city: *The Relational Aesthetics*.

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[28]Goodman C.P., *Op. Cit.*

[29]Nonaka I. , *The Knowledge Creating Company,* Harvard Business Review 69 (6) , 1991

[30]Grant K.A , *Tacit knowledge revisited – We can still learn from Polanyi,* available online @ http://www.ejkm.com/issue/download.html?idArticle=101

First coined in 1996 by the art critic, author, curator and director of the École Nationale Supérieure des Beaux-Arts, Nicolas Bourriaud the term defines the emergence of a new type of art practice, participatory art, based on open endedness and inclusiveness, which would improve and intensify human relations and their social context by strengthening social connections rather than through a detached, independent and private visual experience.
Rather than an encounter between a viewer and an object interlinked by the action of contemplation, Relational Art and consequently Relational Aesthetics deal with and produce *intersubjective*[31] encounters, where meaning is created collectively and not consumed individually.
Its roots sink in the birth of a world-wide urban culture and from 'the extension of this city model to more or less all cultural phenomena': the broad growth of towns after the end of the Second World War engaged humanity in an extraordinary boom of social exchanges and greater individual mobility.[32] In this *humus* an original ecosystem of activities, networks and knowledge rose and a new emerging social system based on collaboration and openness was about to sprout: the world wide net, Internet.

In the current speculation on self-organization, open endedness, and open source where relational logics of empowered social networks, based on the free exchange of information, are constructing new meta-authorities and expertises overthrowing traditional institutions and knowledge frameworks, Relational Aesthetics might acquire a more and more dominant role.
It is an aesthetics that represents *social interstice:* '[...] this *interstice* term was used by Karl Marx to describe trading communities that elude the capitalistic economic context by being removed from the law of profit [...].The interstice is a space in human relations which fits more or less harmoniously and openly into the overall system, but suggests other trading possibilities than those in effect within this system. [33]'
This social interstice, being an aesthetic experience, does have emotional impacts since it creates new bonds between social processes and the values they symbolize. In the same way, contemporary networks, bottom up systems and the so called *wiki-culture* as new emerging social systems based on relationships are deeply and fundamentally challenging the way in which we define value and thus quality.

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[31]Bourriaud N. , *Relational Aesthetics*, Presses du Reel, 1998
[32]Bourriaud N. , *Op. Cit.*
[33]Bourriaud N. , *Op. Cit.*

In Relational Aesthetics value is intrinsic in the idea of *transitivity* whereby transitivity is meant the 'forever unfinished discursiveness, and a never recaptured desire for dissemination.[34]' It postulates dialogue as the actual origin of the image-making process and the exchange of information, the intersubjectivity, as the aesthetic experience itself.
In this framework the history of Aesthetics is the history of the production of relations with the world: firstly between Man and Deity, then between Man and The World (the Renaissance), later on between Man and Objects (Modernism) and last between Man and other Men.[35]
Aesthetics as a social interstice is in other words the invention of new models of sociability, of conviviality, of intersubjectivity where value is identified with relational power among individuals, among contexts, among meanings, among disciplines, among organizations, as well as among bodies.

Fig.1.10: Relational Art: Marina Abramovich in 'The artist is present', Moma, NY, 14-31 March 2010

1.2.6. Neuroscience and the embodiment of space: aesthetics as *embodied simulation*

The social dimension we have been investigating in the previous chapter plays a powerful role in the definition of Aesthetics in yet another very interesting debate developing in the world of Neuroscience today: the discovery of the Mirror Neurons delivers us a new notion of intersubjectivity neurobiologically founded and principally connoted as *intercorporeity* and this notion is at the base of a very innovative concept of Aesthetics.

[34]Bourriaud N. , *Op. Cit.*
[35]Bourriaud N. , *Op. Cit.*

‘Our capacity to understand the others and what the others materially accomplish does not depend exclusively on theoretical-linguistic competences, but it strongly depends on our socio-relational nature, of which corporeity constitutes the deepest and not further reducible structure. *Intercorporeity* becomes then the main source of knowledge of the world and of the others.[36]’

But what is intercorporeity and how does it affect our aesthetic perception of the world?

To understand that we need firstly to comprehend what the study of mirror neurons and ‘affective neuroscience’ have established: to each perception of the world corresponds a hedonic/affective experience which conditions and shapes our assessments. The nature of such emotional and affective aspects which determines any relational modality with the world is of a sensory-motor type. The sensory-motor relations are in turn defined by mechanisms of motor and mirroring simulation. ‘*Intercorporeity* is the mutual resonance of intentionally meaningful sensory-motor behaviours[37]’

The concept of intercorporeity has been further developed by a group of neuroscientists of the University of Parma (the same group that discovered the Mirror Neurons) into a theory that identifies the neural basis of the aesthetics experience: *the embodied simulation*.

The embodied simulation is a common underlying functional mechanism which mediates our capacity to empathize with others, sharing the meaning of actions, intentions, feelings and emotions. It is based on the discovery of the Mirror Neurons and other mirror mechanisms in the human brain showing that ‘the same neural substrates are activated when these expressive acts are both executed and perceived[38]’ which means that ‘action observation causes in the observer the automatic activation of the same neural mechanism triggered by action execution.[39]’

According to the embodied simulation ‘an aesthetic experience is what allows who experiences it to ‘perceive – feel – sense’ a work of art, and this in turn implies the activation of sensory-motor, emotional and cognitive mechanisms. [...] In this sense the aesthetic experience is a process on multiple levels which exceeds a purely visual analysis of the

[36]Gallese V., *Preface*, in L’empatica degli Spazi. Architettra e Neuroscienze by H. F. Mallgrave, Raffaello Cortina Editore, Milano, 2013

[37]Gallese V., *Mirror Neurons, embodied Simulation, and the Neural Basis of Social Identification*, in Psychoanalytic Dialogues, 19:519-536, Routledge, 2009

[38]Gallese V., *Op. Cit. 2009*

[39]Gallese V., *Op. Cit. 2009*

work of art and leans on the visceral-motor and somato-motor resonation of whoever experiences it.[40]'

Adventuring further in the world of the embodied simulation we discover that its models 'speculate that the same neural structures involved in our bodily experiences contribute to the conceptualization of what we observe in the world around us.[41]'

This means that such simulations happen in a precognitive phase of the aesthetic experience, in other words, firstly we empathize emotionally and physiologically with what surrounds us, and only at a later time we understand consciously the source of our aesthetic experience and cognitively its reason and meaning.

The implications of such discovery are paramount within the aesthetic discourse. As a matter of fact, as Mallgrave reminds us, it questions the very basis of the aesthetic theory of the XX century: the Kantian primacy of thought over emotions or other sensations[42].

Emotions as precognitive output of our interaction (intercorporeity) with the world are the real and first basis of knowledge, in fact, as Gallese and Lakoff affirm, much of our conceptual knowledge is de facto *embodied*, meaning that it is neurologically mapped in the sensory-motor system which controls all our conscious movements and traces back our bodily sensations.[43]

In this light Aesthetics and the importance of including Aesthetics in any discourse and action about not only Sustainability but any field which aims to be relevant in the contemporary debate about architecture, city and territory, becomes obvious, almost tautological.

Without incorporating Aesthetics in the equation, no concept can become part of our cognitive system and will be forever doomed to be just a whisper in a hurricane.

But there is more.

Another important aspect about Aesthetics that emerges from these studies and the enunciation of the embodied simulation theory is related to the thorny issue of the *evaluation of aesthetic parameters*.

The question on the more or less possible objectification of the aesthetic evaluation might have finally found a turning point.

According to Gallese it is possible to naturalize the aesthetic experience using neuroscientific investigation, meaning that we could frame the

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[40]Gallese V. and Di Dio C., *Neuroaesthetics. A review*., in Current Opinion in Neurobiology, 19, 2009

[41]Ebisch S.J.H. and others, *The sense of touch. Embodied simulation in a visuotactile mirroring mechanism of observed animate or inanimate touch*, in Journal of Cognitive Neuroscience, 20, 2008

[42]Mallgrave H. F., *L'empatia degli Spazi. Architettura e Neuroscienze*., Raffaello Cortina Editore, Milano, 2013

[43]Mallgrave H. F., *Op. Cit.*

artefacts of human creativity with modes and modalities less conditioned by the contemporary western aesthetic taste or cultural canon.
In fact we do know that aesthetic preferences result from a variety of factors (sensible appearances, emotional values, personal experiences, memories, etc..) but the specific *sense of beauty* arises from a '*joint activity* of cortical neuronal populations, responding to specific characteristics of elementary or superior order that are present in the work of art, and of neurons situated in the centres for control of emotions. [44]'
From this point of view, Beauty is something biologically objective, as sort of innate heuristic and organizational rule associated with the hedonic system of the brain, and at the same time something individually subjective, modifiable by the force of the experience or personal culture. [45]

It is the scientific confirmation of Guattari's position: Subjectivity, now specifically defined as Intersubjectivity or Intercorporeity, is a form of knowledge and a tool for aesthetic creation.

For the purpose of our discussion, a part for the new ruling position that Aesthetics have acquired in terms of objective biological and therefore organizational power, what matters to us is that hard sciences (Neurosciences) applied to human sciences (Aesthetics) have eventually met through a proper transdisciplinary type of investigation succeeding to finally break the obsolete Cartesian dictate based on the dichotomy between *sóma* (*σῶμα*), body and *psyché* (*ψυχή*), soul, which unfortunately still constitutes a strong mental structure in the western culture.

[44]Di Dio C. and others, *The golden beauty. Brain responses to classical and renaissance sculptures*', in PLoS ONE, 2, 2007
[45]Mallgrave H. F., *Op. Cit.*

‘

1.3 The origins of COMPLEXITY THEORIES in Urban Planning and Urban Design

“Cities [are] living organisms; [they] are born and … develop, disintegrate and die … In its academic and traditional sense, city planning has become obsolete. In its place must be substituted urban biology”
(Jose Luis Sert, Congrés Internationaux d’Architecture Moderne. (CIAM), 1942, quoted in Time Magazine, November 30, 1942).

“ … there is a fundamental law about the creation of complexity …(which) states simply this: all the well-ordered systems that we know in the world, all those anyway that we view as highly successful, are generated structures, not fabricated structures.”
(Christopher Alexander (2002) The Nature of Order, Book 2: The Process of Creating Life, Center for Environmental Structure, Berkeley, CA)

1.3.1. Obsolete academics: Typologies and typological thinking

The traditional TOP DOWN planning, on which still very much of our contemporary urban interventions are based upon, is a very founded, deterministic and organized discipline, whose models and tools have become somehow outdated and superseded.
Already back in 1967 the architects Cedric Price, Paul Baker and the town planner Peter Hall in an article called ‘*Non-Plan, a Radical Rethinking of Planning Orthodoxy*’[1] were fiercely criticizing the urban design promoted by CIAM and highlighted a serious crisis of confidence towards the output of the ‘technicians’ in architecture and town and regional planning. This crisis is still going on: “the barriers between the different disciplines, the all-too obvious distance between designers and users and the lack of both scientific and economic means, only serve to further discredit projects.[2]”
Urban planning today seems to be in its darkest period: ‘it has lost ‘epistemologically’ the sense of reality […], perched behind a short-sighted technicality, it was never able to become a ‘human science’. […] Cities, in their living complexity, seem to interest very little to urban planners, used to chase more or less drastic solutions related to equipment that has been very little updated in the last 50 years. […] The representation of the complexity is still an ‘atlas’ made of screens, flows, zoning areas, in which it is extremely difficult to recognize not

[1]Price C., Baker P. And Hall P., *Non-Plan, a Radical Rethinking of Planning Orthodoxy*’, New Society magazine,1969
[2]Châtelet V., *Moving towards Control Tensegrity*, available on line @ http://www.editions-hyx.com/sites/default/files/anomalie6_chatelet.pdf

only a '*genius loci*', but , most of all, a relationship of belonging and mutual influence between the city and its citizens.[3]'
Traditional urban design tools like typologies and land use have turned out to be too rigid and prone to oversimplify a reality which is far more complex and unstable.
Let's try for a moment to analyze for instance the notion of typology and typological thinking which are so much enshrined in the academics of traditional urban planning and seem to be living a sort of contemporary revival in the last years.

The notion of Typology in architecture implies indeed a desire for order, control, reason and syntax. It refers to what Caroline Bos and Ben van Berkel have named as 'a legacy of rationality'[4].
In times where, on opposite ends, both the economic recession in the West and the large scale opportunities in Asia and the Middle East are defining the conditions of city and territory, the aspiration for an ordering device as a sort of polar star to direct people seems to be tempting.

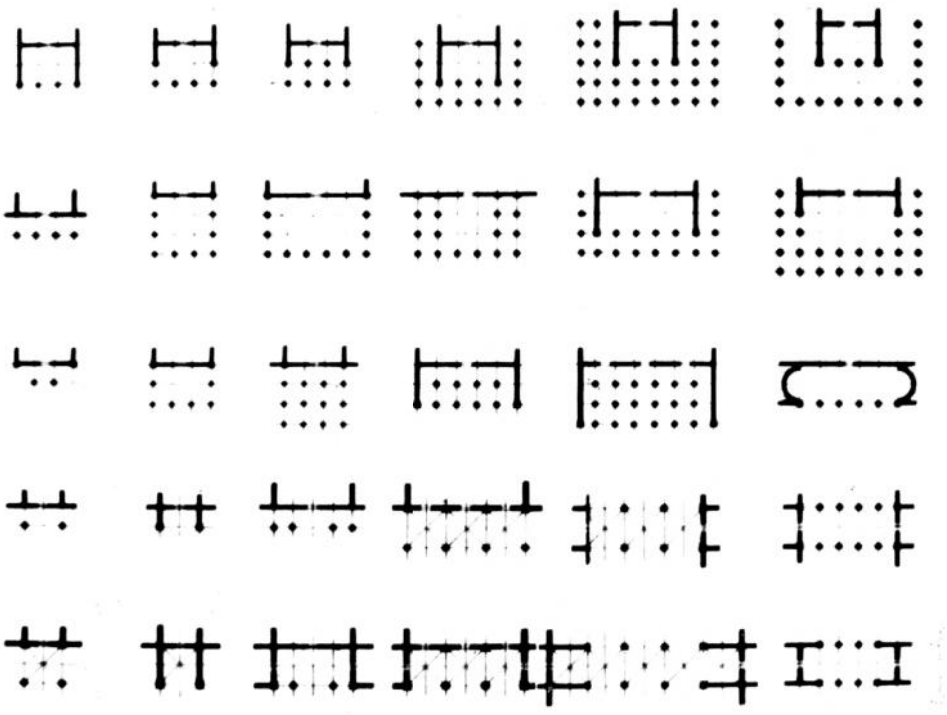

Fig. 1.11: JNL Durand, Portico Typology

[3] La Cecla F., *Contro l'Urbanistica*, Giulio Einaudi editore, Torino, 2015
[4] Bos, C. & van Berkel B., *Typological Instruments. Connecting architecture and urbanism*, in Typological Urbanism, AD n°209, January/February 2011, Wiley & sons, London, 2011

Typological design offers the advantage of a quick and standardized product with precedents, a clear taxonomy, strictly logic, extremely communicable, reassuringly predictable and the power of being both an instrument of analysis as well as an element of design.
Broadly speaking typological reasoning is a great model or principle for the legibility of socio-cultural and material products and its strength lies within its capacity to establish relationships: *relationships between entities supposedly different*, creating chains and resonances among objects of different species, revealing the stratifications subjected to many experiences[5];

Fig. 1.12: R*elationships between entities supposedly different* : Circus Maximus, Rome, Italy. VI-IV cent BC

Fig. 1.13: R*elationships between entities supposedly different* : Panathenaion, Athens, Greece, VI-IV cent BC

[5] Semerani L, a cura di, *Dizionario critico illustrato delle voci più utili all'architetto moderno*, Edizioni C.E.L.I., Faenza 1993. The entry «tipo» curated by Carlos Martì Arìs, pp. 183-194.

Fig. 1.14: R*elationships between entities supposedly different* : Piazza Navona, Rome, Italy, I cent BC – XVII cent AC

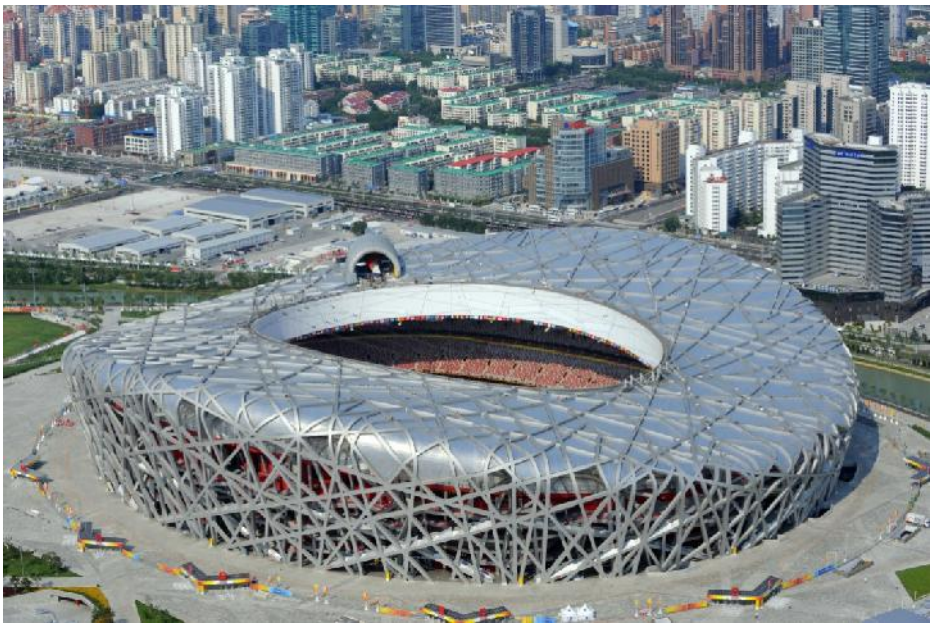

Fig. 1.15: R*elationships between entities supposedly different* : Olympic Stadium, Beijing, China, 2008

relationships between the collective memory and the city, informing the image of a city, what Aldo Rossi called the 'apparatus' for mediation between the individual object and the collective subject[6]; *relationships between a design method, forms of knowledge and production processes,* and, above all, between the architectural work and the broader set of 'conditions', the inherent forces and mechanisms of each production: *"[…] a notion in common to designers, clients, contractors, users which allows the understanding and agreement of*

[6] Rossi A., *L'architettura della città*, Città studi Edizioni, Milano, 1995

the social body in the setting-up of its built environment. It is the selective result of many further elaborations which enables capacity's collaboration in space and time and the improvement of the product, unattainable by a single talent.[7] *"*

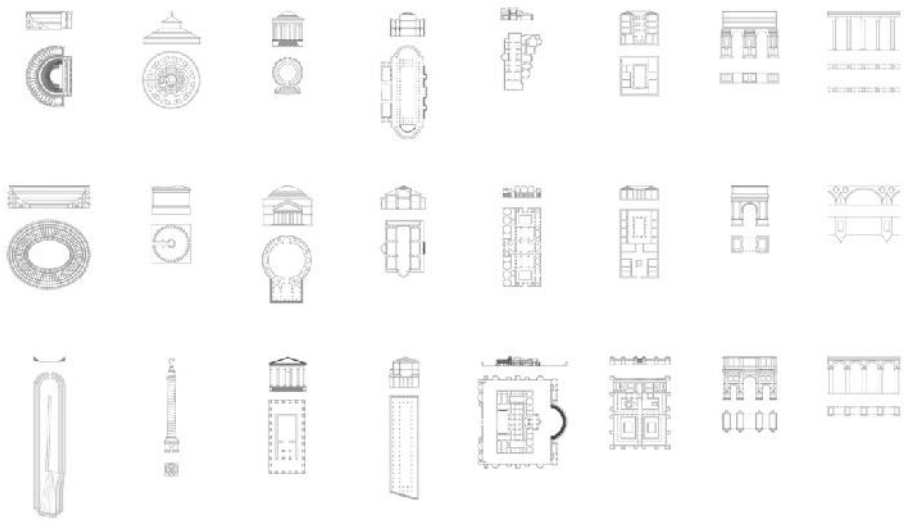

Fig. 1.16: *Relationships between the collective memory and the city: The Roman classical System, typologies as unifying symbols in the Roman Empire*

Fig. 1.17: *Relationships between a design method, forms of knowledge and production processes: American Baloon Frame Typology*

[7] Benevolo L., *Le origini dell'urbanistica moderna*, Laterza, Bari, 2005

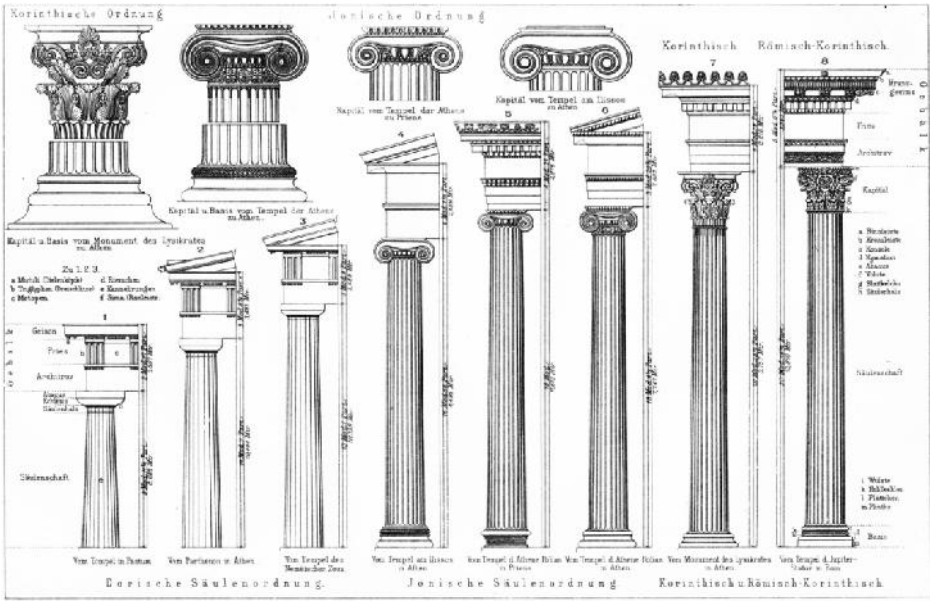

Fig. 1.18: *The power to name, organize and speculate a particular knowledge: Vitruvius Canon on columns*

Another important aspect of types and typology has been and still is *the power to name, organize and speculate a particular knowledge,* in the more specific sense of the disciplinary knowledge[8].

Types are meanings or *schema*, as Argan[9] would say, and they follow logics of significations, they have an incredible semantic and semiotic authority because they enable dialogue and discourses not only between the actors of the discipline but also and most importantly between architecture and the city. However, in order to do that, they need to synthesize and simplify the complexity of the urban in order to permit operability, both cognitive and productive, to reduce to a finite number of cases the possible infinite ones.

This simplification of the complexity of the urban apparatus could be seen as well as an *over-simplification* and, in this perspective, as one of the disadvantages of Typological thinking.

In addition to the above, typologies suffer from another major weakness: quite inflexible and embedded with a structural and ontological need for control and repetition are *unprepared and, paradoxically, disorganized to deal with self-organization,* in specific with the so called 'informal' settlements which constitute the majority of urbanization processes (the so called *favela urbanism*), and with *the relentless design output of large numbers.*[10] Their inadequacy to respond to such topics belongs in part also to their intrinsic condition of

[8] Gregotti V., *Idea di tipo,* Casabella 509-5010, 1985

[9] Argan G.C., *Progetto e destino,* Il saggiatore, Milano 1965, pp.75-81

[10] For more details on self-organizing, emergent models applied on favela urbanism see: Salingaros N. and others, *Favelas and social Housing: the urbanization of Self-Organization,* , paper presented at the Brazilian and Ibero-American Congress on Social Housing, 2006

Fig. 1.19: *Typological weaknesses: oversimplification of the urban apparatus: Peter Cooper Village, Manhattan, NY, USA*

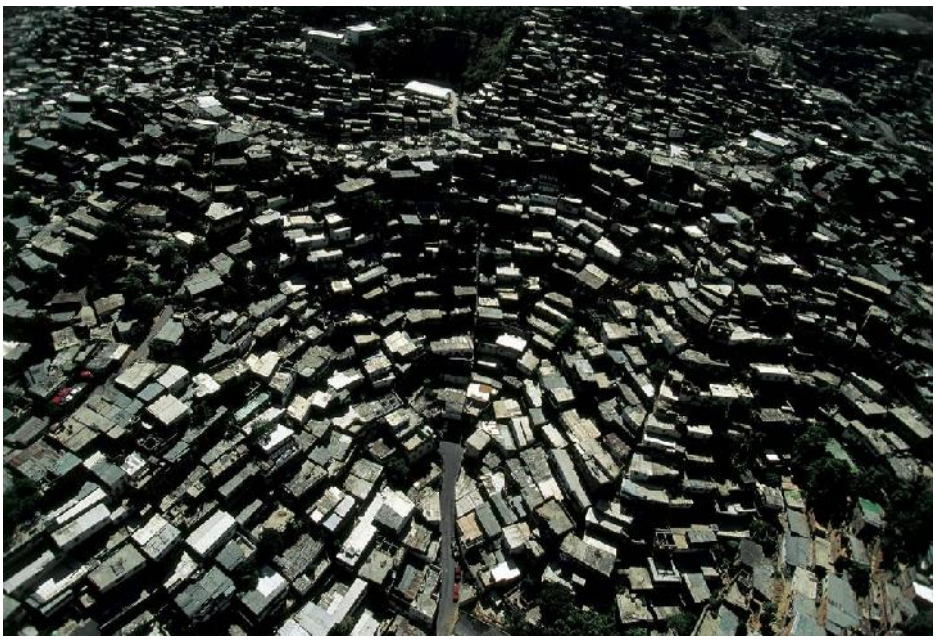

Fig. 1.20: *Typological weaknesses: unprepared to deal with informal settlements: Barrios, Caracas, Venezuela*

being a sort of syntax of the Top-Down approach to urban planning. They belong to what is also called the 'geometry of control' where control is exercised by not allowing individual variations, since '*complexity and variation are perceived as losing overall control – not only of building typology, but also of the way decisions are made – and thus are avoided.*[11]'

[11] Salingaros N. and others, *Favelas and social Housing: the urbanisation of Self-Organization*, Salingaros N. and others, paper presented at the Brazilian and Ibero-American Congress on Social Housing, 2006

Fig. 1.21: *Typological weaknesses: unprepared to deal with relentless design outputs of large numbers: Housing towers, Shenzen, China*

Fig. 1.22: *Typological weaknesses: The TOP DOWN geometry of control: Haussmanian boulevards, Paris XIX cent*

It was precisely this tie together with their ordering agencythat has contributed to place them at the base of the birth of the sustainable agenda in city planning at the beginning of the XX century.

I believe however that this very birth was the beginning of their death.

1.3.2. The beginning of the fall: from the death of typologies to the rise of cellular automata

The *complexity* described by La Cecla is instead at the core of the scientific-philosophical framework which all current researches and debates are thriving from: a set of different spin off, known as Complexity Sciences, of a more general thesis called Complexity Theory based on stochastic, self-organized and emergent BOTTOM-UP models.

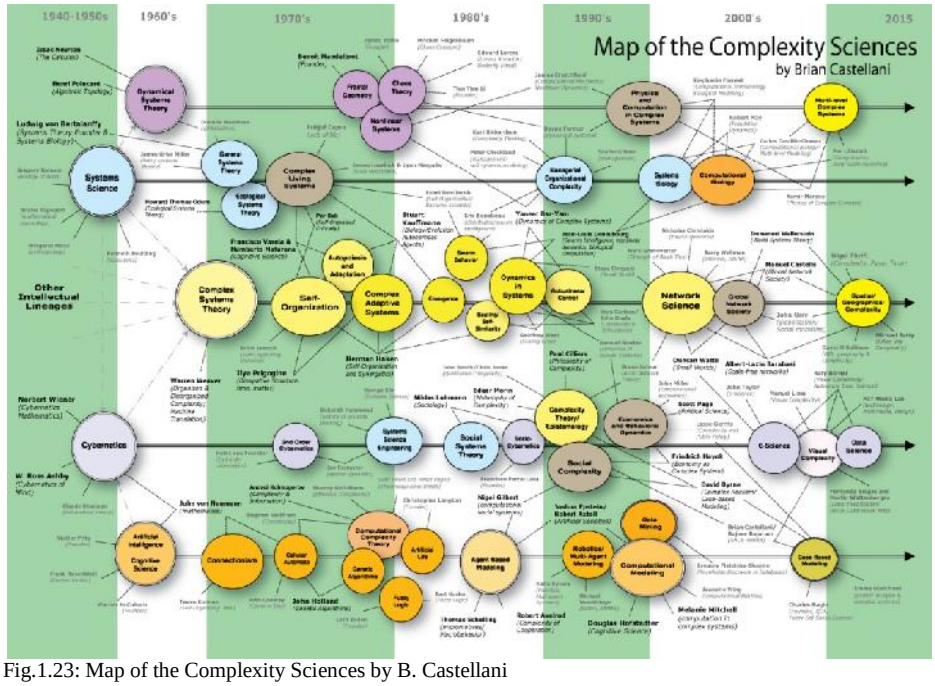

Fig.1.23: Map of the Complexity Sciences by B. Castellani

Complexity theory is deeply rooted in evolutionary thinking so that John Holland, one of the pioneers in the field of emergent software programs, wanting to explore the way simple rules could lead to complex behaviours, introduced in the 60's the logic of Darwinian evolution in computer programming. He created a breakthrough code which he later named *genetic algorithm* because it was capable of open-ended learning as in natural selection processes.

Genetic algorithms are just one of the many forms of representation and study of *emergence intelligence*, an ability to store and retrieve information, to recognize and respond to patterns in human behaviour and the main factor to have determined the city super-organism to triumph over other social orders[12].

Interestingly enough this same approach is at the base of the birth of the sustainable agenda in city planning, when Patrick Geddes set the stage

[12] Johnson S., *Emergence*, Penguin Books, London, 2001

for a humanistic matrix to urban planning and urban design. (See also Chapter 1.1.)
With the Complexity Theory in the '60s and later on in the '80s with the Chaos theory the approach to science, including human sciences, has radically changed the way we approach reality and in doing so they have also reframed the models and tools to look at our environments.

When in 1915 Patrick Geddes published '*Cities in Evolution'*, where he first introduced the concept of Ecology and Sustainability within city design and planning, he was trying to fight against the social and environmental chaos and evil of the spontaneous (read: Bottom–UP) sprawl of the city after the industrial revolution.
He was the first one to consider the city as an environment which could influence, positively or negatively the organism it contained and in doing so, he was promoting a certain aesthetic quality of the city space and at the same time he was linking social progress to spatial design and quality of the environment through the use of different tools or devices, among which stood typologies.
However, and here we tie back to the notion of *order vs chaos*, although his method can be clearly described as a TOP DOWN approach to planning in a very deterministic, organized and predictable way, his book was also the first publication to shift the accent from a developmental paradigm to an evolutionary one, following the neo-Darwinian framework where small changes can lead to big effects: from predictable to unpredictable, from form to function, from structure to process[13].

The Top Down approach promoted by Geddes, even though not initiated by him, was challenged for the first time few years after in 1938 by Lewis Mumford and his definition of '*The Culture of cities'*[14]*:* an anthropologic approach which would set the city as a product of a specific intention, that 'making of the city' which escapes an idea of TOP DOWN planning and identifies that same 'making of the city' as one of the most ancient characteristic of human practice.
On the same line in the 60's people like Jane Jacobs and Christopher Alexander rediscovered the potential of small incremental and spontaneous changes on a vast scale as per the evolutionary paradigm.
Jacobs in her '*Death and Life of Great American Cities'* in 1961 declared that 'the diversity of cities that marked their quality is the

[13] *Batty M., Darwinism, Evolution and the Development of cities,* Talk to 2nd Year UG Bartlett Planning Students Thursday, 25 November 2010
[14] Mumford L., *The Culture of the cities*, Harvest Books, 1970

diversity that was formed from countless individual decisions, generated from the bottom up.'

The sentence is of particular relevance if we consider proper the definition according to which there is Aesthetics 'anywhere the qualitative processes of reception and production, of pleasure and making are examined[15]' because it contains a logic association between quality, hence Aesthetics and the evolutionary bottom up model.

A similar position was taken in 1964 by Alexander who in '*Notes on the synthesis of form'* argued pretty much the same: good architecture, he said, was well adapted to context, the product of many decisions about form which were tried and tested as those who lived and used buildings sought to adapt them to their purpose[16].

Finally in 1968 Henri Lefebvre in his '*Le Droite a la ville*[17]' denounced that the main problem of urban planning was to have killed urbanity, where *urbanity* was that BOTTOM UP activity of production of the city that people normally do in living it.

The trend towards the re-appropriation of the Bottom Up model had a final push in the '80s with the formulation of the before mentioned Complexity Theory and the need to incorporate the 'uncertainty factor' about the result of the process of change: the essential principle for a complex system is a group of elements that perform independently of one another but nonetheless manage to act altogether, through constraints and limits to their actions and through competition and co-evolution. The physical map of complexity is the feature of *self-organization*.

Such a passage becomes even more remarkable if seen in concomitance with the interest for clean and renewable energies which seems to flourish in about the same years.

If we look at history as a sequence of different human metabolic systems we see that the type of energy resource men used to draw on in the first two metabolic systems (hunter-gathers societies and agricultural societies) by acting on the biophysical matrix processes in their territory was always a cycle of production and consumption limited to the biosphere. With the access to mineral resources and therefore to the lithosphere, the sustainable cycle of production and consumption got broken because the biosphere was not able to metabolize the unwanted waste coming from consumption of the

[15] Franzini E. e Mazzocut-Mis M., *Estetica,* Mondadori, Milano, pp. 1-12, 1996

[16] Alexander C., *Notes on the synthesis of Form*, Harvard University Press, 1964

[17] Lefebvre H., *Le Droit à la ville*, Paris: Anthropos (2nd ed.), Ed. du Seuil, Collection "Points", Paris, 1968.

lithosphere materials[18]. Curiously enough the type of prevailing city models in the first two cases was a Bottom Up one, which was substituted by a Top Down one after the Industrial revolution.
The research towards new types of energies, shifted again in the biosphere realm, seems to have been accompanied by a renewed awareness of the potential of the Bottom up model of city planning, a more complex and emerging mode of action where **the Bottom Up/Self Organized approach could be seen as a possible morphogenetic process for sustainable city design.**

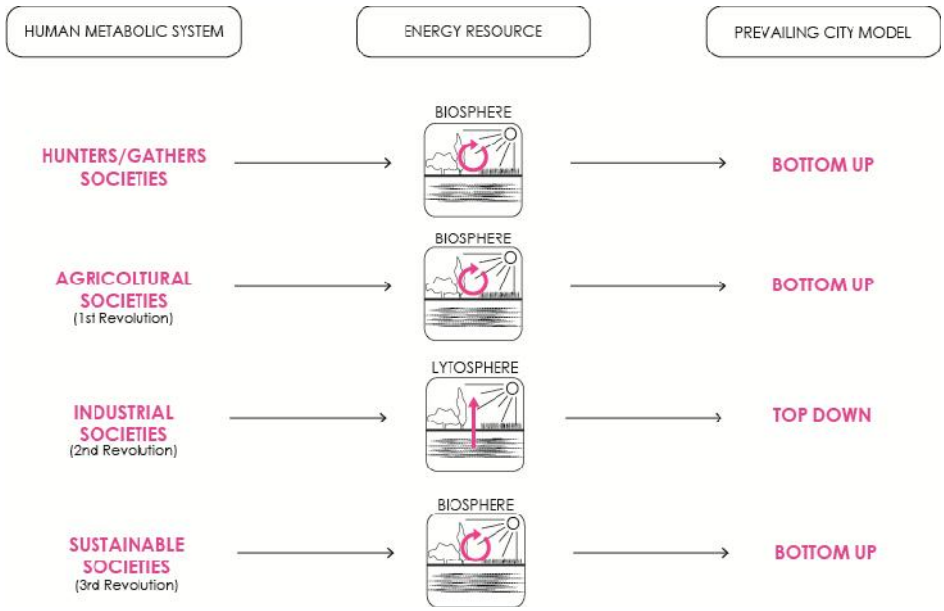

Fig. 1.24: Human metabolic systems and prevailing city models

What is exactly the self-organized city and how is this model suitable with the sustainable agenda and most of all with the Aesthetics of the sustainable agenda?
According to Peter Langley, Professor of Geographic Information Science at the Bartlett, University College London, 'self-organized cities are cities that seek to fill their space in the most efficient manner following rules of self-similarity that show how they arrange their parts to conserve and utilize the transport of their energy in the most efficient way'. On the same line Michael Batty, Professor of Planning at the Bartlett, University College London and Director of the Centre for Advanced Spatial Analysis, argues: '[The self–organized cities are] models of cities simulating morphologies that are surprising in that their form cannot be anticipated from the assumptions and processes adopted in their representation. […] It is a consequence of the complexity

[18] Rueda S., *Climate Change: urban projects to mitigate greenhouses gases*, paper from web, 2008

approach that appropriate models should provide ‘information’ rather than ‘solutions’, should ‘inform’ rather than ‘solve’.’
The main differences between a ‘Self Organized-Bottom Up’ model and an ‘Organized-Top Down’ one could be summarized in eight couples of opposite modes: apart from the tautological Self-organized Vs Organized, we could add Stochastic Vs Deterministic, Far from Equilibrium Vs In Equilibrium, Characterized by a Decentralized decision making Vs Characterized by a Centralized Decision making, Surprise and Novelty expressed in the language of transition Vs Predictability, Emergent Vs Founded, Topologic Vs Discreet, Heterogeneous Vs Homogeneous.

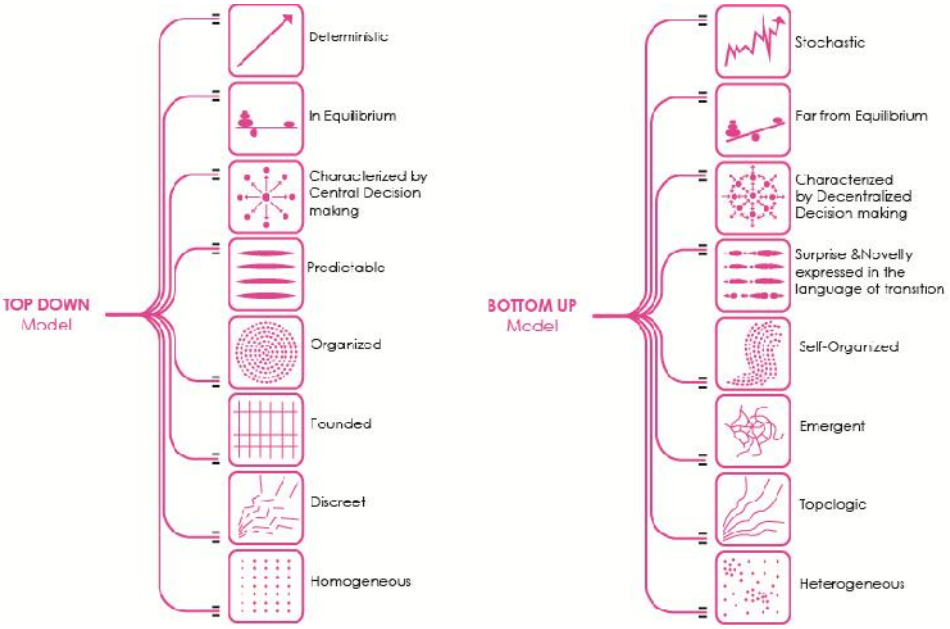

Fig. 1.25: Top Down vs Bottom Up models

The notion that cities are always ‘out of equilibrium’ and are constituted by a multitude of bottom up decisions which, though producing coordinated and ordered patterns, can behave in the most unpredictable ways, force us to take on board the neo-Darwinian framework also when thinking about the effects of climate change, per se barely predictable.
Such point leads to the recognition of the need to offer solutions which would allow various elements of design to self-organize, guaranteeing a margin of improvisation, so that architecture, city and the anthropic landscape could be understood and designed as ‘amalgams of processes’, spaces of vectorial flows which modify and adjust themselves according to some inputs: open languages of fluid and dynamic Aesthetics based on the logic of biotopes, ecosystems and ‘loop structures’, typical of Sustainability.

1.3.3. Order versus Chaos

Within this scientific framework of complex, emergent, bottom up logics a very confined and terminal place was left for typological thinking: as Deleuze reminds us, '*Darwinism's two fundamental contributions moved in the direction of a science of multiplicities: the substitution of population for types and the substitution of rates or differential relations for degrees*.[19]'

It is this new ontological structure that seems to have decreed in different disciplines the death of typologies and the rise of self-organizing/generating models such as the ones of multi-agents systems and cellular automata: algorithmic codes are being organized to digitally breed cities, dealing with the 'organization, quantification and systematization of quanta of data[20]'.

The use of Typological thinking and its related use of typologies as categories of thought is based indeed on a deterministic, heuristic process, while cognitive processes are stochastic by nature since they combine choice and chance in the development of knowledge.

Such position has strong links to the origins of dynamical system thinking and in particular to the work of Joahn von Goethe, author of the 'Metamorphosis of plants'. Quoting Ernst Cassirer, 'Goethe effectuated the transition from generic thinking, from the habit of thinking about form within the fixed and decidedly typological lineal tables of genera and species, to the genetic habit of mind which sees form as an active process of generation, improvisation and expression[21]'.

It is what Ernst Mayr, one of the fathers of evolutionary thinking, would later describe as 'Population thinking versus Typological thinking': '*For the Typologist, the type (eidos) is real and the variation an illusion, while for the Populationist the type (average) is an abstraction and only the variation is real*.[22]'

Variations, differentiations, and *multiplicities* are categories of paramount importance within the evolutionary paradigm. They differ from the term *variants*, acceptation more proper to typological thinking, as they imply the replacement of visual sameness with similarity, in fact

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[19] Deleuze G. & Guattari F., *A thousand plateaus: Capitalism & Schizophrenia*, The Athlone Press, London, 1999

[20] Parisi, L., *Contagious Architecture: Computation, Aesthetics, and Space* , The MIT Press, Boston, 2013

[21] Kwinter S., http://vimeo.com/28810672 , Proto_E_cologics Symposium, 2011
Sanford Kwinter perfectly summarized this process when, in his lecture at the *Proto_E_cologics Symposium* in 2011, stated that 'The relation of matter and forms are temporal and it is related to the path they have done to get there. [21]' (In computational terms that path is an algorithm.)

[22] Mayr S. E., *Evolution and the diversity of life: Selected essays*, The Belknap Press of Harvard University Press, Cambridge, Massachusetts, Usa 1976

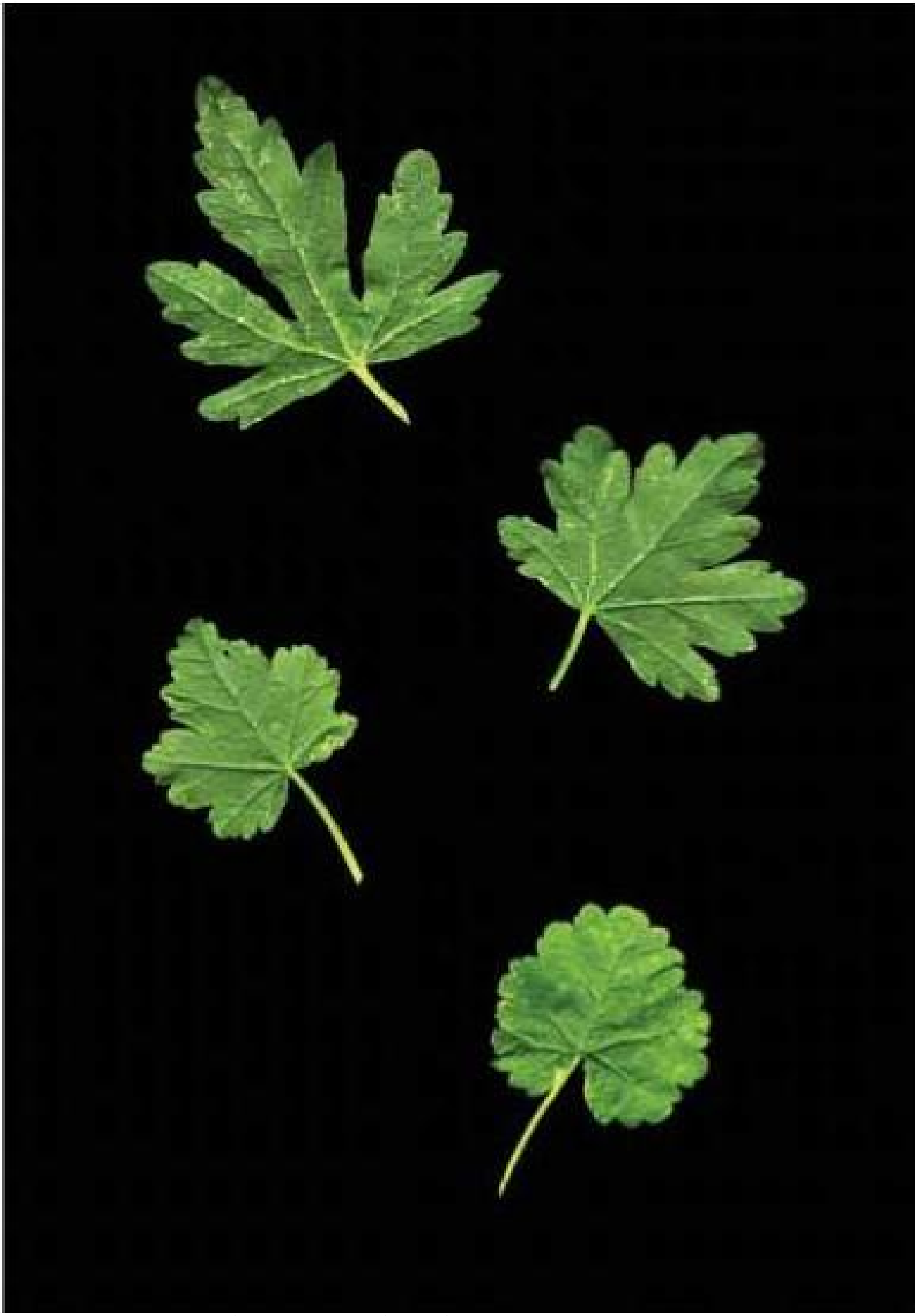

Fig. 1.26: From *The Metamorphosis of Plants: Sidalcea malviflora*, ***Leaf sequence/variation,***

Fig. 1.27: From *The Metamorphosis of Plants: Chrysanthemum morifolium,* ***Regular metamorphosis*** (Left) *Chrysanthemum grandiflorum,* ***Irregular metamorphosis*** (Right)

while variants represent modifications to an original artefact/project/model, variations do not imply the existence of a primitive, a matrix or an archetype, they rather indicate marking differences of one individual from another of the same species. Most importantly, shifting from biology back to architecture, they embody the passage from typicality to non standard seriality[23].

It is the passage from the science of models characteristic of a series, where, by models, we mean rules, to the science of codes, where by codes, we mean rules; in other words, from types to variables.

Variables and multiplicities, interpreted through the Deleuzian lens, are yet again semantic entities of a rhizomatic way of thinking capable of self-organizing without internal hierarchies with neither entry nor exit points.

This type of knowledge stands opposite the arborescent conception of knowledge - to which the concept of types and its 'relatives in law' such as archetypes, prototypes, etc… belongs - which is instead a type of research that proceeds with deterministic categories and binary choices.

Following the deleuzian form of thought once again, Manuel De Landa, examining evolutionary simulations as breeders of new forms replacing normative design methods, suggests that there are another couple of elements distinguishing standard from non standard approaches to

[23] Carpo M., *The Alphabet and the algorithm*, Writing architecture series, The MIT press, Cambridge, Massachusetts, USA, 2011

design: Extensive vs Intensive properties and Euclidian geometry vs Topological geometry[24].

The first couple of antagonists bring us straight back to the very beginning of the complexity theory as proposed by Ilya Prigogine through his study of thermodynamics and out of equilibrium systems. Intensive properties refer to quantities that cannot be subdivided as such like temperature, pressure, speed, conductivity, resistance, etc.. in opposition to extensive properties which instead refer to magnitudes such as length, area, volume etc…. Beyond the obvious lack of divisibility what really interested Deleuze about intensive quantities were those *degrees of intensity* which are productive since they 'drive processes in which the diversity of actual forms is produced'[25] and in this matter he is still dealing with differentiations and variations.

Differential, variable, multiple and semiotic are also the features of the 'abstract diagram' or 'abstract machine' which develops out of Topological geometry in opposition to Euclidian geometry. The 'abstract machine' of Deleuze and Guattari consists of '*uninformed matters and nonformal functions.[…]it is not made up simply of formed substances (aluminium, plastic, electric wires, etc.) or organizing forms (programs , prototypes, etc.) but of a composite of unformed matters exhibiting only degrees of intensity…*[26]'.

In a very interesting book, 'Cities out of Chaos', Pulselli and Tiezzi brilliantly summarized the call to follow Evolutionary Sciences in the study of our environments with the following: 'Today, "dwelling the space" imposes the choice of Complexity, not only as object of investigation, but as a method of investigation to understand the multi-dimensionality and the integral totality of the world and to get to know its evolutionary nature[27].'

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[24] De Landa M. , *Deleuze and the use of genetic algorithm in architecture*, available on http://www.egs.edu/faculty/manuel-de-landa/articles/deleuze-genetic-algorithm-in-architecture/

[25] De Landa. M. , *Op.cit.*

[26] Deleuze G. and Guattari F., *A thousand plateaus. Capitalism and Schizophrenia.* Athlone Press, London, 1999

[27] Pulselli M. and Tiezzi E. , *Cities out of Chaos. Urban self-organization and Sustainability*. WIT Press, Southampton, UK, 2009


Fig. 1.28: Order Vs Chaos, Navajo reservation as suburb of Phoenix, Arizona, © Edward Burtynsky

1.3.4. Emergence and the Temporal Dimension. The Past: Self-Organization in history

Dealing with Sustainability within the framework of the Complexity theory and Emergence demands necessarily to be scrutinized also through another category of thought: Time.
Emergent and Self-Organized systems are not new in the history of city and humankind. As a matter of fact according to Bruno Zevi a history of human artefacts, 'organic, alive, modulated by the needs of users, capable to expand; free from any formalistic taboo as well as symmetry, alignment and perspective's rule[28]' could be determined. It would be the history of 'temporalized architecture' (*architettura temporizzata*), embracing only the law of mutation, as opposed to 'academic architecture' which relies on codified compositional rules.
It is the mode of medieval towns, Christian monasteries, gothic churches and African villages; it is the mode of a collective action which, although organised by strict rules, it self-organises with vivacity so that 'order and oddness, eurhythmy and variety must be installed together[29]'.

[28] Zevi B., *Ebraismo e Architettura*, La Giuntina, Firenze, 1993
[29] Milizia F., as quoted by Paolo Portoghesi in *Natura e Architettura*, Skira, Milano, 1999

By closely observing past examples of self-organization and how they actualized in different locations and time periods, we can actually withdraw an important legacy.
It involves the concept of *quality* (aesthetic as much as processual) in terms of Emergence.
No matter the locations or the historic period to which they belonged, all self-organised urban assemblages (from the single unit of monasteries and cathedrals to the multiple units of villages and towns) have in common the quintessential value of complexity: a strong underling organizational structure which incorporates harmoniously within a superimposed liquid meta-structure of vivacity and contrasts.
Nobody would deny the rigor of certain emerging structures even the more spontaneous ones (just think at the impeccable mathematical fractals of many African villages[30]) and yet no one could ever forget about their improvisational power and its extreme seductive results.
It is possibly the towering potential of the *field* over the one of the *object*, referring to the well known terminology by Stan Allen: 'bottom up phenomena defined not by overarching geometrical schemas but by intricate local connections[31].'
Eventually it seems that the self organizational quality could be assimilated to the capability of envisioning an idea orchestrating a certain *degree of disorder* (Prigogine's *'order through fluctuations'*?) and *mutation through time.*
We could ultimately argue that it is that capacity of material organizations to develop and evolve through time following a *concept* rather than a design: the more articulated, refined and meaningful is the concept, the more sophisticated is its temporal organization.
In fact, while, in the attempt of define emerging, self-organised artefacts, it is not possible to talk about a specific authorship owning an idea or a concept, it is possible to illustrate them including Adorno's *'[die] Arbeit des Begriffs*', 'the labor of conceptualization' (as per John Cumming's 1972 translation) or '*the labor of the concept'* (Steven Helmling). The *labor of concept* is the work involved towards the union of two domains of experience that, in Adorno's critical view, Western culture tends to separate through a process of anaesthesis or '*ataraxia*': feeling and thinking.[32]

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[30] For more on this issue, please see the studies and writings of the ethno-mathematician Ron Eglash
[31]Allen S., *Field Conditions*, in Points + Lines, New York: Princeton Architectural Press, 1999
[32]Helmling S., *During Auschwitz: Adorno, Hegel, and the 'unhappy consciousness' of critique*, available on line @ http://pmc.iath.virginia.edu/text-only/issue.105/15.2helmling.txt

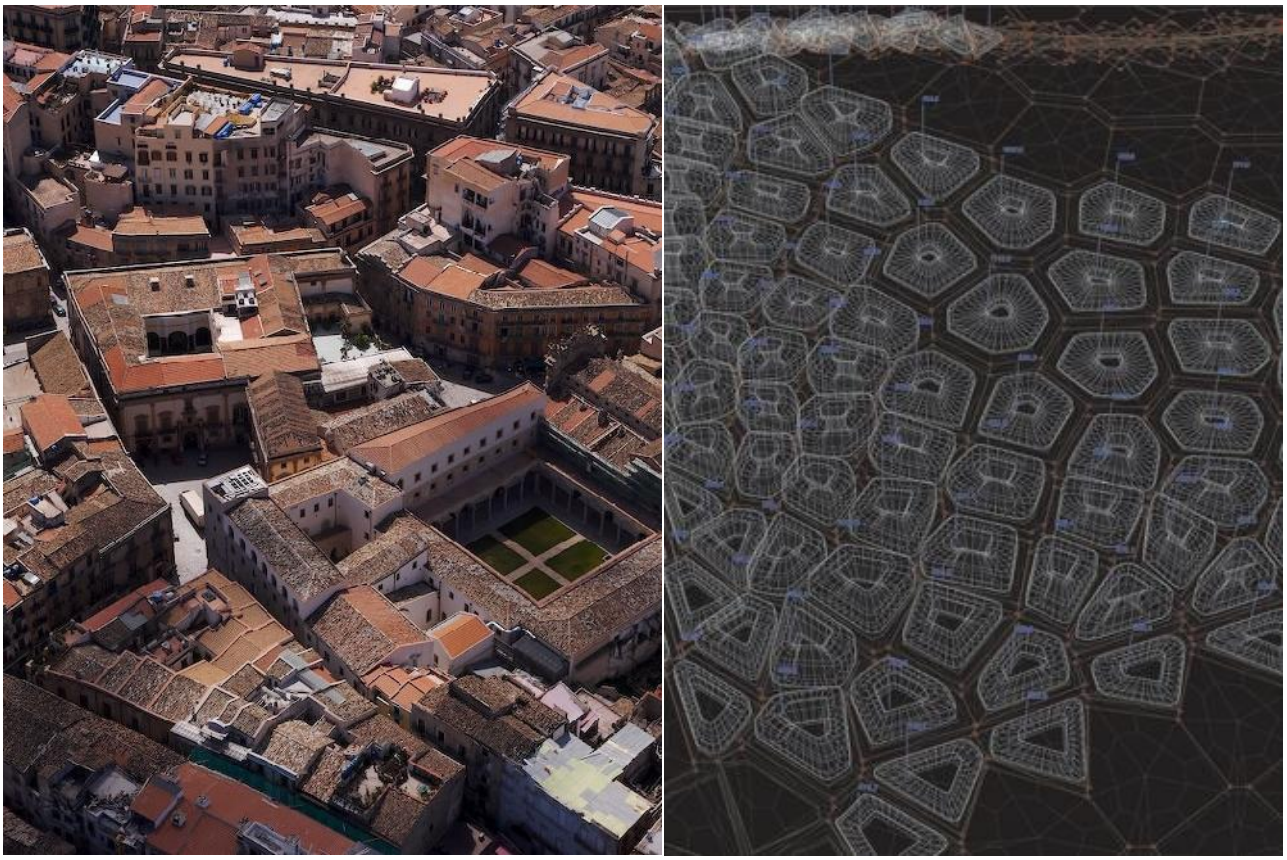

Fig. 1.29: Self-Organizing models: Actual & Virtual. Palermo & Ka Care City (Ecologicstudio & Carlo Ratti)

Fig. 1.30: Self-Organizing models: Actual & Virtual. Kenya villages & Water Slope city (D. Dobrev)

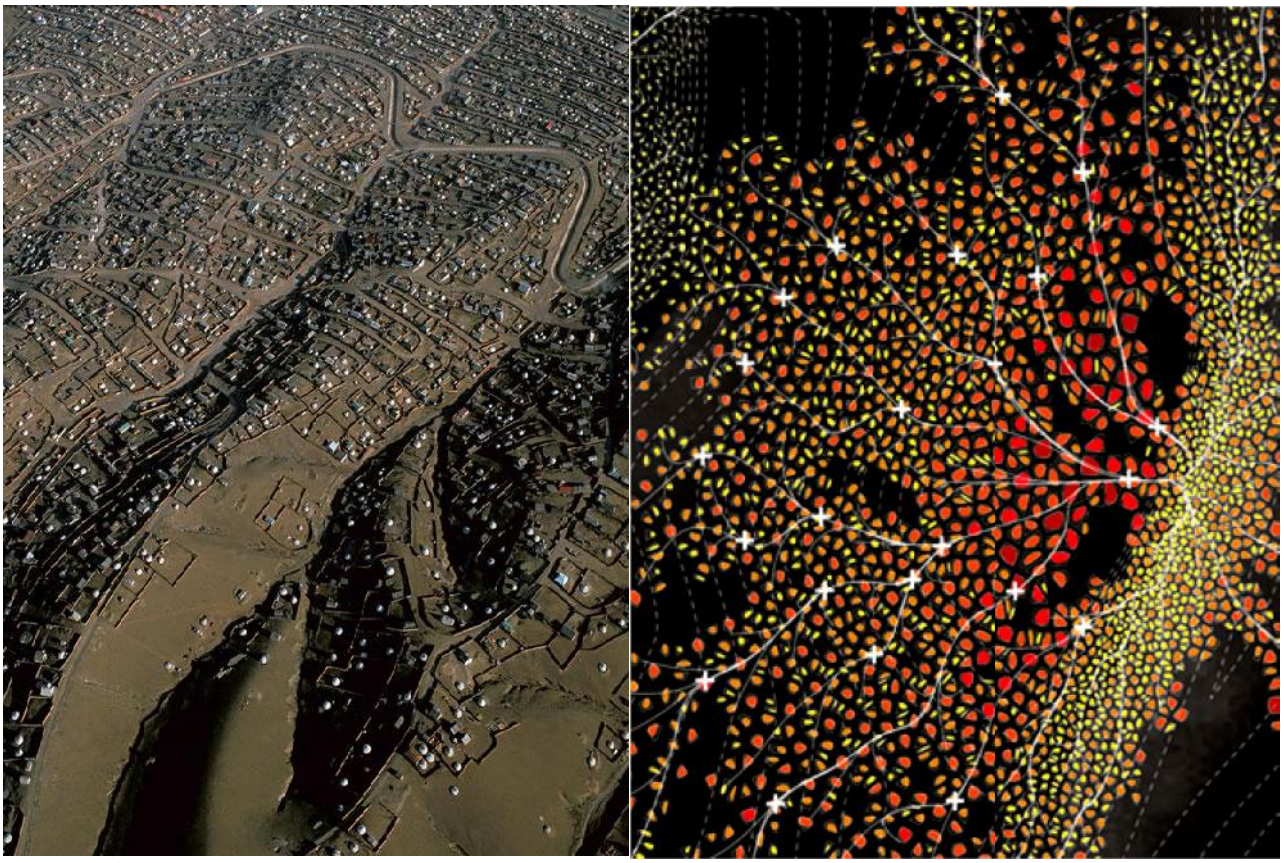

Fig. 1.31: Self-Organizing models: Actual & Virtual. Ulan Bator, Mongolia & Islamic Garden City (Shi Oi Ng)

Fig. 1.32: Self-Organizing models: Actual & Virtual. Joal Fadiouth, Senegal & Mist City (T. Tetarintze)

Fig. 1.33: Self-Organizing models: Actual & Virtual. Barrios of Caracas, Venezuela & Digital Favelas (N. Leach)

Fig. 1.34: Self-Organizing models: Actual & Virtual. Angkor Watt, Cambodia & Recursive Formation (SPAN Architecture

'The *labor of the concept* involves laboring to uncover, focus, articulate, and express its properly affective elements [...] Affect must be completed, 'rescued', even redeemed, by being concretized in the labor of 'apprehending it as thought'; likewise, thought [...] must suffer the ordeal through which alone thinking maybe apprehended as feeling'[33].

This process of *affectualization (labor of affectualization)* which precedes the *labor of the concept* is both a personal and a social procedure. It can be initiated and accomplished by an individual as much as by a group, a collectivity and in that case it becomes a culture-wide affective discipline which travels through people and generations.

It is precisely that 'thinking apprehended as feeling', that labor of affectualization, which resonates through Time and arrives to us still charged with meaning and seduction, quality in other words.

Quality in emerging human artefacts could therefore be the labor of a *concept* enacted by a community/society.

This is the legacy we can withdraw from the 'temporalized architecture'.

1.3.5. Emergence and the Temporal Dimension. The Present: Emergence and Emergency

From Kant who considered the essential role of time as to coherently unite all the elements of knowledge by establishing a relation between thought and perception and therefore time as the necessary condition to any particular experience because makes perception possible and intelligible, to Virilio who assumed that the 'pursuit of form is only a technical pursuit of time[34]', Time has always been conceived as an Aesthetic category.

But if we examine Time through the lens of the present, the fourth human metabolic system, The Sustainable Society (see Fig. 1.24), Time has acquired a sense of urgency, or emergency, as never before.

Time has become an Emergency category.

We seem to live in fact in a constant state of vulnerability that needs to be addressed urgently in a permanent condition of emergency with a growing urge for immediate necessary action. It is a pressing call for speed, ubiquity, heterogeneity, certainties and calculable and pragmatic expectations. In this picture *Emergence* might look as if failing not so much for a time factor (as a matter of fact calculus can allow time

[33] Helmling S., *Op. Cit.*

[34] Virilio P., *The Aesthetics of Disappearance*, Semiotext(e), Los Angeles, 2009

warps relying on sped up evolutionary design methods[35]) but rather for a problem of predictability.
The result is a consistent request for solutions/technological apparata and 'technical prostheses of mediatisation[36]' capable to manage, design and organize not only the present but also the very 'immediate future' creating conversely and paradoxically a sort of paralysis of the 'future to come', *l'Avenir,* as Marc Augé calls it[37].
Augé in his book *The Future* seems to give us an interesting insight into this theme: we need to differentiate between the 'immediate future' (*le Future*) and the 'future to come' (*l'Avenir*). The two do not coincide. The first one is the 'time of a conjugation' where life is lived individually and deals with the evidence, the latter instead has always a social, collective dimension and deals with the symbolic. It is the field of hope and desires, of dreams and revolutions.
The tendency today when considering issues related to Sustainability, Emergence and Climate Change is to rely on skills, competences and good management. This is the reason why in the conceptual vocabulary the word *governance* has become a very powerful and worn political neologism[38]. However this same concept, precisely because it is linked to a mere question of control and government in the 'immediate future' fails in tapping into the 'future to come', as if society would not need anymore its imagination and its demand for seduction.

1.3.6. Emergence and the Temporal Dimension. The Future: Technology, Superfluous and Seduction

But why Emergency is so devoted to technological apparata in order to be addressed? Is it perhaps because apparata are 'a kind of a formation, so to speak, that at a given historical moment has as its major function the response to an urgency', to quote Foucault? Or maybe because 'a man without technique, that is without a reaction against the environment, is not a man'[39]? Possibly but not exclusively.
Originally, if we examine the root of the word 'technology', we will find it comes from the ancient Greek *τέχνη* (*téchne*), a concept that included both craftsmanship and art at once. It resembles the word *epistēmē* in the implication of knowledge of principles, although *téchne*

[35] Colletti M., extrapolated from an email conversation of the 16th of January 2016
[36] Virilio P., *Op. Cit.*
[37] Augé M., *Futuro*, Bollati Boringhieri, 2012
[38] Augé M., *Op.cit.*
[39] Ortega y Gasset J., *Meditazione sulla tecnica e altri saggi su scienza e filosofia,* Mimesis/Volti Ediz., Milano, 2011

differs in that its intent is making or doing as opposed to disinterested understanding: it is about the human activity to make and perform.
But while craftsmanship is related to a practical, skilful, effective, pragmatic, mental and explicit ability, art is rather affiliated to a conceptual, talent related, speculative, aesthetic, emotional and implicit act. Producing the *objectively necessary* the first one, and *the superfluous* the latter.
What originally was united today stands apart: it seems in fact that in general technology has been focusing, with some virtuous exceptions like the works showed in specially curated exhibitions such as the Frac centre in Orleans or the MOMA in New York, on a 'hyper performing craftsmanship' at the expenses of an 'emotionally charged art'.
However, as Ortega y Gasset reminds us, the concept of 'human need' comprehends from the beginning the objectively necessary and the superfluous: the efforts of humankind to live, to be alive, are inseparable from his efforts to stay well. 'Man has no desire to be alive. What instead he really strives for is to stay well. [...] Therefore only what is objectively superfluous is really necessary for man. [...] It shows that even what is objectively necessary for man is such only if it refers to the superfluous. There is no doubt that man is an animal for whom only the superfluous is necessary[40]. Ortega concludes: '(Therefore) *technique is the production of the superfluous*.'
This is what we should remind ourselves when dealing with the Emergency category typical of the Sustainable Society. Consequently we must use our technical apparata to achieve the superfluous, the excess and implicitly also our objects of seduction, our dreams and desires.
Our technical apparata have the potential to tap into that world of 'desires and revolutions' that is the 'future to come' (*l'Avenir*). (For more on this subject see also Chapter 3.1.3.)
What happens in this logic to the Emergence approach with its problems of predictability? We believe that the mental framework we have chosen to follow would suggest a radical shift through a new readjustment in our priority of needs: rather than fulfil/meet our expectations we should chase/pursue our desires.
This would imply a modification in the structure of the dilemma: from a *problem of predictability* we would drift to a *problem of projectability*, where for projectability we mean the empathic capacity to envision our most internal desires.

[40] Ortega y Gasset J., *Op. Cit.*

In other words the Emergence approach should aim to achieve the capacity to accompany society through the difficult task of managing its bulimic need for urgent actions in order to gain back again access to its seductive, dream driven, mysterious, and utopian dimension.

1.4 The key for change: TRANSDISCIPLINARITY

"More than ever today, nature has become inseparable from culture; and if we are to understand the interactions between ecosystems, the mechanosphere, and the social and individual universes of reference, we have to learn to think 'transversally'."
(Guattari F., The three Ecologies)

"The disciplinary structure of knowledge is a problem of fragmentation, a difficulty to be overcome rather than a criterion to be met. Real problems do not observe academic boundaries. We certainly believe that thinking should be 'disciplined' in the sense of observing logic and facts, but not 'disciplinary' in the sense of limiting itself to traditional methodologies and tools that have become enshrined in the academic departments of neoclassical economics."
(Daly H.E. & Farley J., Ecological Economics. Principles and Applications. Island Press: Washington, 2004)

1.4.1. Transdisciplinarity and new models

Framing our research within a systemic thinking where the notion of *Complexity and Evolutionary Sciences* implies an enormous paradigmatic shift in the perspective about the ontology of urban planning and urban design, should also make us consider revaluating the hermeneutics.
This is a necessary change every time the divergences between theories and reality become too big, as Thomas Khun used to say[1].
There is a need for a new hermeneutics which would bring along a new aesthetics according to the 'fundamental law about the creation of complexity: all the well-ordered systems that we know in the world, all those anyway that we view as highly successful, are generated structures, not fabricated structures. [2]'
New models are required in order to breed cities in 'digital laboratory', models that can be borrowed by other disciplines like biology, genetics, economy, cybernetics, botanic etc.., as Jose Louis Sert said 'cities [are] living organisms; [they] are born and … develop, disintegrate and die … In its academic and traditional sense, city planning has become obsolete. In its place must be substituted *urban biology*[3].'

The key to such a challenge resides within the concept of *Transdisciplinarity,* a synthesis between disciplines that destroys academic barriers and creates new disciplines in which everything is

[1] Khun T., *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago, 1962
[2] Alexander C., *The Nature of Order, Book 2: The Process of Creating Life, Center for Environmental Structure,* Berkeley, CA
[3] Sert J.L., Congrés Internationaux d'Architecture Moderne. (CIAM), 1942, quoted in Time Magazine, November 30, 1942

more than the sum of the parts and which has something to do with the complexity theory.
Transdisciplinarity responds to the need for a loss of a former unity of knowledge and satisfies the expectations of a contribution to problem solving which is more than juxtaposition.
It differs from *Interdisciplinarity* because, conversely to this one which is based on communicative logics among ancillary disciplines, *Transdisciplinarity* establishes relational logics among disciplines that initially would have very little in common.
Its essence lies in combining pre-existing elements to create something new, as the work done by the team of the University of Parma on the *embodied simulation* theory has demonstrated.
We could argue in a way that *Transdiciplinarity* is a form of infrastructure, ultimately, a *metaphysical* and *mental infrastructure* applied in the search of new praxis.
In fact as infrastructures are technical structures, physical components, of interrelated systems providing commodities and services essentials to enable, sustain and enhance societal living conditions, the Transdisciplinary thought is a theoretical structure, a metaphysical component, of interrelated systems providing advantages and benefits to enable, sustain and enhance the conditions for humankind's acquisition of knowledge.

These new borrowed models are at the end a 'much more comprehensive set of constructions that allow us to understand the many perspectives on the city that reflect its diversity and plurality.[4]'
The modality itself, intrinsic in the definition, of the complexity sciences is open to embrace many different approaches and models because one of its core aspects deals with the idea that no one approach is predominant.[5]
Such models, as originated in distant domains or regimes, once transferred into our own, are often accompanied by an unjustified scepticism about their appropriateness.
However, in order to contain and minimise similar concerns, it is worth to recall what Le Ricolais, the pioneering father of the space structures, used to say: "matter, material, construction systems, structural configurations, space, and place comprise a continuous spectrum rather than isolated domains. Such an understanding provides a model for

[4] Batty M., *Building a Science of Cities*, UCL Working Papers Series, paper 170, 2011
[5]Miller, J. H. and Page S.E., *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*, Princeton University Press, Princeton, NJ. S. E. (2007)

organizing forces and their effects that is communicative, reverberating across scales and regimes.[6]'

Considering reality as a *continuous spectrum* is pivotal to understand the potential of a transdisciplinary approach.

The discourse about the urban has already taken advantage of the migration of certain models from other disciplines: cybernetics, biology, geography, mathematics, statistics, computational sociology, etc... (See Chapter 2) but we are still just at the very beginning.

A much more radical and bolder attitude must be undertaken as it has been done in other disciplines.

We must embark on this by now overdue adventure not to run the risk to be left aside as an obsolete and useless discipline incapable to deal with the real challenges of contemporary reality, leaving the fear of mistaking or missing the target behind, since, as a matter of fact, 'if we are afraid to be wrong, we will never come out with something original[7]'.

It is important to keep in mind what Helga Nowotny reminds us about Transdisciplinarity: 'Knowledge, as well as expertise, is inherently transgressive. Nobody has anywhere succeeded for very long in containing knowledge. Knowledge seeps through institutions and structures like water through the pores of a membrane. [...]Transdisciplinarity is therefore about transgressing boundaries.[8]'

1.4.2. Transdisciplinarity and the passage from design to organization.

The discourse about transdisciplinarity exposes another interesting and crucial aspect in the definition of the discipline of architecture and urban design: the passage from the mechanical era of *design* to the digital era of *organization.*

During the mechanical era and up to now *organization* and its methodologies have been mainly the operational field of the urbanists, the architects whose major role was to develop strategic paradigms for the city and territory, as opposed to the architects who were instead involved in the production of single buildings, repertories of forms with their own peculiar *design*/style.

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[6] Reiser+Umemoto, Atlas of Novel tectonics, NY: Princeton Architectural Press, 2006

[7] As extrapolated from a lecture given by Sir Ken Robinson on TED, 'Do schools kill creativity?', available on line @ https://www.ted.com/talks/ken_robinson_says_schools_kill_creativity

[8] Nowotny H., The potential of Transdisciplinarity, available on line @ http://www.helga-nowotny.eu/downloads/helga_nowotny_b59.pdf

The research of new models to study and describe the complexity of cities exploiting a transdisciplinary approach implied a sort of 'decontextualization' of the praxis in search of a *meta-language* which would allow addressing properly, critically and fruitfully models and techniques migrating from other disciplines and codes.

During a very stimulating debate hold at Harvard GSD in October 2015 entitled 'Organization or design?', Ciro Najle brilliantly pointed out that 'the notion of *design* involves the understanding of architecture (and urban design) as an act of embellishment of the environment to make it agreeable, pleasant, visually amicable and domesticating what we see for the purpose of softening out its sharp edges and therefore making itself liveable. [...] such good intentions are usually perverse and the notion of *organization*, as harsh as it sounds, confronts the wrongness of the conditions of our practice much more directly and takes a vehement distance towards this wrongness.[9]'
In other words, quoting Sanford Kwinter, the way in which *organization* and even *self-organization* of material reality *transform* perception and their relationship to feelings, ideas and the *sense of the world* is the new definition of architecture.
The word design has disappeared and we are possibly facing a paradigm shift, whereby our practice would be defined as *the capacity to transform through organization the sense of the world.*

The word organization, moreover, enjoys a privileged position compared to the word design in respect to two significant concepts of todays' investigation about the future of architecture and urbanism: *space* and *ecology*.
Organization, dissimilar to design, has a deeper, more structural and fundamental epistemological link with the concept of *space*. To organize in fact is to arrange methodically parts or elements of something in *space* into a structured order.
And the concept of space at the present time is of paramount importance in any methodological strategy for our discipline: 'Nowadays to occupy a spatial position might turn out to be as important as it was to keep an ideological position for the vanguards. If the quantity of information produced in the era of late capitalism has devalued representation as vehicle of communication, the system of meanings or of traditional values could be replaced by material or

[9] Najle C., in *Organization or design*? Architecture symposium held at Harvard GSD, October 2015, available on web @ https://www.youtube.com/watch?v=xRRYDzNg8hA

spatial organizations which will work as basis for communication, interchange and consensus.[10]'

Likewise integral to the definition of organization stands the notion of accomplishing something in an orderly and *efficient* way, *optimizing* organizational structures, definition which connects to the concept of ecology.

Organization indeed is a particularly pertinent term when dealing with complex models about urban sustainability and ecology, since ecology, as Pierre Belanger reminds us, is a form of spatial and territorial organization based on non linear dynamic foundations.

Again, the term organization contains the possibility to be declined as *formal* or *informal*, a prerogative that turns out to be quite important within the framework of the complexity theory.

Formal organizations are associated to concepts like equilibrium, rules, regulations, with determined objectives (therefore also deterministic) and founded structures, often based on individual responsibilities characterised by central decision making.

Informal organizations refer rather to ideas of far from equilibrium structures, relationships, networks, with emergent structures, based on complex social decentralised dynamics and emotional sources.

Formal and informal organizations however are not in any way referring to the reductive, for disciplinary, acceptation of 'shape' or 'appearance' or 'style' as conversely the couple *formal and informal design* do.

Organization is indeed a much more powerful concept. It comes from the Greek *ὄργανον (organon)*, tool, instrument, a medium to achieve. It implies no crystallisation, no impasse, no final results, but, because of its intrinsic impossibility is an engine, a source of energy 'and instead of being applied it must be first constructed. [11]'

Furthermore, it is an *open* word in the sense that, dissimilar to design, it is not *restricted* to a specific community of masters: it can travel from a discipline to another without losing its power.

Any discipline is a form of organization and models are the conditions of existence of organizations, their frame, their ground, their plane of consistency.

The fact that architecture's main scope has been reframed as an organizational one in the digital era of the complexity sciences, allows for the opportunity to expand the configuration of its models, borrowing

[10]Zaera Polo A., as reported in FOA, backcover of Quaderns 220 (Topografias Operativas), 1998

[11] Najle C., *Op. Cit.*

and hybridizing from other disciplines, remaining ‘disciplined’ but not ‘disciplinary’.

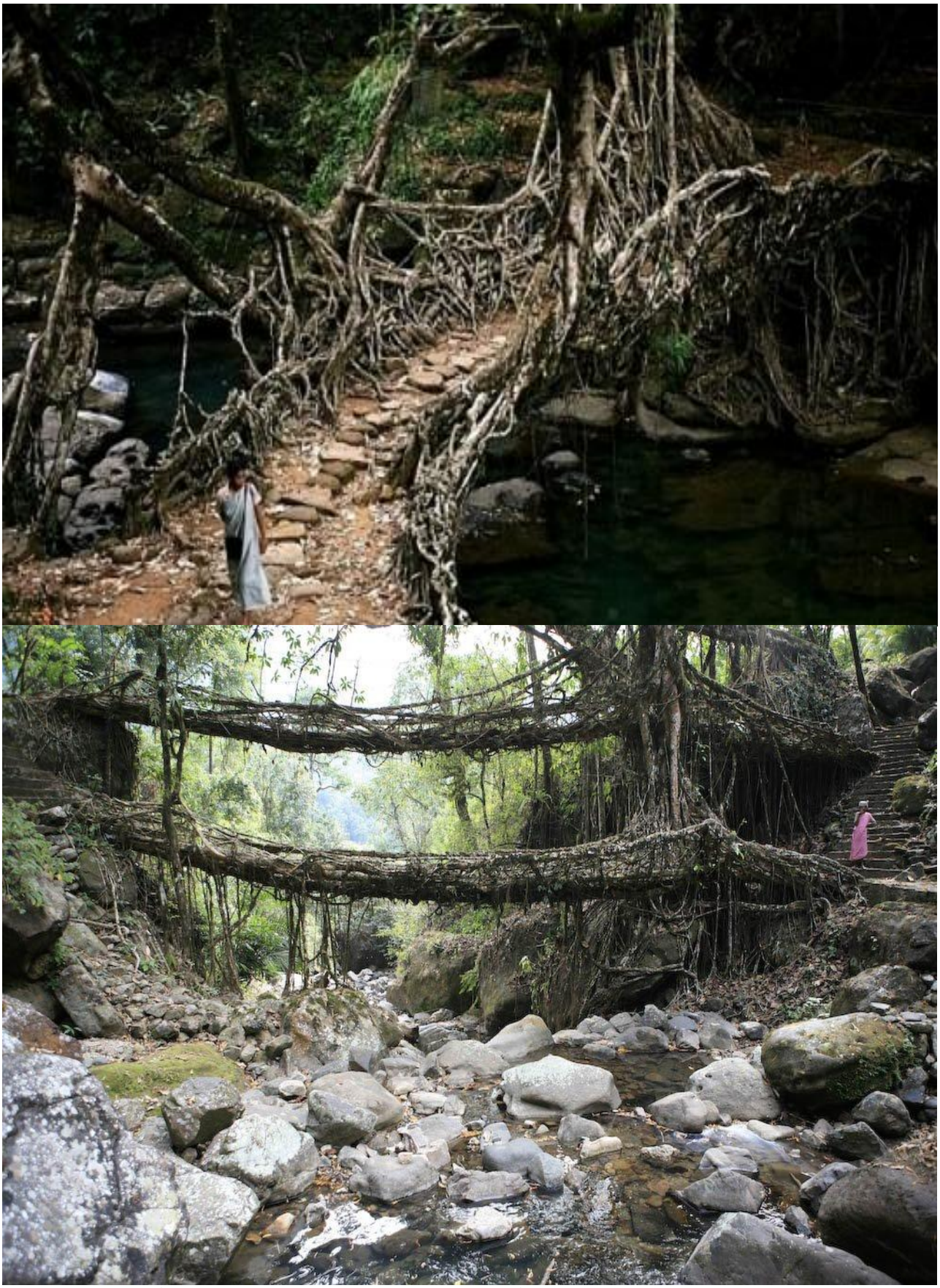

Fig. 1.11: The Creation of Complexity through Organization: The Living bridges of Cherrapunji, India

Fig. 1.12: The Creation of Complexity through Organization: The Living bridges of Cherrapunji, India

2. THE SELF-ORGANIZED CITY: MODELS AND TOOLS

2.1 Complex city models and the migration of knowledge

"The medium is the message"
(M. Mc Luhan, Understanding media: The Extension of man, 1964)

" […] Thus, architects wishing to use the new tool of genetic algorithms must not only become hackers (so that they can create the code needed to bring extensive and intensive aspects together) but also 'to hack' biology, thermodynamics, mathematics and other areas of science to tap the necessary resources. "
(M. De Landa, Deleuze and the use of genetic algorithms in Architecture, 2001)

"Models thus act as instruments which enable scientists and designers to explore the world, to predict it and to plan for it prior to 'acting' on the world in some irrevocable way. Models thus act as mediators between reality and theory, between the past and the future and have a central role in how we bridge the gap between these two domains."
(M. Batty, Model cities, 2007)

2.1.1. The agency of the MODELS: when the medium is the message

In this chapter a series of models that have been borrowed by other disciplines such as cybernetics, biology, statistics, mathematics, sociology and geology, and have been applied to urban design and planning will be presented as an attempt to give a compendium, which, though possibly incomplete, should start to give some suggestions to a different promising path.
Why models are so important within the concept of the *Aesthetics of Sustainability* in systemic thinking?
In first instance models are in general very important because from the 1960's and most of all in the digital era, the word model has substituted the term 'theory' across all disciplines[1] as much as simulation has replaced analysis in many different sciences and this would be already a very good reason to allocate a specific section of the research to them.
But models are not 'just' theories, they are mediators between theories and reality, between the past and the future and have a central role in how we bridge the gap between the two domains[2].
Going more into the specific, the concept of Sustainability is intimately bound up with maintaining some kind of desirable state into the long term future. But in complex systems the goal-post are always

[1] Batty M., *Model cities,* TPR 78 (2) , 2007
[2] Batty M., *Op. Cit.*

moving: what might seem sustainable today might not be in the future, which is basically a *problem of predictability.*
As Mike Batty says, we need to classify models and tools which assume predictability of different kinds in fact, once a model is defined, we have a device for making prediction and in doing so we need to develop much more pluralistic styles of modelling, planning and negotiating that are relevant to collaborative strategies and it goes by consequence that each one of these models brings along its own aesthetics and hermeneutics.

The specific choice of one rather than another medium has obviously brought along a morphological message but in such a way that it is very likely to be reminded of Mc Luhan's sentence, *the medium is the message*: simulations models, designed as tools, have become the message/output itself.
In the eyes of Juval Portugali[3], one of the pioneers of complexity theories applied to urban processes, the above is one of the problematic aspects of this new approach, and even though one would normally agree with his opinion, we believe that in this particular case one should look at it from a different perspective. A much more promising one which deals with the implications that concepts like subjectivity and agency could have in morphing the discipline's future.
These models, as a matter of fact, could be seen not just like simulation media, but as a dialogue, a notational code, between man and machine and between the architect, and his/her single authorship, and the collectivity. We will discuss this concept in greater depth in Chapter 3.
Since urban environments are artefacts or, as Stephen Read says, '*techno-constructions'* which support specific urban societies and economies, models and tools are here analyzed according to both their technical performance as well as their material hermeneutics and aesthetics: 'objects are not simplistically 'given' but are produced in a process that makes the context of the object's 'appearance part of the intentional or subjective side of the experiment[4]'.

Many of the models or methods of simulations proposed follow the methodological principle explored by Frei Otto since the late '60s. In his investigations on construction principles he would perform without

[3] Portugali J., *Complexity theories of cities: Achievements, criticism and Potentials, in* Complexity Theories of Cities have come of age. Springer : Complexity, Berlin, 2012
[4]Read S., '*Meaning and Material: Phenomenology, Complexity, Science and 'Adjacent Possible' Cities', in* Complexity Theories of Cities have come of age. Springer : Complexity, Berlin, 2012 .

being directed by neither specific purposes nor deterministic formal control so that what he called *the intrinsic material creativity* could be triggered: a bottom up approach not driven by intentions but rather by intuitions that, allowing irrational and unplanned aspects to emerge, would eventually bring together the *kalokagathìa* (harmony between performance and beauty).

To some regards various questions about the *modus operandi* of certain models are still open for critique: some seem to be still unripe to certain degrees but about to flourish as well, some others appear extremely mathematized but at the same time without losing sight of the human factors.
And yet they are promising.
It is the concept of *urban biology* Sert was advocating for in 1942 ("Cities [are] living organisms; [they] are born and … develop, disintegrate and die … In its academic and traditional sense, city planning has become obsolete. In its place must be substituted urban biology") when the migration of models and tools between disciplines was yet not in the horizon or foretold just by few.

Last but not least the results are indeed luring us: both complex and beautiful.
The drawings representing the projects at different scales have that appeal that most natural, self-organized systems can achieve: the grace and aesthetics of emerging structures.
Their models as much as the drawings are surprisingly tactile and convoluted, the digital 3D models even call to be touched: made in water, wax, caramel, bacteria, algae….some interactive, some even wet, some others with that three-dimensional poetic richness and delicacy that just the skin of some animals possess. They reminded us of the words of Steven Vogel in his book *'Cats' paws and catapults'* but as a attempt to overturn such words: "Natural and human technologies differ extensively and pervasively. We build dry and stiff structures; nature mostly makes hers wet and flexibly bend. […]We fabricate large devices directly; nature's large things are cunning proliferations of tiny components."
In other words these models seem to aim to develop a germinal effort, a strain, towards bridging that gap within the framework of the evolutionary theory.
As Claudia Pasquero says about their work in the Bio-Urban Design Lab at the Bartlett "our research deploys bio-mimetic and bio-technological models of collective intelligence to develop resilient and adaptive urban protocols and morphologies. These protocols of self organization generate emergent global solutions from a set of local rules

of interaction; we operate across scales and disciplines in the understanding that a large quantity of small local changes can produce drastic global effects. [5]"

In their appearance they are not just the traditional models meant to explain but they are models destined to stimulate, to engage and provoke responses.
Within the framework of the evolutionary theory this new Aesthetics seem to have regained their role of ecological category.

[5]Pasquero C., *Intro of the Bio-Urban Design Lab*, RC16, in March UD compendium 2013/14, the Bartlett School of Architecture , UCL, The Bartlett Prospective

2.2 Borrowing from CYBERNETICS

Gordon Pask in 1975 presented the concept of Cybernetics as a meta-language that allows addressing critically the role of the new architect: "the designer of systems with his interests centred into the organizational properties of the systems of development, communication and control. [6]"

As the 'scientific study of control and communication in the animal and the machine'[7], Cybernetics explore through a transdisciplinary approach regulatory systems, their structures, constraints and possibilities including concepts like adaptation, communication, social control, emergence, efficiency, efficacy and connectivity.

What is really interesting to us is that being Cybernetics used in a variety of different sciences, its definition seems to vary according to the discipline and the people trying to designate it and, in doing so, it performs as the fundamental *transdisciplinary discipline.*

Let's look at some notable definitions:

- Science concerned with the study of systems of any nature which are capable of receiving, storing and processing information so as to use it for control." (*A. N. Kolmogorov)*
- "The art of securing efficient operation." (*Louis Couffignal)*
- "'The art of steersman-ship': deals with all forms of behaviour in so far as they are regular, or determinate, or reproducible: stands to the real machine -- electronic, mechanical, neural, or economic -- much as geometry stands to real object in our terrestrial space; offers a method for the scientific treatment of the system in which complexity is outstanding and too important to be ignored." (*W. Ross Ashby)*
- "A branch of mathematics dealing with problems of control, recursiveness, and information, focuses on forms and the patterns that connect." (*Gregory Bateson)*
- "The art of effective organization." (Stafford Beer)
- "The art and science of manipulating defensible metaphors." (*Gordon Pask*)
- "The art of creating equilibrium in a world of constraints and possibilities." (*Ernst von Glasersfeld*)
- "The science and art of understanding." (*Humberto Maturana*)

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[6]Ortega L., in *Organization or design*? Architecture symposium held at Harvard GSD, October 2015, available on web @ https://www.youtube.com/watch?v=xRRYDzNg8hA

[7]Wiener N., *Cybernetics, or Control and Communications in the Animal and the Machine,* Cambridge: MIT Press, 1948

- "The ability to cure all temporary truth of eternal triteness." (*Herbert Brun)*
- "The science and art of the understanding of understanding." (*Rodney E. Donaldson*)

In our frame of reference, most of all in terms of Sustainability, possibly the most pertinent definition is the one firstly used by Plato in the Alcibiades, “the study of self-governance”.
Cybernetics provide a mean for examining the design and function of any system, including control systems and self-organizing systems, for the purpose of making them more *efficient* and *effective*, in other words more sustainable.
Its focus is on how anything (digital, mechanical or biological) processes information, reacts to information and changes or can be changed to better accomplish the first two tasks.

Kevin Kelly, trying to describe how future organizations should perform in order to aspire combining top down, sequential processes, defined by Kelly as ‘clock’ type systems (as typical of mechanical systems) with bottom up, non sequential processes, defined as ‘swarm’ type systems (as typical of collective patterns), suggested that the best performing apparata would have been ‘some *cyborgian* hybrid of part clock, part swarm’ balancing in the fulfilment of their tasks some control for some adaptability[8].’
In saying so Kelly was clearly advocating the inner capacity of cyborgian systems to negotiate linear and non linear systems within their realms, which, at the end, consists exactly in their ultimate and supreme agency.

[8]Kelly K., quotes extrapolated from his book *Out of Control: the new biology of machines, Social Systems and economic world*, 1994, available on web @ http://kk.org/mt-files/books-mt/ooc-mf.pdf

2.2.1. Bio-technological models for Energy Infrastructures

Project Credits:
- *Course:* Master in Urban Design, UDII, BPro, The Bartlett, UCL, 2012/13
- *Project Title*: Edible Landscapes – Sidi Bouzid
- *Students and Image Credits*: Shi Min Pong, Ruowei Song, Ting (Wendi) Wen
- *Tutors:* Claudia Pasquero, Marco Poletto (RC 16)
- *Computation:* Immanuel Koh and Iker Mugarra
- *Lab Leader*: Claudia Pasquero

Fig 2.1: Multi layered model of Operational territories. The model materialises a projective terrain for the breeding of a new edible landscape

The location of the project is Sidi Bouzid, located in the middle of Tunisia at the intersection of the Mediterranean climatic zone and Saharan desert, the site where the most of Tunisian food is grown and it is one of the main agricultural hubs of the country. Up to few decades ago it boosted diverse agricultural products from temperate fruits and vegetables to semi-arid olives and plants. However, due to recent climatic shifts, agricultural food production has decreased exponentially. More wells needed to be dug to obtain the water for the growth of Mediterranean crops - further exacerbating the productive landscape.
Another interesting point in the region is the presence of important technological systems: from government irrigation programs to private algae cultivation initiatives, the actors/agents within the productive landscape of Sidi Bouzid have already adopted different practices and strategies to mitigate the acute water situation and the shifting climatic conditions of the area.

Climate change, the rising price of food and the reliance on global imports of wheat have placed great pressures on farmers to produce and have pushed many of them to turn their lands into intensive farming proposed by Western Corporations which have been exploiting the territory and its inhabitants, giving rise to the Arab Spring.
The project is an attempt to give a different opportunity to the landscape and the people who inhabit it.
It adopts bio-inspired algorithmic design methods to draw terrains of negotiation across strategic and tactical forms of intervention; algorithmic coding enables the testing of design intentions across a fluid eco-social terrain, generating a multiplicity of responses and effects across scales and regimes (from the molecular to the territorial)
Edible Landscapes deploys lightweight and low-tech farming kits to create a new self-organizing infrastructure able to augment productivity and introduce new food streams; the infrastructure is controlled by a robust and adaptive urban code that provides constant reconfiguration in response to changing environmental stimuli, offering microclimatic control, bio-energy production and new trading opportunities. Thanks to a virtual interface it becomes possible for farmers to trade and grow their crops in an independent manner; this stimulates a more adaptive and robust cultivation system in contrast with the intensive farming proposed by western corporations.

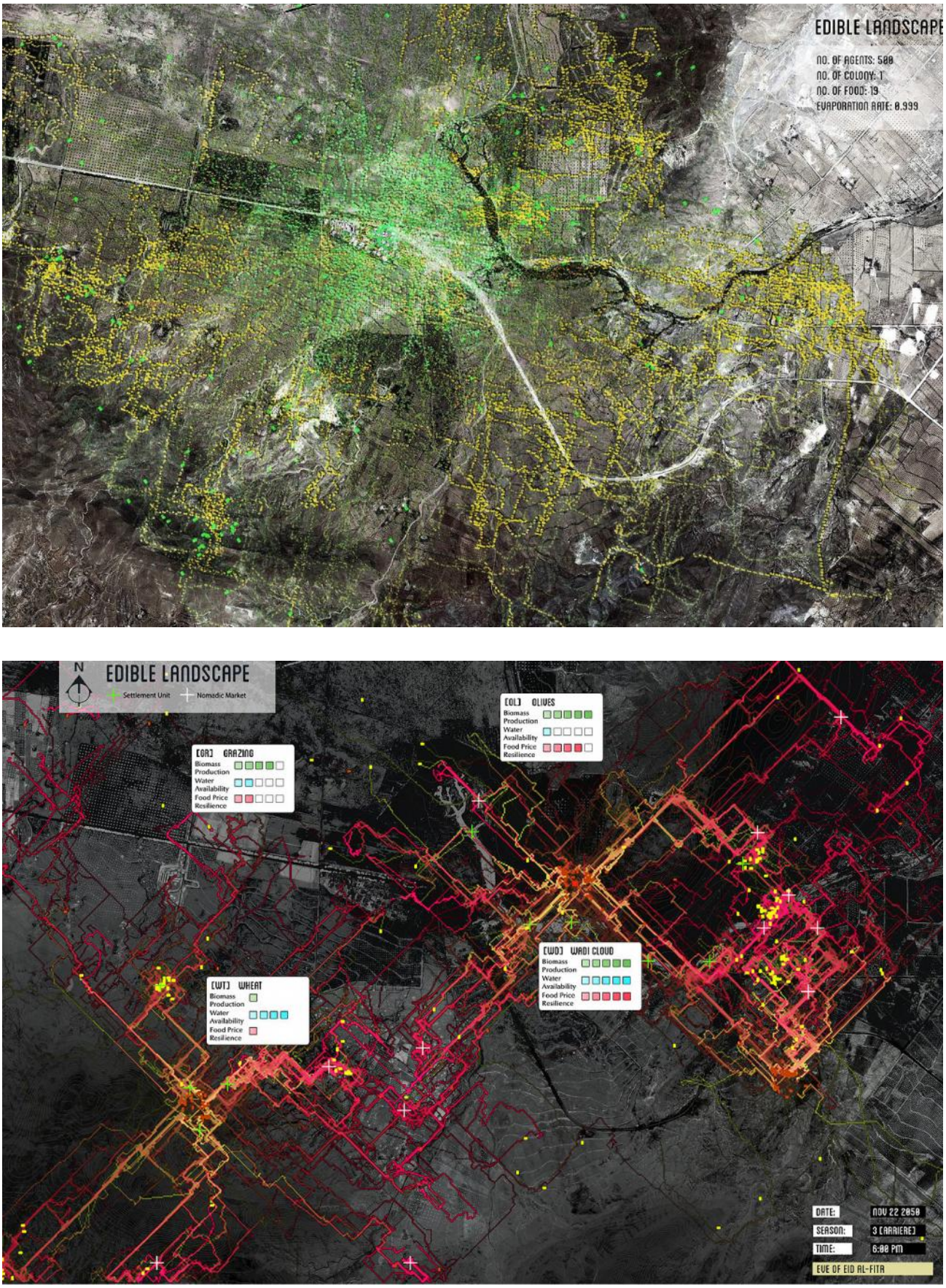


Fig 2.3 -2.4: Edible landscape

The study has been articulated in five main components:

_The Operation Field or Projective Food Network: it is computed by tracing minimal paths between food producing plots and existing distribution markets. As the production fluctuates so does the network which adapts by adjusting the position or dimension of the paths. The concept of a nomadic market emerged from the iterative application of this machinic device

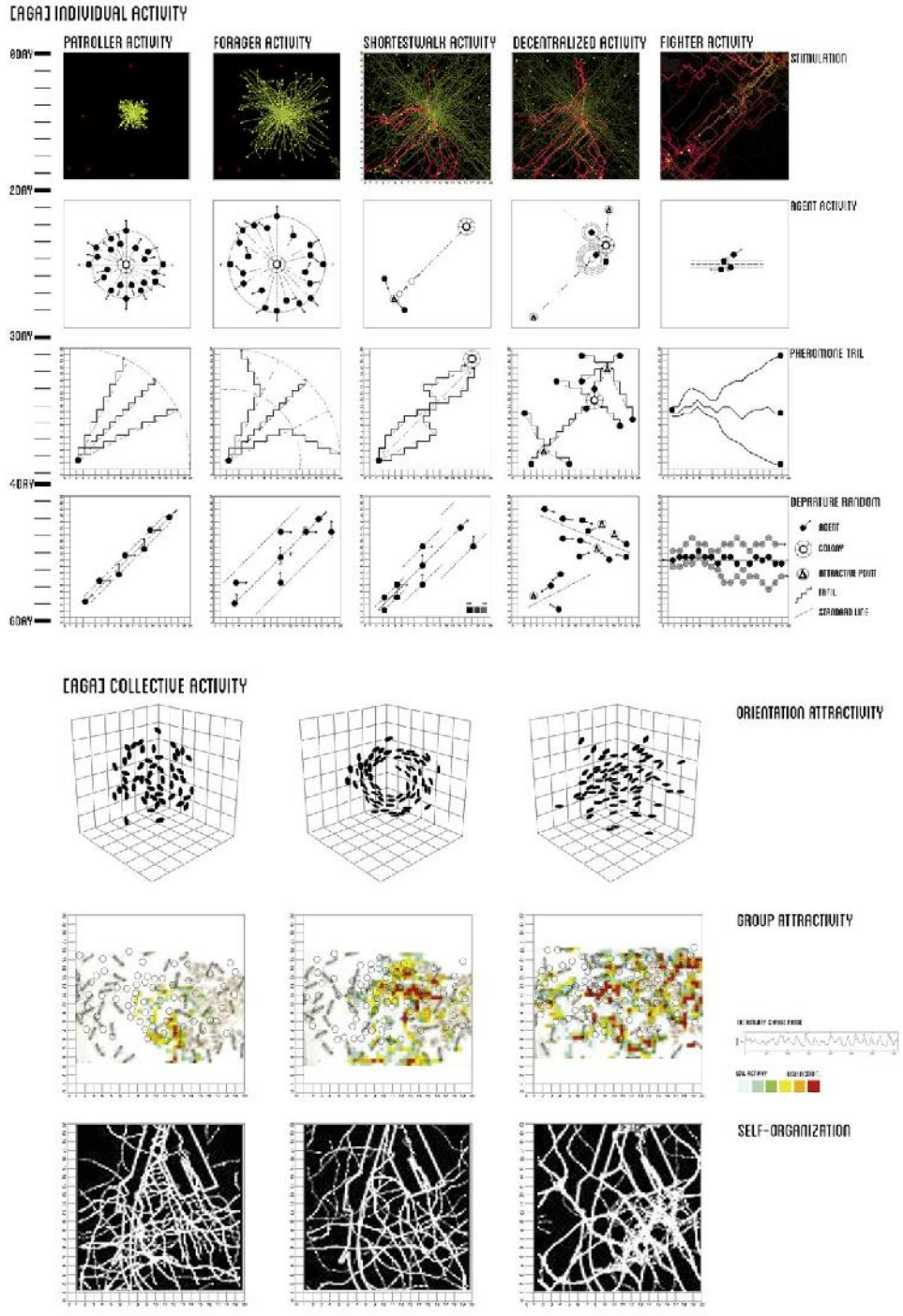
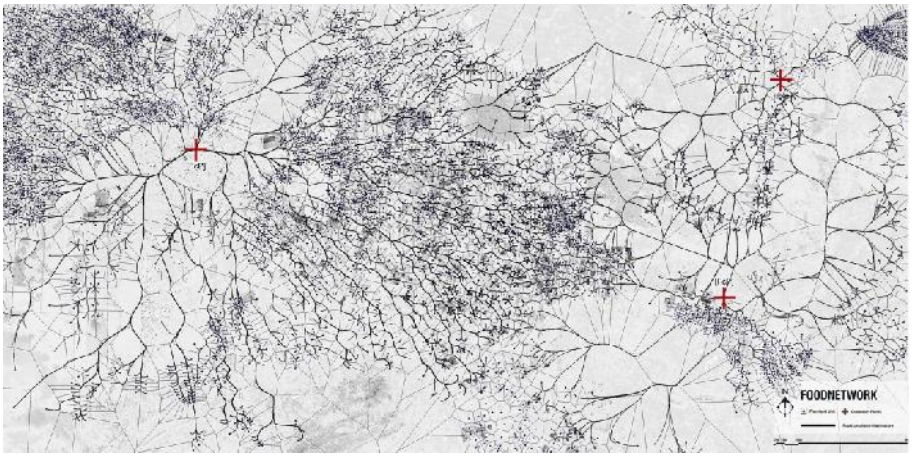


Fig 2.5 – 2.6 – 2.7: Operational fields: collective agent activities

_Water flow patterns and collection Points: The algorithmic map reads topographic data and rain patterns to compute patterns of distribution and collection of rain water across the agricultural territory and creates a potential field of intensified cultivation as well as an indication of potential erosion and desertification.



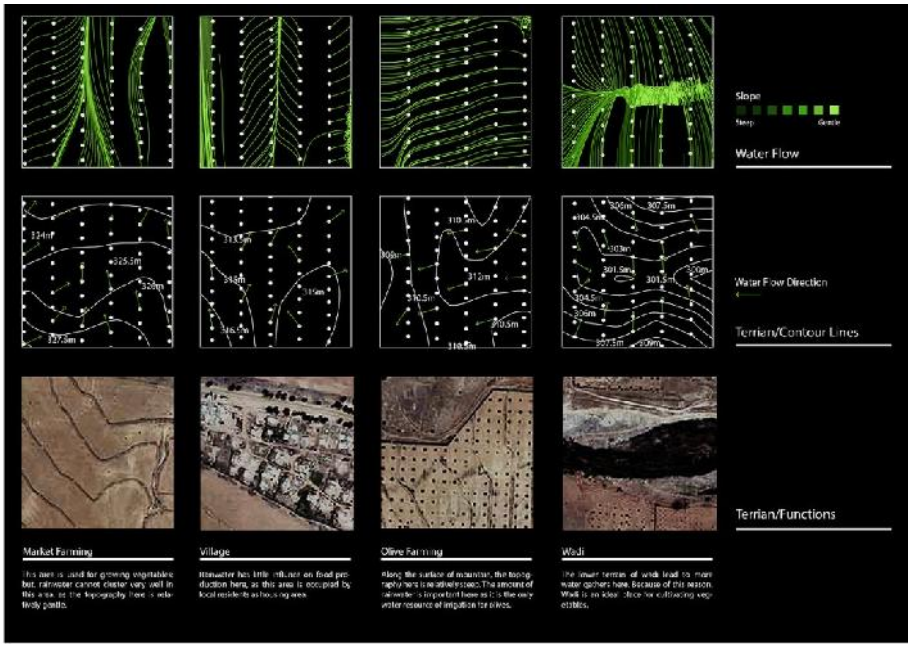
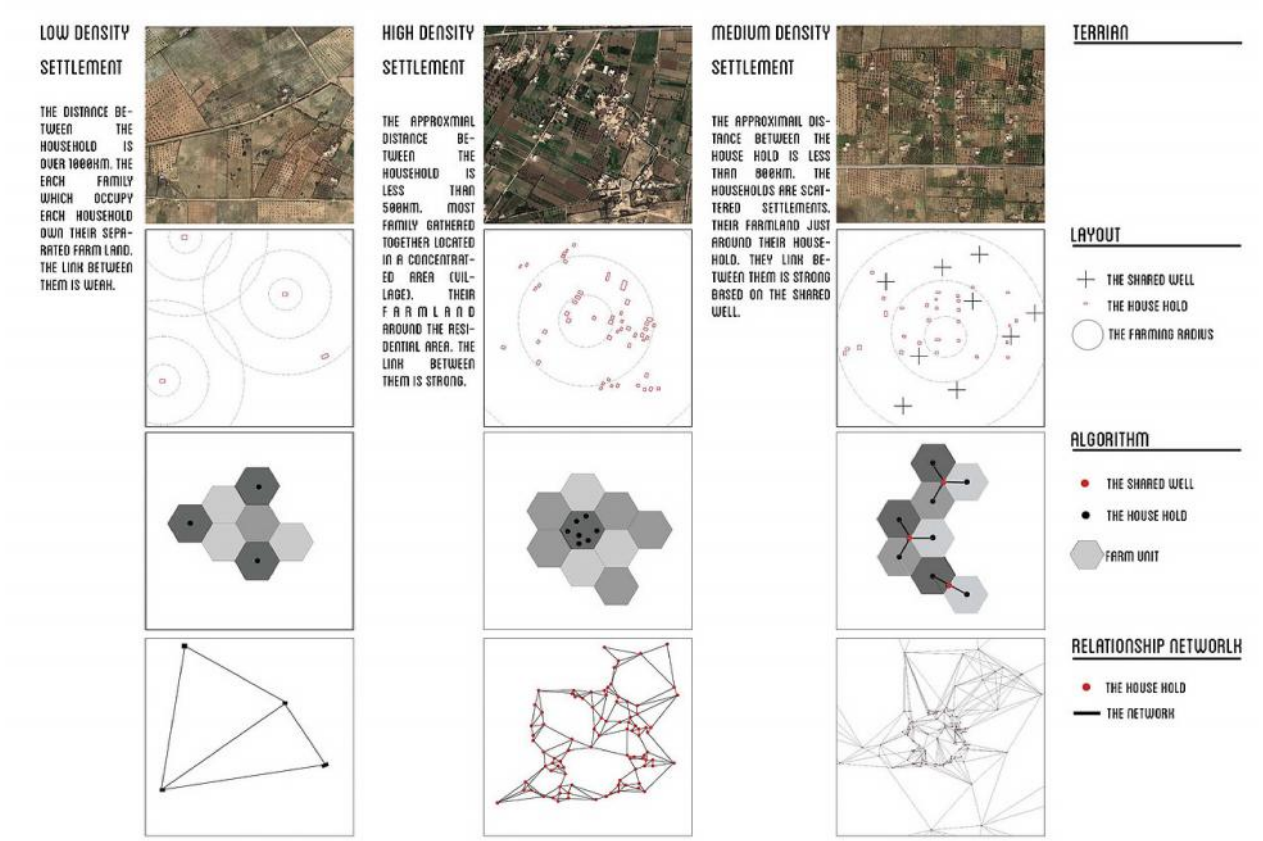


Fig 2.9-2.10-2.11: Operational fields: food network and water flow



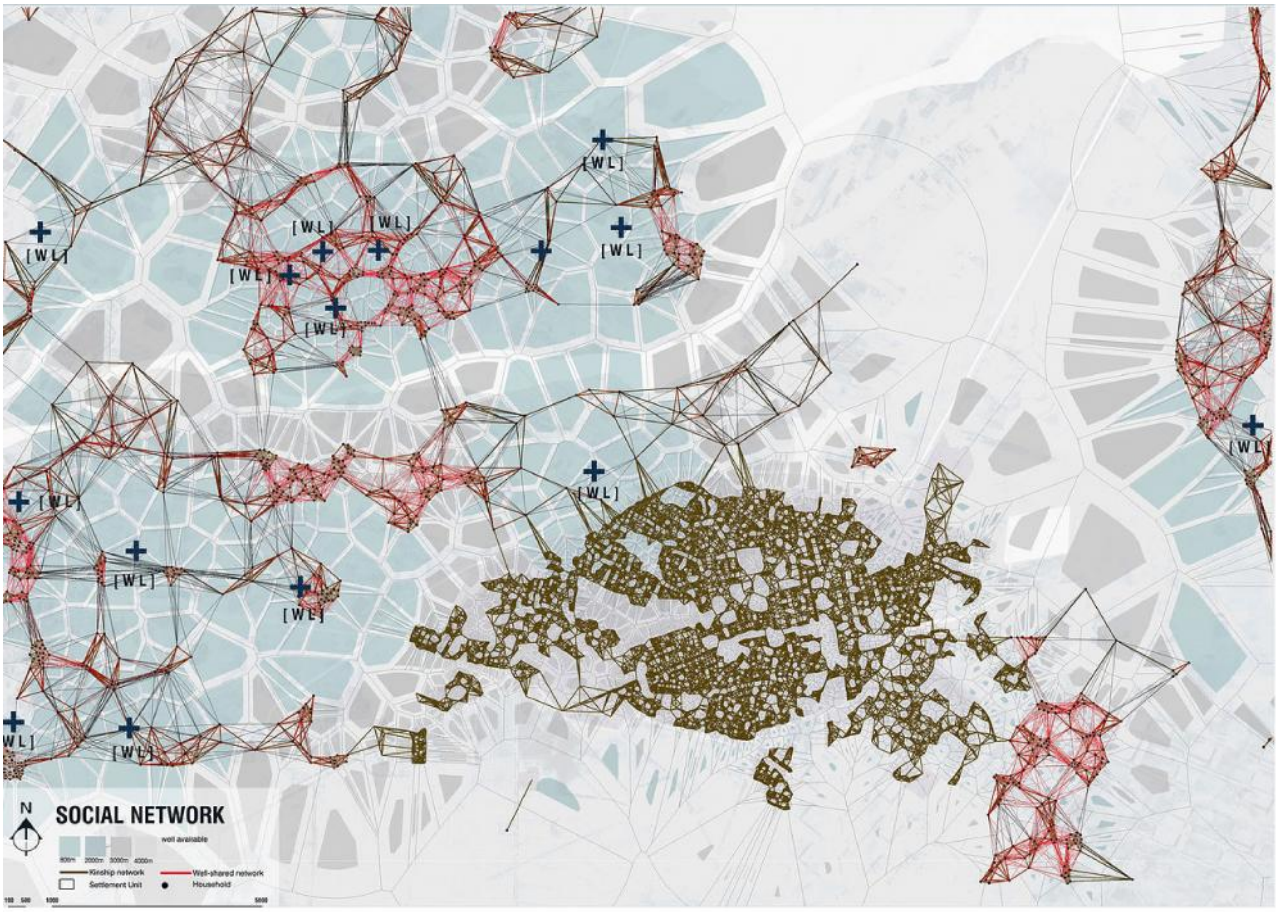
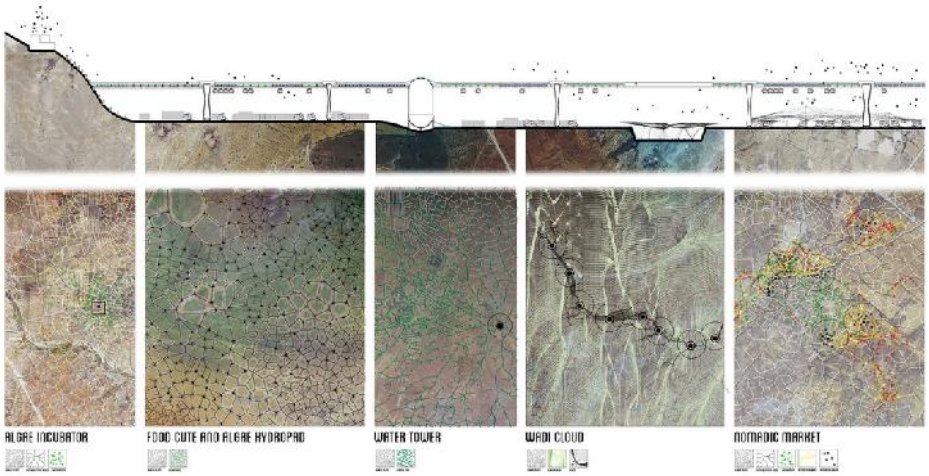


Fig 2.12-2.13: Operational fields: social network studies

_The 3Dimensional model: it materializes a projective terrain for the breeding of a new edible landscape; each layer is read as a stimulus for action/reaction and for the computation of a new agricultural protocol.
_Geolocated flying hydropods: they transport hydrogen gas across the city following energy demand levels on the ground
_The solar powered Wadi Cloud: it floats above the landscape regulating the microclimate below through collection and percolation, intensifying traditional farming



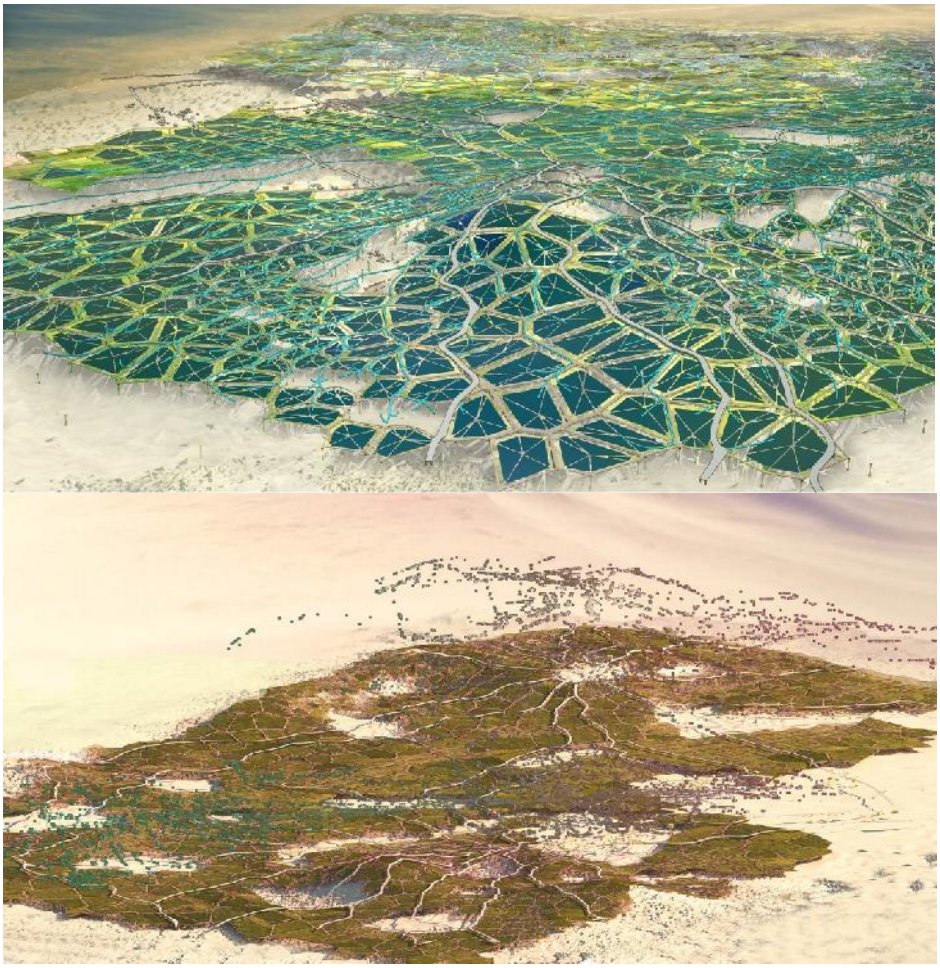


Fig 2.14-2.15-2.16: 3Dimensional model

2.2.2. Distributed Intelligence to reprogramme habitat structures

Project Credits:
- *Event:* XI Venice Biennale. 2008
- *Project Title*: Hyperhabitat. Reprogramming the world
- *Team and Image Credits*: Guallart Architects, IAAC, MIT The centre for Bits and Atoms, Bestiario
- *Institutional partners*: Ministerio de Vivienda, Ajuntament de Barcelona, Ajuntament de Gandía
- *Development partners:* Visoren, Proinosa, Construcciones Riera

Fig 2.17: Overall view of the installation at the XI Venice Biennale, 2008

This project, a joint venture among different academic, economic, political and ICT firms, commits to the letter with the logics and processes of *Cybernetics* as defined by Gordon Pask: designing systems with the main interest centred into the organizational properties of the systems of development, communication and control.
The aim of the project is to reprogramme the multiscalar structures of the habitat we live in (from the scale of a room to the one of a territory) through the introduction of distributed intelligence with no central control using the *internet 0* technology (a new microserver technology developed at MIT to generate ambient intelligence by linking a series of miniature computers).

The intention of the designers is based on the idea that in order to pursue a much more efficient, resilient and sustainable life style we need to augment not only the number of relationships within our physical system (the world) but also the interconnections with the digital world, which we are all so much and deeply involved with, using the principle of the network.
As in any biological system, the greater and most diversified the number of exchanges with the outside world and the most successful is the system.
To make the physical and digital world compatible is then just a question of finding the appropriate terms, layers, to describe them on the same plane of immanence. As a matter of fact both the physical and digital worlds share the same network components: 'nodes, connections, environments, protocols, contents and the people that operate them'[9].
Connecting entities in different ways to how we are usually accustomed, it is possible to gain systems, urban systems as well, which consume less energy and generate and promote new social interactions.
Part of the challenge resides in the intuition that through the information networks it is possible to 'reprogramme the world' via multiple interrelated nodes transcending 'traditional hierarchical structures based on the management of the collective by public structures and promote processes of emergence based on peer-to-peer relations[10]'.
In other words the idea is to delineate a different organization of exchanges in a sort of a new 'notation of the world' which operates at various scales and is developed and constructed on the basis of distributed, decentralized systems, by operational nodes– people,

[9]Extrapolated from '*Hyperhabitat: reprogramming the world'* available on line @ http://www.guallart.com/projects/hyperhabitat-reprogramming-the-world
[10]*Op. Cit.*

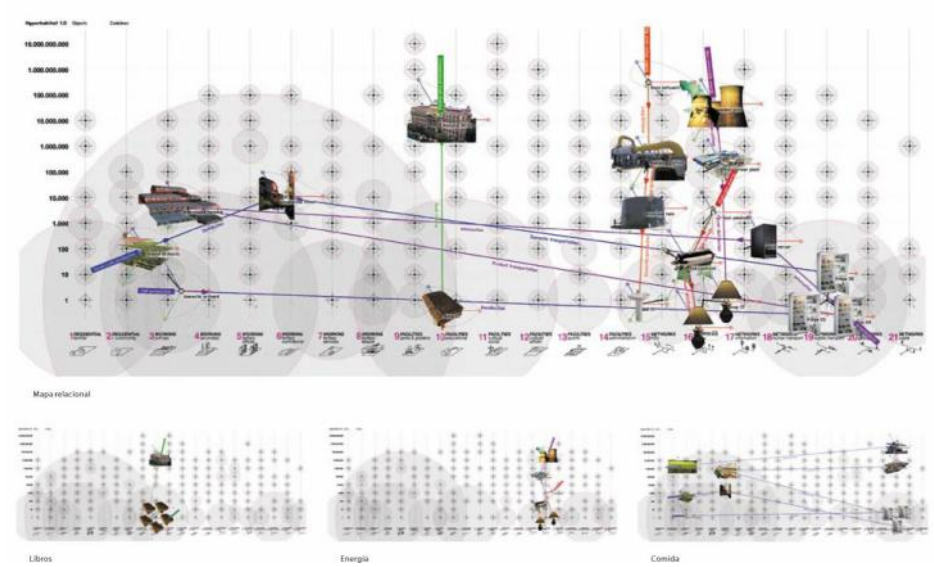


Fig 2.18: Diagrams and Relationl Map

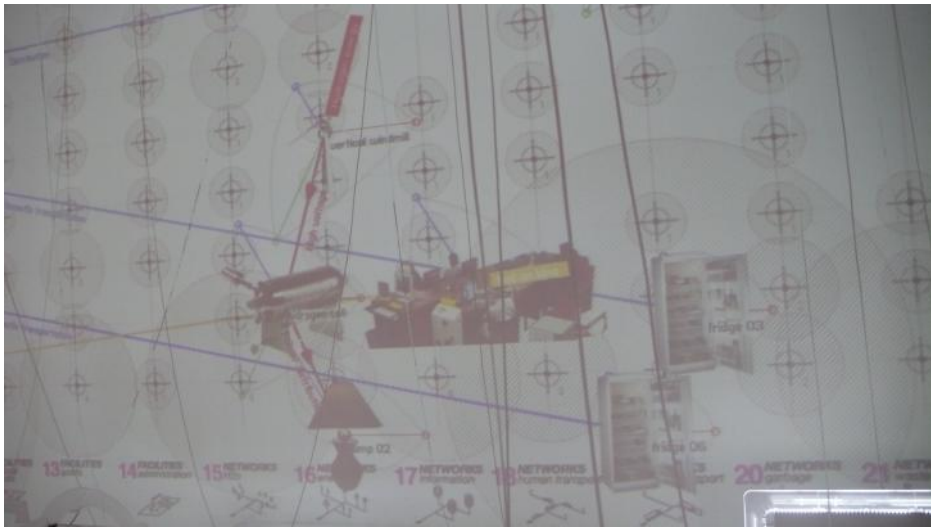


Fig 2.19: New Relationships among entities displayed as large-format projections


Fig 2.20: The embedded microservers on the right inside and the ‘scale slider’ on the left

things, places, territories – cooperating freely in order to be more efficient.

Through the introduction of new digital and mental structures instantiating new approaches to the generation of buildings, cities and territories by restructuring their functional relationships, the team points to formulate a sort of 'urban genome' of our habitat.
In order to do that, they have been creating an installation of a 'minimum urban module', a room, where objects and spaces, made of methacrylate with embedded microservers, interact with one another to generate relationships. Such economic, social and environmental relationships are visually displayed as large-format projections on which new relational 'line codes' are drawn to suggest different, unusual and sometimes inexperienced connections with original affiliations and dependences.

This project, besides assuming an active and participatory role of the citizens in the construction of their habitat which is an *aesthetic act* by all means (For more on this, please refer to Chapter 3.1.), reminds us of a very important function of Architecture and Urbanism: their function as *systemic activities* rather than just iconic ones.
Architecture and Urbanism as mediums to organize relationships and as system thinking elements have the opportunity to balance holistic thinking and reductionist thinking promoting organizational communication between the three distinct worlds we know, spiritual, physical and digital, engaging therefore a transversal ecological praxis.
In this light Architecture and Urbanism would free themselves from a merely definition of a 'spatial discipline' to acquire a wider transdisciplinary role, a cognitive role.
They would become new models of construction, not only construction of spaces but rather construction of proper cognitive maps.
The reconstruction of relationships among entities, as a sort of hypertext, in a non linear, complex and rhizomatic way, it is also the development of a new alphabet, which is ultimately the really beginning of space, as Perec mentions: "Space begins like this, only with words, signs traced on a white page. To describe the space: naming it, tracing it....[...]The Aleph, this borgesian place [...],what else is but an alphabet? [11],

Hyperhabitat is in a way the philosophical 'thought of the possible'.

[11]Perec G., *Specie di Spazi*, Bollatii Boringheri, Torino, 2009

Fig 2.21: View of the installation

2.3 Borrowing from BIOLOGY

'As we make our machines and institutions more complex, we have to make them more biological in order to manage them. [...] The most potent force in technology will be artificial evolution. We are already evolving software and drugs instead of engineering them. [...]
Organic life is the ultimate technology, and all technology will improve towards biology [and] in order to harvest the power of organic machines, we have to instil in them guidelines and self-governance, and relinquish some of our total control[12]'.
The above lines are just a few ones from the prophetic book of Kevin Kelly published in 1994 where he was advocating the coming of our technological future as a run up to a neo-biological civilization, a civilization where we would *breed* and *grow* apparata rather than produce or make them.

Today some of the models originally developed in Biology such as *Allometric, Stigmergic and Sugar-Scape models* have been borrowed by other fields among which, very recently, urban design.
These models are used to analyze and evaluate energy flow patterns of natural systems that seek to fill their space in the most efficient manner following rules of self-similarity that show how they arrange their parts to conserve and utilize the transport of their energy in the most efficient way.

Allometric models studying the relationship of body size to shape, anatomy and finally behaviour, can be used to link the size and shape of living objects to the networks they use to deliver resources to their parts, like in the case of the project called 'Urbanism in the Dust of Mining Industry'.
The detailed microscopic study of the behaviour of the *Physarum polycephalum,* an eukaryotic microbe often chosen as a model in many studies involving amoeboid movement and cellular motility given its capacity to choose the shortest route within a labyrinthic environment to get to nutrients. The so called *PHYSA algorithm* has been developed in this research, in order to rechannel the interactions present in the territory into a system that redistributes un-concentrated Ferrum and Molybdenum material from waste rock piles into urban landscapes, suggesting through an emerging morphology an intelligent

[12] Kelly K., quotes extrapolated from his book *Out of Control: the new biology of machines, Social Systems and economic world*, 1994, available on web @ http://kk.org/mt-files/books-mt/ooc-mf.pdf

and non-linear way of material delivery and recycle system after the mining exploitation in the Copper Corridor area.

Stigmergic models are defined by a series of subsequent actions tending to reinforce and build on each other, leading to the spontaneous emergence of coherent, apparently systematic activity. Like in the case of the *Urban MMS project* where the definition of urban morphogenesis in an extreme environment has been investigated as a microclimatic dependent process based on a real time self-organization of living modules inspired by Niger ants nest building algorithm. Or again in the project called *Post Waste Cities*, where collective intelligence, in specific the one of Attini ants, has been used to harness biomass as a universal resource to grow bio-degradable environments.
Stigmergic models have been further enriched in terms of cognitive emergent behaviours when borrowed in turn by IT scientists who introduced the presence of *artefacts as environmental modifiers.* The research team headed by Prof. Ricci working on the concept of Stigmergy as a MASs (multi-agent systems) technique for realizing forms of emergent coordination in societies composed by simple, non rational agents, introduced the use of '*suitable engineered artefacts*' to explore instead the concept of Stigmergy in the context of societies composed by cognitive/rational agents[13]'
The standing hypotheses at the base of the study were mainly two: *the environment as subject to open interpretation and perception*, therefore subject to an aesthetic conventional and collective system of signs and *the environment as mediator of behaviours*, articulated and composed of artefacts which, subjects to human cognitive activity, assemble the social workspace. Artefacts are therefore entities representing the environment that mediate agent interaction and enable emergent coordination. They represent the rationality/intentionality of agents' actions.
In this perspective the environment acquires a key role, acting not only as a container, a passive landscape against which all the interactions occur, but rather as a negotiator and a ruler of interactions promoting the emergence of local and global coordinated behaviours.
This specific research is of particular interest in the field of architecture and urban design because, as Patrick Schumacher rightly points out, since architecture and even more urban design are at the genesis of modes of abstract thinking where conceptual structures and schema can

[13] Ricci A. and others, Cognitive Stigmergy: a Framework based on Agents &Artifacts, on line http://www.academia.edu/277398/Cognitive_Stigmergy_Towards_a_Framework_Based_on_Agents_and_Artifacts

emerge, it follows that architecture sets up social order and in this line becomes explicit the importance of the role of artefacts because ‘they are the factors upon which society is built up[14]’

[14]Schumacher P., Proto_E_cologics Symposium, 2011, on line http://vimeo.com/28816240

2.3.1. Allometric models for Circulation Infrastructures

Project Credits:
- *Course:* MArch in Urban Design, UDII, BPro, The Bartlett, UCL, 2013/14
- *Project Title*: Urbanism in the Dust of Mining Industry
- *Students and Image Credits*: Kaikai zhou, Mingjie Fan, Nan Yang, Shihong Sun
- *Tutors:* Claudia Pasquero, Marco Poletto (RC 16)
- *Computation:* Immanuel Koh and Iker Mugarra
- *Lab Leader*: Claudia Pasquero

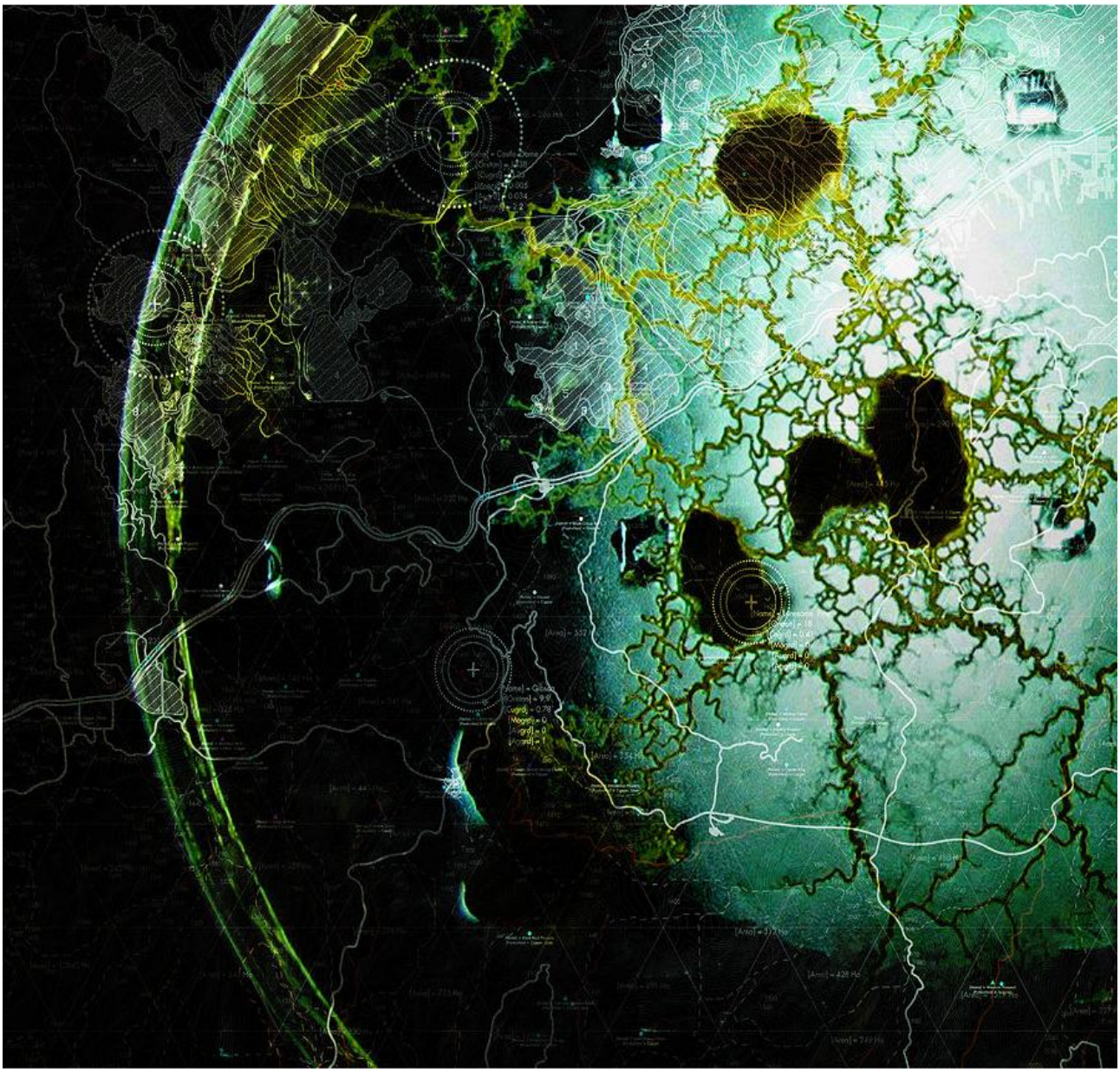


Fig 2.22: A slime mould culture of *Physarum polycephalum* is fed with information related to the present and future mining activities in the copper corridor, Arizona. (CLOSE UP) As the organism optimizes its own metabolic functions it generates a network-like morphology of minimal material distribution channels

The project is set up in the Copper Corridor in Arizona, known as the energy district of America because of its huge deposits of copper.
The mining activity brought in the area not only industries, jobs and money for people but also an entire revolution in terms of landscape identity and administration.
Mining towns in fact have been growing and disappearing at a fast pace, following the rhythm of activation and abandonment of the mining pits, which became vast abandoned, polluted and unused landscapes.
The existing policy for the treatment of the dismissed mine instead is taking into consideration only the treatment of the waste contained in the soil but doesn't consider programmatic solution for the re-thinking of this abandon landscapes. However this is a damage limitation strategy that while greening the area doesn't resolve the problem at its core.

Fig 2.23: A copper pit in the Copper Corridor, Arizona, USA

The project intervention aims to exploit the discordances and the latent capacities of the mining landscape in order to rechannel the agential interactions present in the territory into a system that distributes organic and inorganic material flows into urban landscapes.
The research focuses on the qualities and quantities of waste rock piles, which get redistributed while the mine is still in function in a way that can support the mining system but also the possibility to distribute new program on this post-industrial landscape once the mine is dismissed.
The project tries to take advantage of the overburden piles material as source for the construction of new inhabitable landscape and public space.

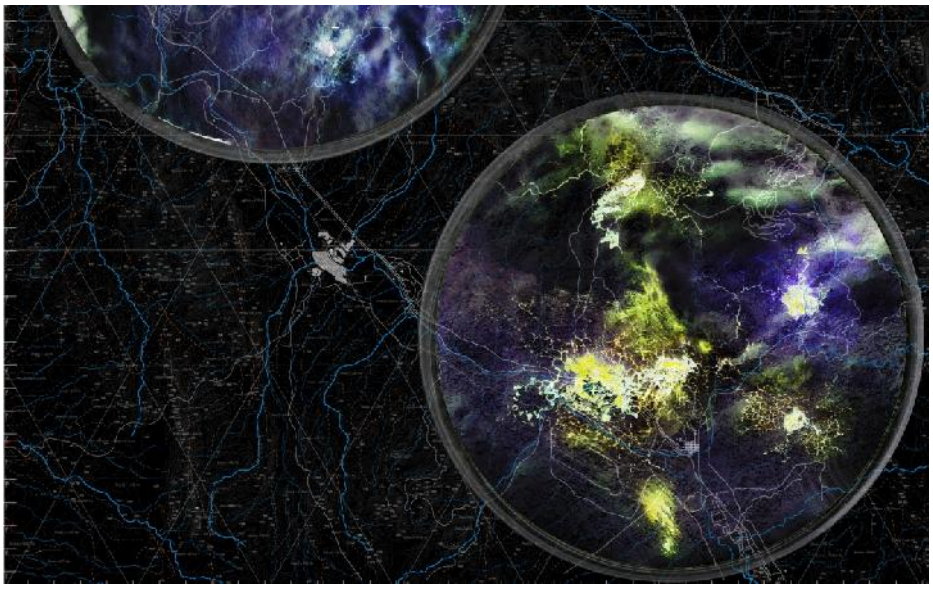


Fig 2.24: Projected scenarios of bio-computed ‘manufactured landscapes’ in the Copper Corridor (CC) with colour coded material flow

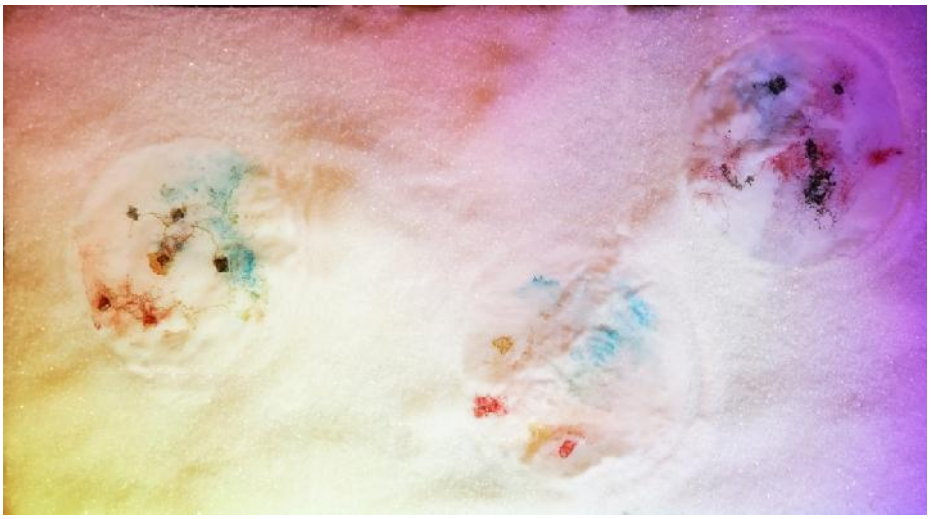


Fig 2.25: The three Petri dishes correspond to the three key mining zones in the CC. The colour indexes the mining mineral composition and is used to highlight the slime mould behaviours during optimization process.

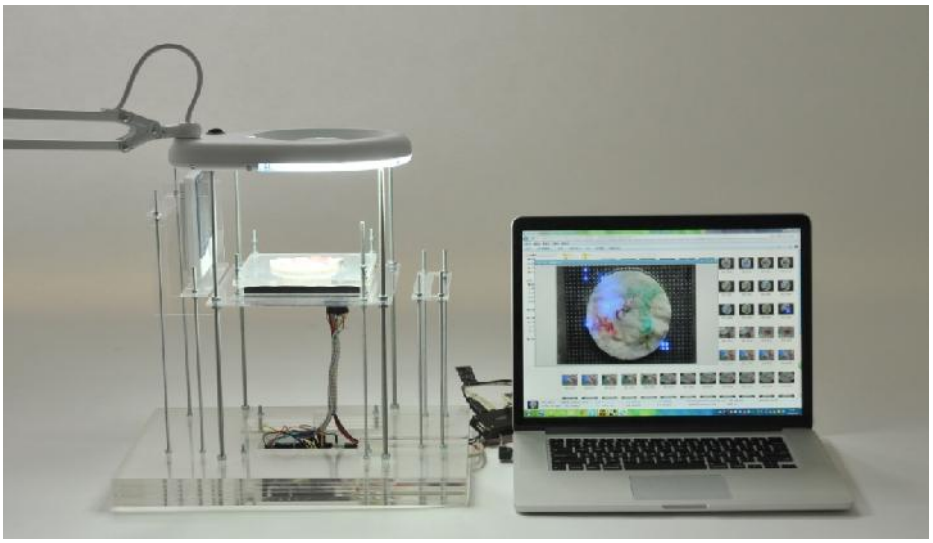


Fig 2.26: The Bio-digital apparatus

The team developed a methodology which deals with the adaptation of the territory in real time and in order to do so they have borrowed the tools from a Bio Lab, through the implementation of a *Bio-digital apparatus.*

The apparatus is a complex 'eco-machine' consisting in the superimposition of different layers of biological, computational, optic and printing material: a living slime mould, colour ink, agar, 3D-printed substratum, LED matrix, magnifying lens 5X, high-res web cam, Arduino microprocessor and processing code. The apparatus enables the bio-digital communication between the living slime mould and the computer.

'The slime mould is fed information from survey drawings via food location, 3D printed morphology and light signals.

The behaviour of the monocellular organism is then recorded in real-time to feed a processing script able to decode its position, speed and colour to compile an evolving manufactured landscape for the Copper Corridor.[15]'

The algorithmic model is based on a novel machine for bio-computation, which exploit the capability of the *Physarium policefalum*, the slime mould, to perform network optimization and material re-distribution. 'We are interested in bio-computing because the way slime mould perform these tasks is unlike any engineering or master planning strategy as it doesn't proceed through top down decisions but generate bottom up ones thanks to mechanisms of collective intelligence and distributed spatial memory[16]'.

The operational steps followed in the research have been mainly two:

_**The construction of an apparatu**s that enabled the team to feed GIS information in real-time to the slime mould (the biological algorithm) and to read back information that fed in the drawings and evolutionary plans.

_**The emerging design of an evolutionary plan** which would guide, together with what the slime mould as bio-algorithm has defined, the rules to transform the territory by the action of on-site territorial machines so that this new plan will be able to suite both the need of the mining industry and, in a second stage, the preparation of a new inhabitable landscape while the mine will be dismissed.

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[15]Pasquero C., quote extrapolated from an interview held in London between Claudia Pasquero and the author in May 2015

[16]Pasquero C., quote extrapolated from an interview held in London between Claudia Pasquero and the author in May 2015

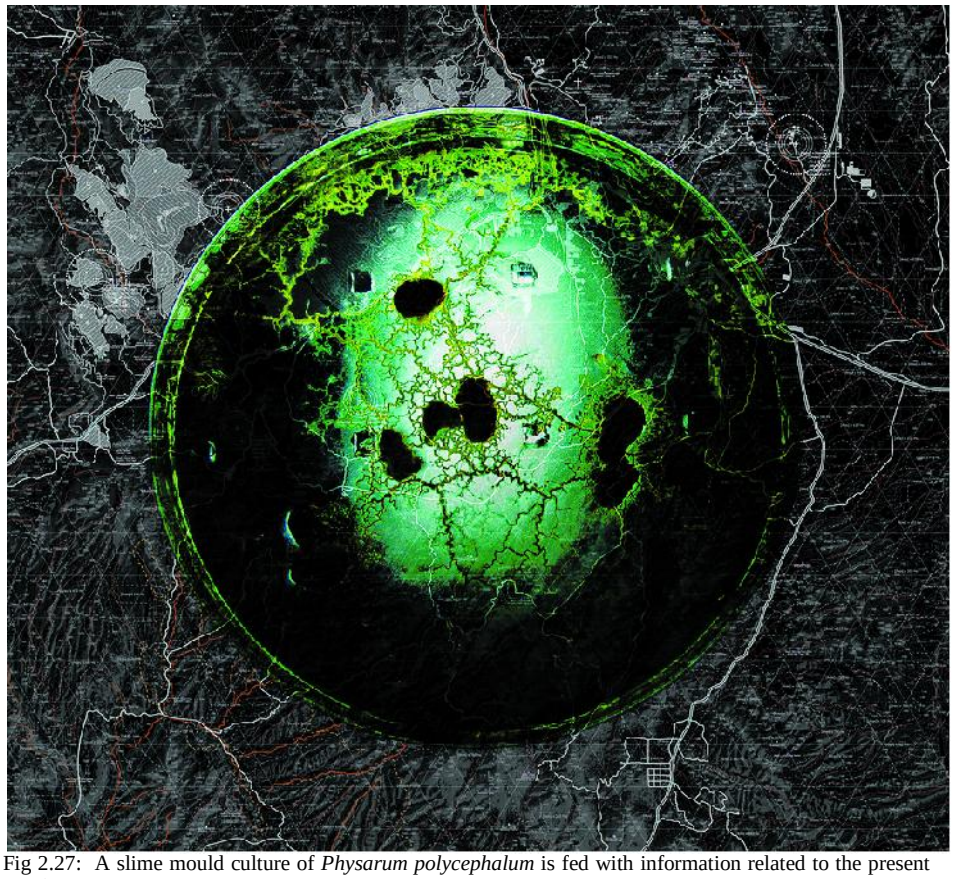

Fig 2.27: A slime mould culture of *Physarum polycephalum* is fed with information related to the present and future mining activities in the copper corridor, Arizona.(OVERALL VIEW)

Fig 2.28: The Evolutionary plan which would guide the rules for the site transformation

In synthesis the PHYSIA Algorithm offers a model for this post-industrial landscape to be transformed not as a metaphorical connection but rather as an operational and real-time transformation of the territory. The resulting landscape emerges as a continuous feedback between the territory and the bio-machine that has been designed and 'our role as designers shift from the one of planners to the one of gardeners[17].'

This last notion, of designers like gardeners, borrowed from Gilles Clement, introduces us to a very interesting speculation on transdisciplinarity about which we talked in the introduction (See Chapter 1.4.1.) and which is inherent to this project as well: the possibility to combine and hybridize two very apparently different domains, in this specific case, mathematics with its algorithmic models and gardening with its botanical and biological ones.

Is it possible to effectively combine a mathematical model such as the algorithm with the behaviours of a biological organism? And is it possible to apply it to an urban or landscape model?
What sort of bridging mechanism should we apply in order to consider them as meaningful tools?
And what about issues concerning the scalar relations present in the model (transcalarity issue) and their applicability in the inevitable passage of scale: how does the model not loose applicability when relations analysed at a microscopic scale are adapted to a territorial one?

The conceptual search for a concrete way to embed algorithms ('forms of algorithmically solvable questions'[18]) in a coherent form of material organization is possibly the basic solution to all the above mentioned questions.
Algorithms, in a 'machinic' framework such as the one defined by Deleuze, are *abstract machines* and as such they exceed the purely technical realm to be instead abstract generative devices that can be detected and observed in any organic and inorganic reality.
They are strictly linked to their 'milieu', their environment, but they can operate across multiple realms and scales.
In this light scalarity functions not merely related to a question of dimensions and proportions but rather as a sort of magnifier lens capable to increase or decrease the number of variables and phenomena

[17]Pasquero C., quote extrapolated from an interview held in London between Claudia Pasquero and the author in May 2015
[18]Pasquero C., quote extrapolated from an interview held in London between Claudia Pasquero and the author in May 2015

analysed and described in terms of their relationship among each other and with the environment according to the level examined.
The potential of the algorithm and its machinic declinations, be it mathematical ones, botanical ones, biological ones or urban ones, belongs therefore to its very nature as a transdisciplinary tool for its internal and ontological capacity to break through disciplinary boundaries creating new powerful *metaphysical infrastructures* for an empowered and augmented praxis. (For more on the concept of Transdisciplinarity and metaphysical infrastructures, see Chapter 1.4.1.)

2.3.2. Stigmergic models for Microclimatic Studies

Project Credits:
- *Course:* MArch in Urban Design, UDII, BPro, The Bartlett, UCL, 2013-14
- *Project Title*: Urban MMS - Urban Multitude Microclimatic Singularities
- *Students and Image Credits*: Huang Xiaoran, Xue tengfei, Liu Jinying, Cui Chris
- *Tutors:* Claudia Pasquero, Marco Poletto (RC 16)
- *Computation:* Immanuel Koh and Iker Mugarra
- *Lab Leader*: Claudia Pasquero

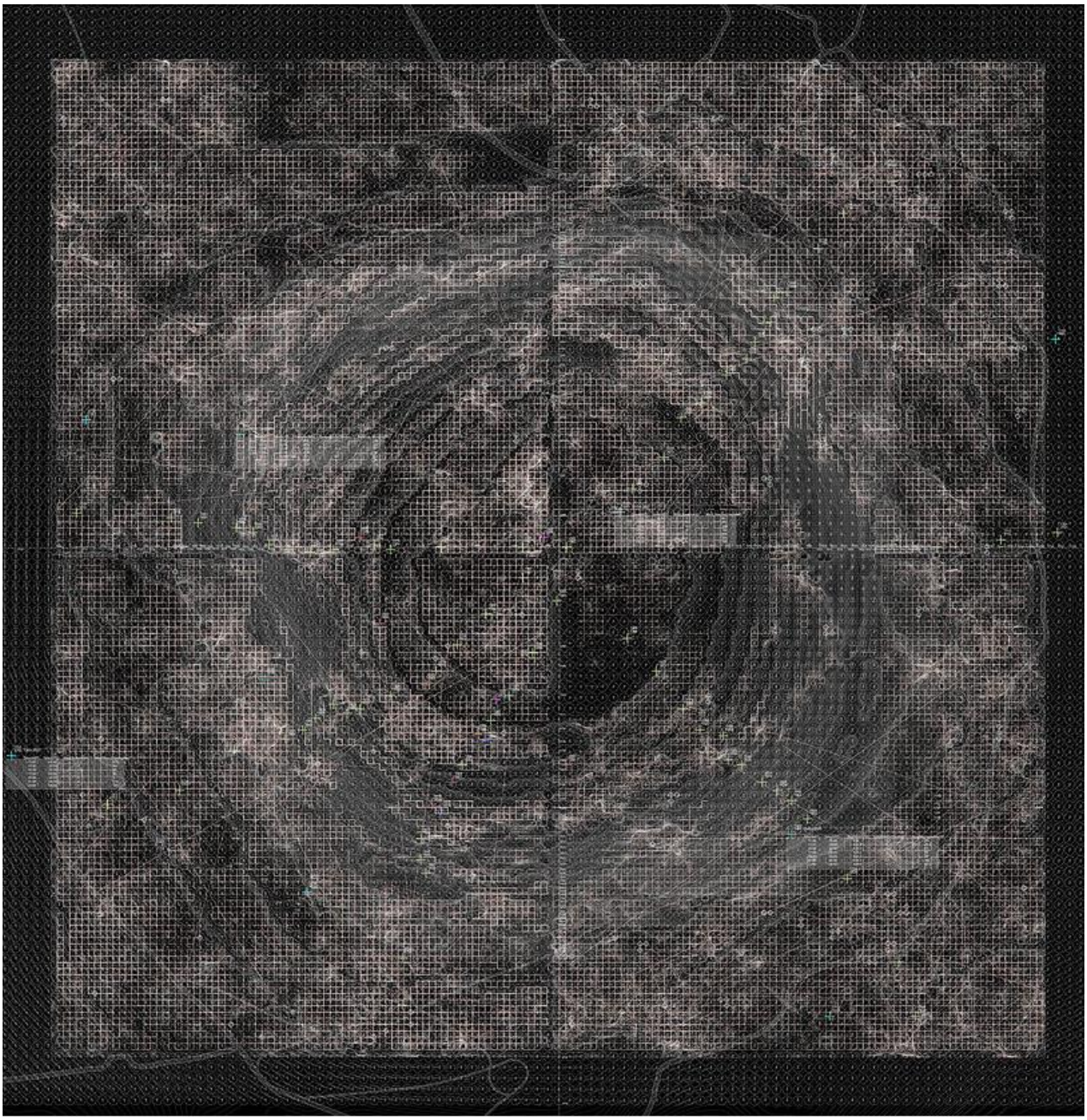

Fig 2.29: Master plan of the new morphology of the Meteor Crater, Arizona, generated by the application of the Niger ant nest building algorithm after 10000 iterations.

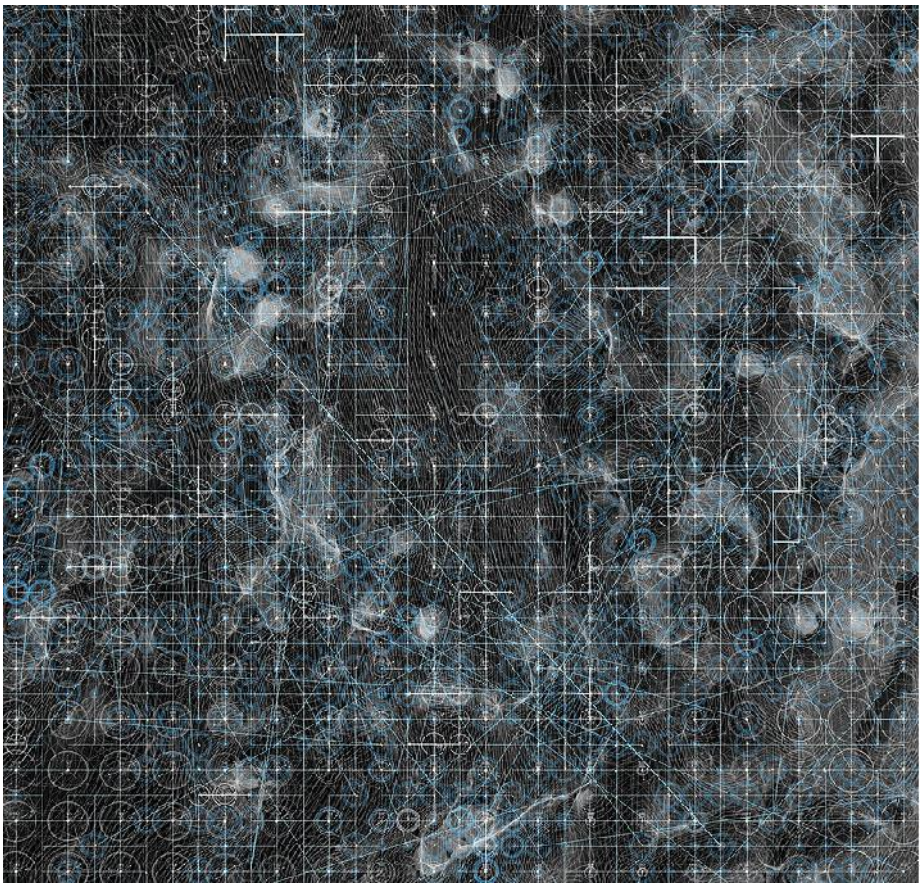

Fig 2.30: Master plan of the new morphology of the Meteor Crater (CLOSE UP)

In the state of Arizona the existing urban strategy of the sprawling, devised as a response to the population growth of the existing cities, is proved to increase consumption of energy and its relentless horizontal expansion is also affecting the vital density and dynamism of the urban realm. This project, situated again as the previous one, in the Arizona desert, but this time in the northern part of it, in an area known as the Meteor Crater, is aiming to suggest a possible alternative to the urban sprawl, proposing a radical, denser, new urban form capable to shift a hostile environment to a habitable urban domain.

In order to do that the project team has chosen to proceed analyzing the problematic of what it means to collectively inhabit a hostile environment, building on the territory's immanent problematic aspects and exploit the climatic and material affordances suggested by all the agencies populating the territory. The answer is a design methodology that relies on the notion of urban morphogenesis as a microclimatic dependent process based on real time self organization of living modules. A behaviour, a stigmergic process abstracted by Niger ants nest building, is simulated through coding allowing to perceive aspects of the complexity of the urban realm through a non human framework that consequently suggests what could be called an urban N.E.S.T.

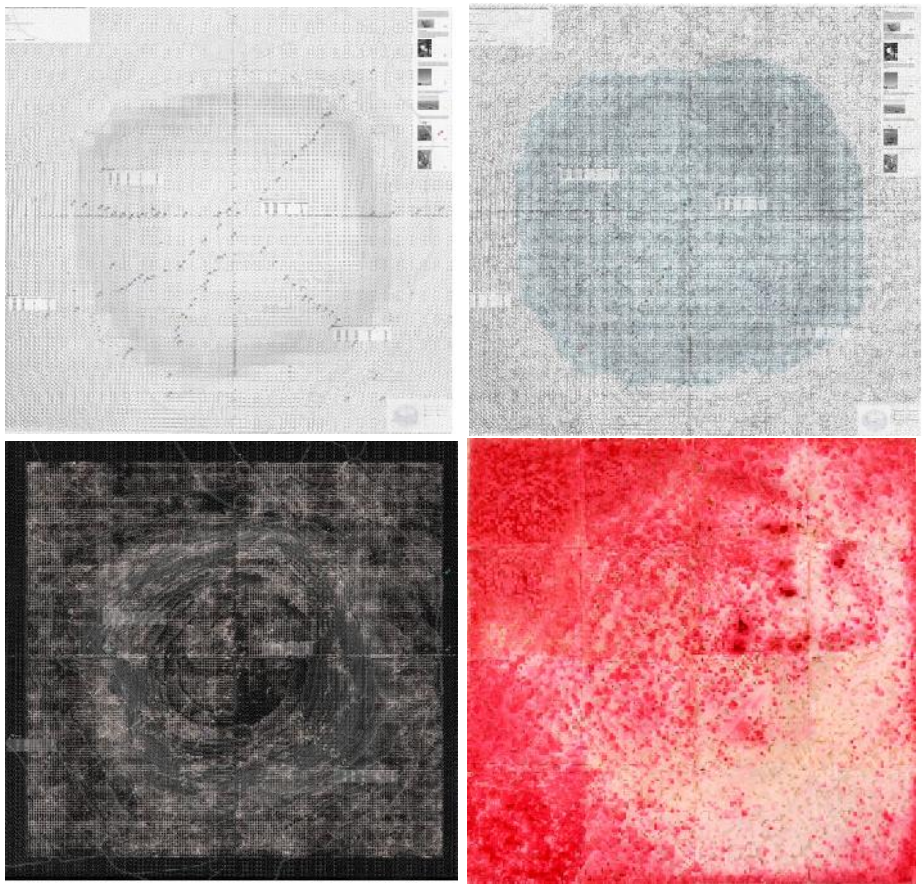

Fig 2.31: The Meteor Crater mapping and indexing.

The choice for this particular stigmergic process was due not so much for the sheer complexity of a nigger ants nest that could somehow emulate the same complexity of a city, but mainly because the self organized, not centrally controlled, behaviour of these insects would co-evolve to ensure the construction of a very efficient structure, the nest, in terms of temperature control and gas exchanges with the outside environment.

The secret of this success lays in a very special mechanism typical of many insects colonies: an interaction between a chemical element (the pheromone), left in different densities, leading to different patterns, and the building behaviour of the ants.

During the building process, the nigger ants use pheromone as a communication mechanism as well as a parameter to control the colony's density. In general, they tend to move pellets to areas where pheromone densities are higher. This density is mainly affected by the temperature because of evaporation effect. Therefore, void patterns are built in lower pheromone territory, which proves a better heat exchange to decrease the temperature as well as the pheromone evaporation rate and, vice versa, which leads a feedback loop and forms a dynamic equilibrium.

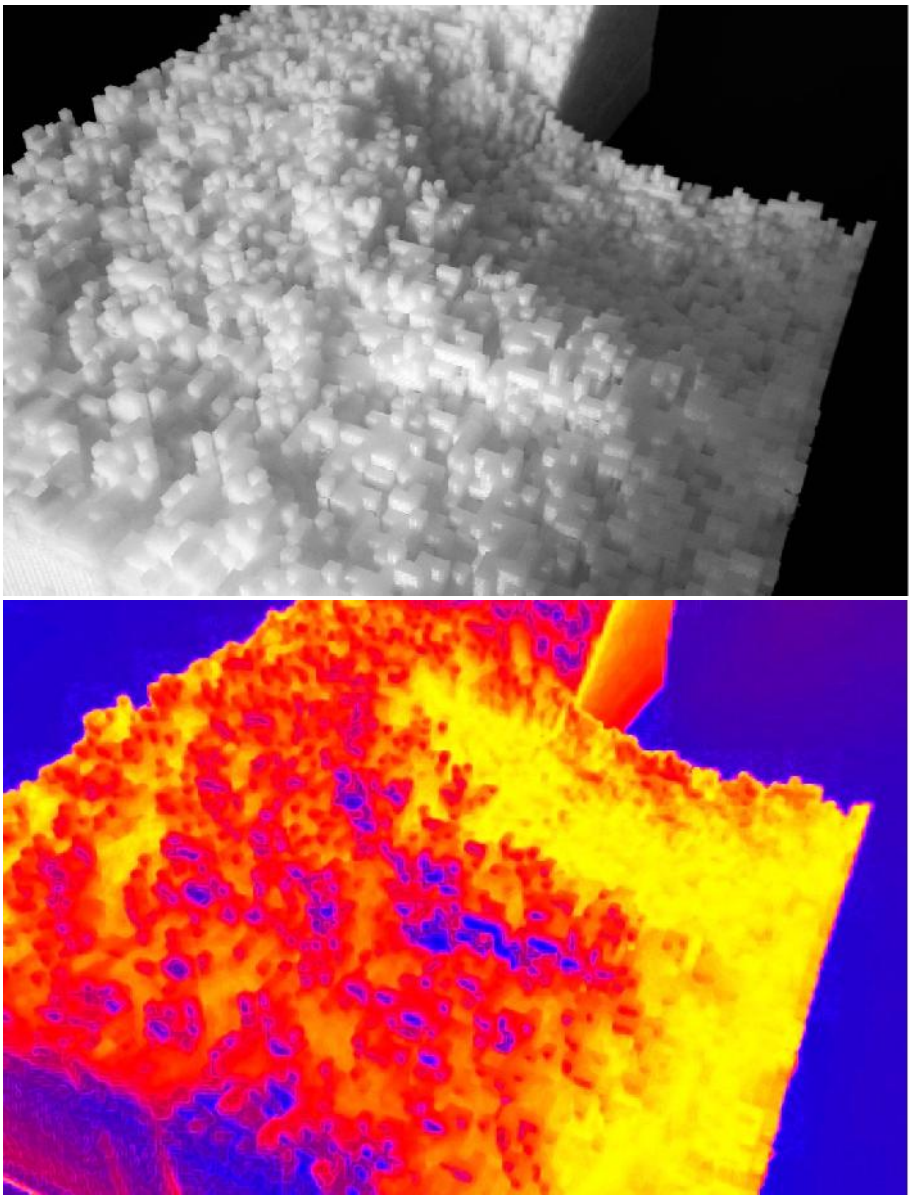

Fig 2.32-2.33: The Site micro-climatic studies on the 3D printed model of the simulated morphology of the Meteor Crater basin

The pheromone de facto contains a set of information (outside temperature and moisture, wind flows, etc..) gathered from the environment and resembles the human notion of ‘artefacts’ and, as we have previously seen in Chapter 1.4.1., *artefacts are environmental modifiers.*

As such they acquire a key role in redefining the notion itself of environment: not anymore considered a passive landscape containing interactions, but preferably a negotiator of emerging interplays and comunications between local and global coordinated behaviours.

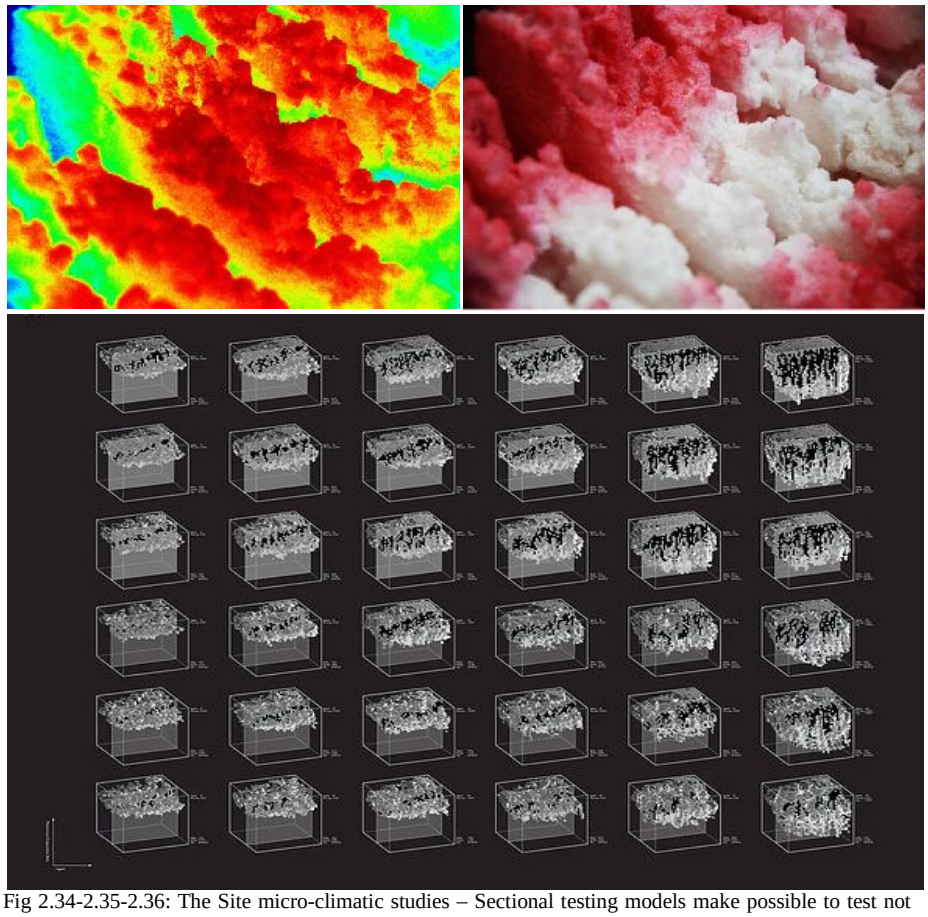

Fig 2.34-2.35-2.36: The Site micro-climatic studies – Sectional testing models make possible to test not only the superficial but also internal morphological variations.

The work of the U.M.M.S. group has tried to understand the emergence idea of prototyping bio-mimetic models as analogical approaches.

The resulting master plan, generated by the application of the 'Niger ants nesting' algorithm for 10.000 iterations can be divided into two layers. The bottom one indexes the local climate conditions (solar radiation, wind direction and speed), affecting the evaporation rate of the digital pheromone signal. The Top one shows the new terrain as a set of contour lines and agents. This new terrain is then tested with simulated scenarios of material differentiation and emergence of biotones and ecological niches. The morphology is assessed and areas of lower solar exposure are identified for planting while other zones are pierced to allow light access with inhabited volumes. A soft robotic system has been designed to feed the morphology with a bacterial solution able to consolidate the soil into biorock formations and provide substratum for plant, animal and human colonisation.

A collective intelligence emerges from an assemblage of human and nonhuman agencies where local materials, technological oriented systems, abstracted behaviours of collectively defined organisms are

capable to establish a multitude of interactions and potential new social protocols between the organic and inorganic.

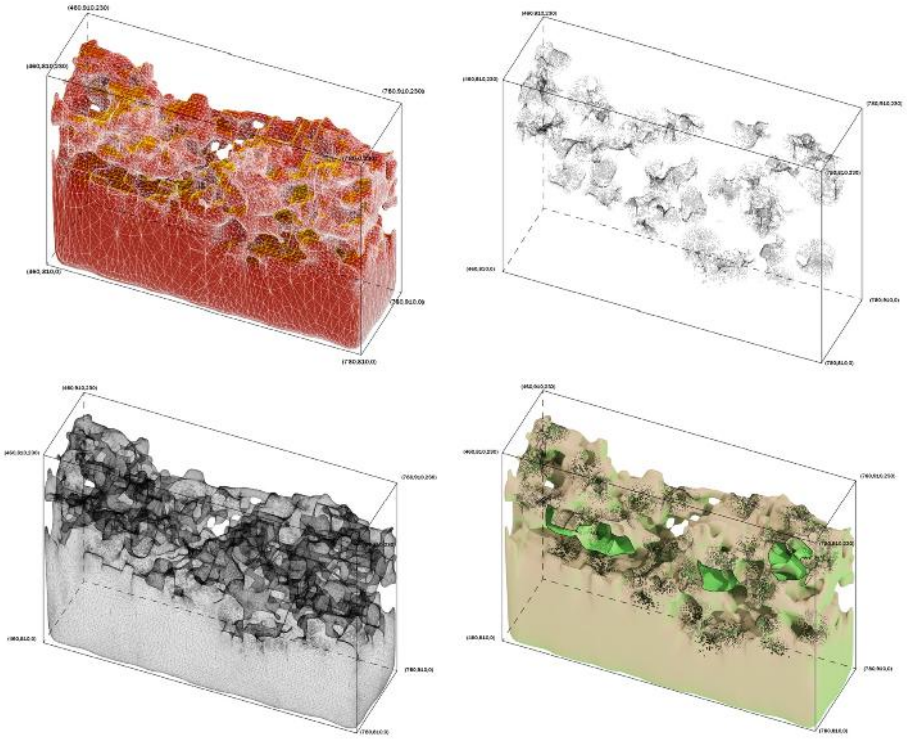

Fig 2.37: Simulated scenarios of material differentiation and emergence of biotones and ecological niches (DETAIL)

Fig 2.38: Simulated scenarios of material differentiation and emergence of biotones and ecological niches

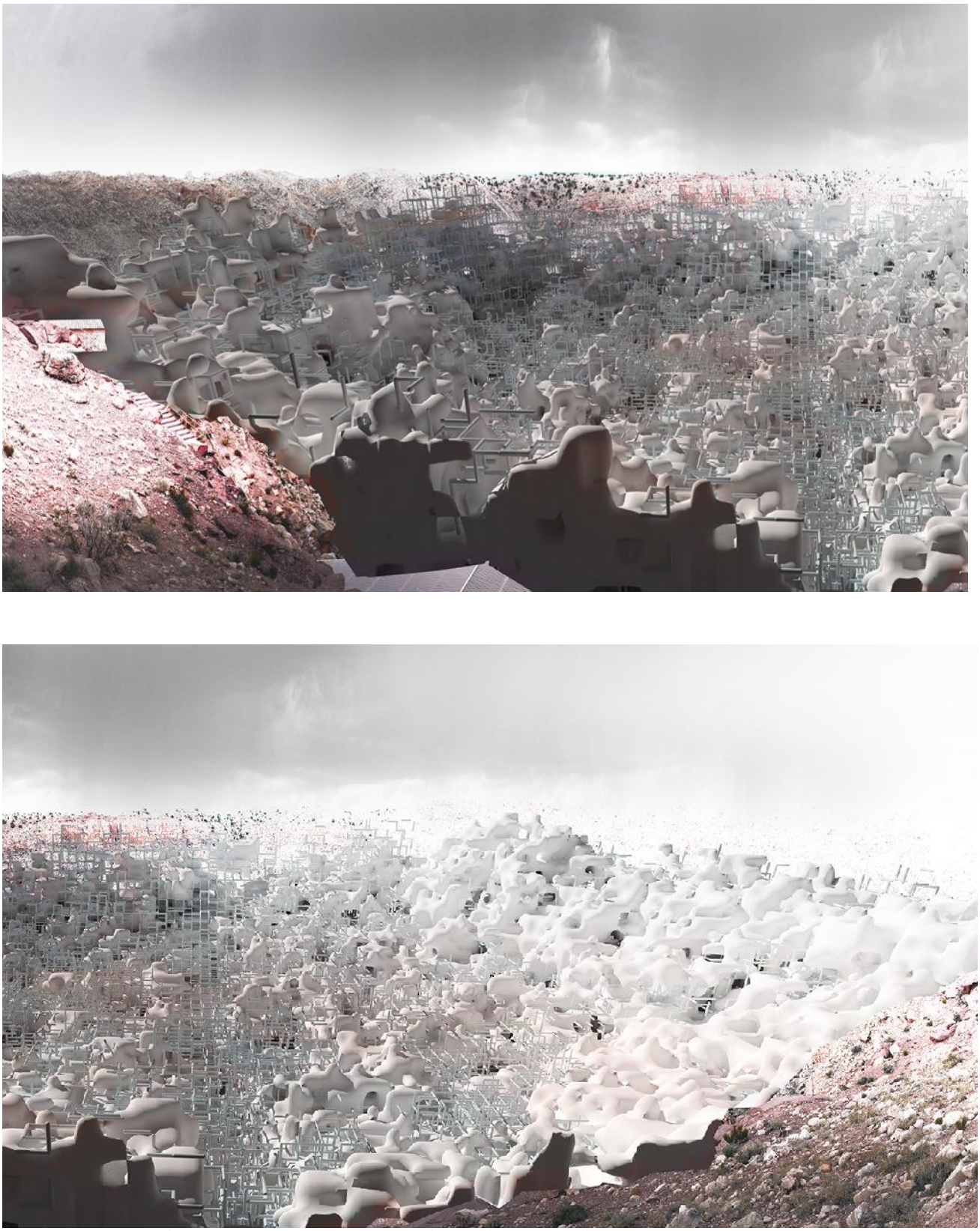

Fig 2.39-2.40: Scenario of the new ground morphology resulting from relocated pellets of soil within the meteor crater basin. The overall quantity of material is kept constant, but the microclimatic singularity of the crater is intensified and differentiated by the algorithm to produce pockets with specific local urban climates

2.3.3. Stigmergic models for Re-protocolising Bio-Mass

Project Credits:
- *Course:* MArch in Urban Design, UDII, BPro, The Bartlett, UCL, 2013-14
- *Project Title*: Post-Waste Cities – Reprotocolising Bio-Mass
- *Students and Image Credits*: Gina Fellendorf-Perkins, Jia Ning, Ren Guoqian, Tang Hongya
- *Tutors:* Claudia Pasquero, Marco Poletto (RC 16)
- *Computation:* Immanuel Koh and Iker Mugarra
- *Lab Leader*: Claudia Pasquero

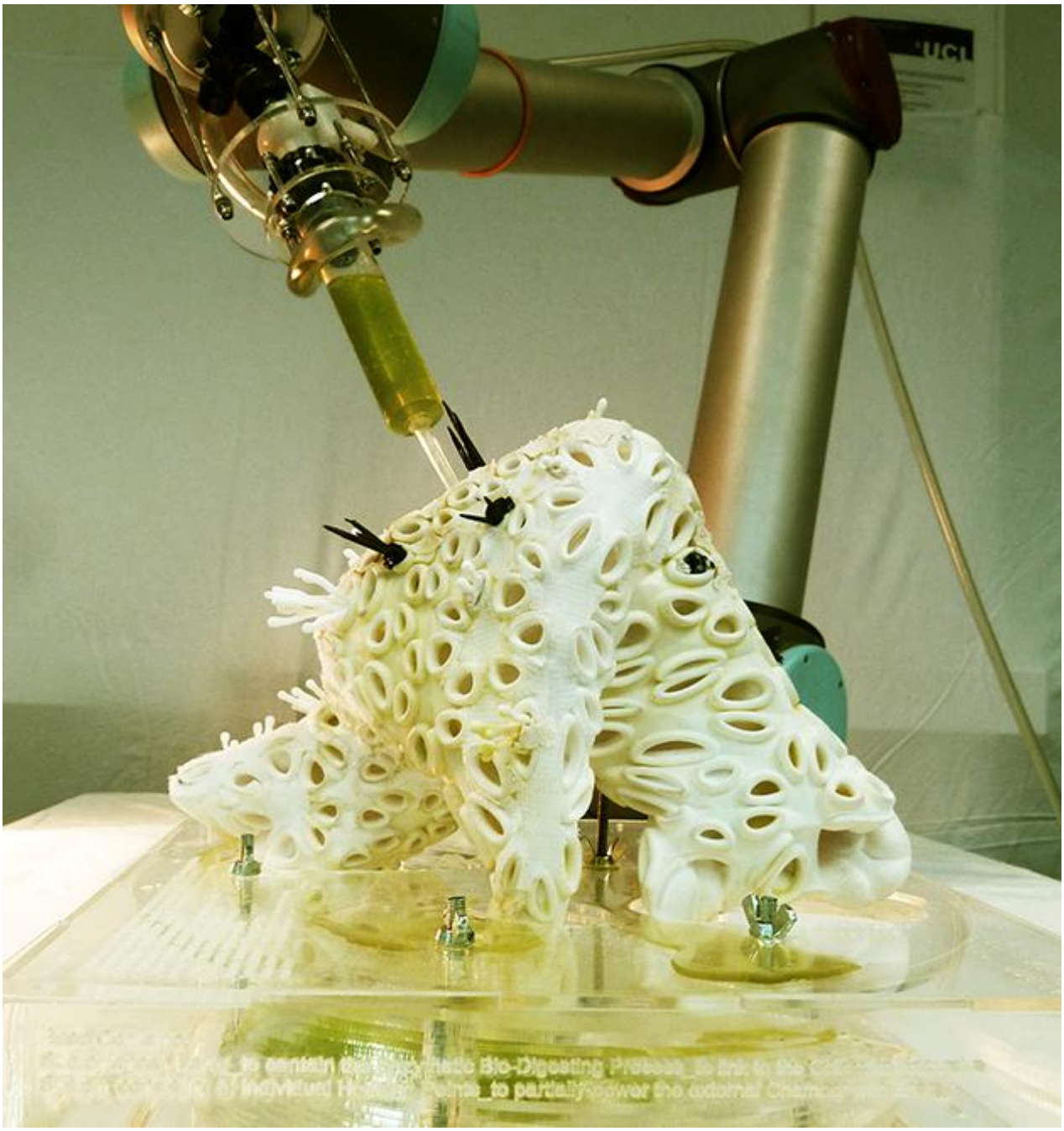

Fig 2.41: The Wet model and robotic apparatus, 3D printed substratum, saw, dust, agar, mycelium, bacteria

The project is located in a specific geographic area to the north of Tucson, Arizona, between the rural suburbs of Catalina and its neighbouring Saddle Brooke.
The project has been defined as an attempt of extreme Re-cycle/Re-Use method that exploits waste and a biological growth process, based on the fungi gardens in the Attini ants' nests, to manufacture large-scale bio-digesting building envelops. A bio-technological system which suggests possible urban morphologies operating by using real time data stream reused waste.

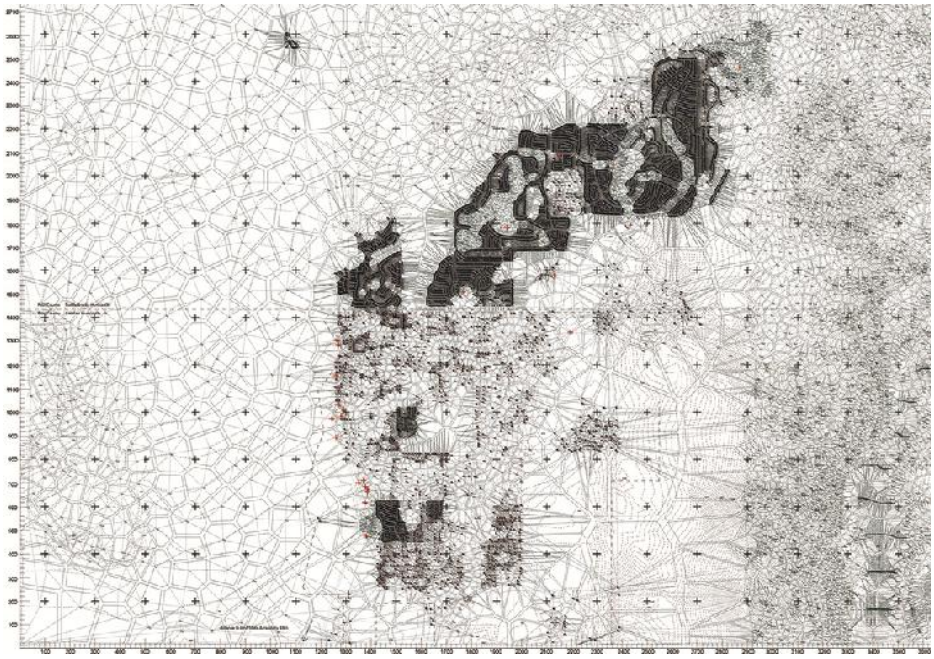

Fig 2.42: Survey drawing indexing production of urban biodegradable waste in the city of Catalina.

Fig 2.43: Biodegesting Chambers: the relationship between urban code and the morphology of Biodegesting chambers based on the fungi gardens in the Attini ants' nests

Starting from the systematic investigation on recent advances in bio-engineering the team had discovered that the potential pollutants in waste could not only be reduced to harmless components, but also be re-used, as was the case in the project *Biosphere 2* (a scientific centre located in Oracle, Arizona, which was born as a self-sustaining space – colonization technology centre and has now become a laboratory for large scale projects aimed at quantifying some of the consequences of global climate change).

Based on biochemical processes that have been observed in the biological models of the fungi gardens of the Attini ants, the team has proposed a system by which newly engineered enzymes could be layered within digesters which would allow diverse organic waste streams to be treated.
These waste streams are produced within urban and suburban areas and follow an iterative protocol revealed by the robotic mechanism, which demonstrates how the biomass/waste can be plugged into an existing scheme and generate new divergent dynamic systems and new urban scenarios. The volumes of waste produced in these areas, which are expressed in bio waste values, would allow for community energy demand to be supplemented by small generation projects.
The enzymes digesters have been named *Biodigesting Chambers.* Their morphology and dimension, based on the previously mentioned fungi gardens, is a function of the climate, number of households, their density and positions as well as the estimated bio-digesting capacity of enzymes.
Their 3dimensional representation together with their performance as a specific urban protocol is materialised and examined through the use of a wet model and a robotic apparatus which enable testing of bio-digesting capacities in relation to a specific urban protocol.
From the biological wet model some growth parameters are extrapolated by a code of ‘waste to nutrient’ digital simulation. This same code simulates scenarios of waste becoming the base nutrient for growing bio-digital building envelopes.

Although the project appears to be still quite crude as an urban environment and for the moment conveys the impression of lacking a convincing human scale, in its performance and aim it seems to achieve the Up-Cycle concept wished for by the ‘cradle to cradle

Fig 2.44: Bio-digestion protocol

design', a biomimetic approach proposed by McDonough and Braungart[19]. In their vision first proposed in 2002 with their book '*Cradle to Cradle. Remaking the way we make things'* and later in 2012 with their second '*The Upcycle. Beyond Sustainability - Designing for Abundance'*, the architect and chemist have called for a radical switch in the way we look at the Re-cycle practice, claiming that any 'reduce reuse recycle' method perpetuate a 'cradle to grave' strategy, that is merely a downcycle (converting waste materials or useless products into new materials or products of lesser quality and reduced functionality), while we should rather aim for an Upcycle: transforming by-products and waste materials into new materials or products of better quality or for better environmental value, essentially waste free.
Their vision is based on a system of 'lifecycle development' where, at the end of their useful life, any product becomes either *biological nutrient* (can re-enter the environment) or *technical nutrient* (needs to remain in a closed-loop industrial cycle).

What is interesting in their vision-manifesto is that they see the sustainable design practice not just as a way to protect the environment from human impact but actually to improve it. They share a deep confidence about the capabilities of design as a creative practice and they reimagine everyday life objects not just to sustain life on the planet but to grow it. In other words they embrace the concept of *Bold Ecology* we have tackled in Chapter 1.1.3.
In doing so they are actually challenging the idea that human industry must inevitably damage Nature, which is something quite provocative but worthy of consideration.

In re-using the potential pollutants found in waste, the '*Re-protocolizing bio-mass*' team is actually performing an Upcycle action and in doing so using the biological model of the Attini fungi, a biomimetic approach, is operating a 'cradle to cradle', regenerative design.

[19] Mc Donough W. and Braungart M., *'Cradle to Cradle. Remaking the way we make things'*, North Point Press, 2002

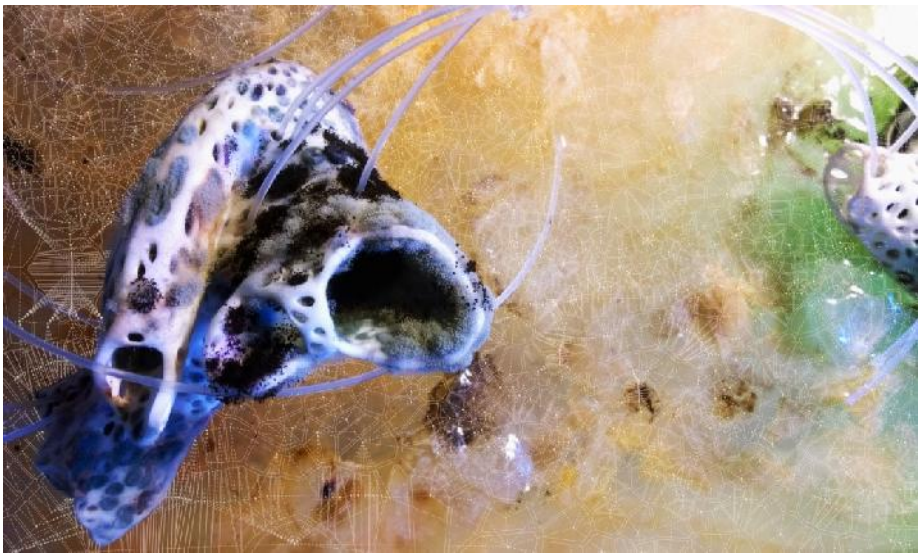

Fig 2.45: The Wet model

Fig 2.46: the Wet model: mapping the biological growth process and colour coding time-based growth patterns

Fig 2.47: Digital 3D scanned model of growth

Fig 2.48: Simulated scenarios of large-scale Biodegesting building envelope in its mature stage of development

2.4 Borrowing from GEOLOGY

Physical modelling of territorial elements built up by teams of geologists and engineers as scaled down versions of the real were commonly used from the 1940's to evaluate the behaviour of civil structures and river dynamics. They have been influential in the generation of management policies at almost a continental level, de facto applicable to entire scale of basins[20].

The work with the above mentioned scaled down physical models, known as *proxy models*, tends to be either the predicting behaviour of the fluid itself or a study of the movement of the medium where the flow takes place.

Although the quantitative results of this model type could be compromised by both the accessibility to the right type of materials and the possibility to achieve a proper dynamic similitude, this category of models was still of a certain relevance[21]. They transmitted in fact valuable information about dependencies in dynamic environments.

Later on *Proxi models* have been developed as part of projects dealing with the material and temporal aspects of the territory and can be traced back to the experiments of networks and self-organizing systems carried out in the 60's and 70's by Frei Otto.

His works on the territory consisted of the study of the properties of connective systems and distribution networks and their comparison with existing territorial patterns.

However, what is really interesting today in the use of these types of models is not really the proxy model itself but rather the design of the *interface* linked to its generation and control.

The development of the interface rests upon the generation of a design space where the user can remotely take decisions on how to interact in the physical generation of the proxy model and simultaneously understand variables related to the effects that these changes produce in the ecologies within a landscape.

The ultimate goal of design interfaces is to bring design conversations to new levels through their capacity to allow interaction with variables and the description on time-dependent processes. The users of these tools can engage directly without being a professional in the field with the human and natural processes that build up the territory over time.

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[20] Rico E. and Llabres E., *Proxi modeling: A tacit approach to territorial praxis*, Journal of Space Syntax, issue 1, volume 5, August 2014

[21] Rico E. and Llabres E., *Op. Cit.*

2.4.1. Proxy Models for landscape organization

Project Credits:
- *Course:* MArch in Urban Design, UDII, BPro, The Bartlett, UCL
- *Project Title*: Delta physical simulation and urban proliferation: dealing with tailing ponds of oil mining industry. Alberta, Canada
- *Students and Image Credits*: Waishan Qiu, Jia Zhang, Guanghui Luo and Sara Chen
- *Tutors:* Eduardo Rico, Enriqueta Llabres and Zach Flucker: Relational Urbanism RC18
- *Computation:* Immanuel Koh and Iker Mugarra
- *Lab Leader*: Claudia Pasquero

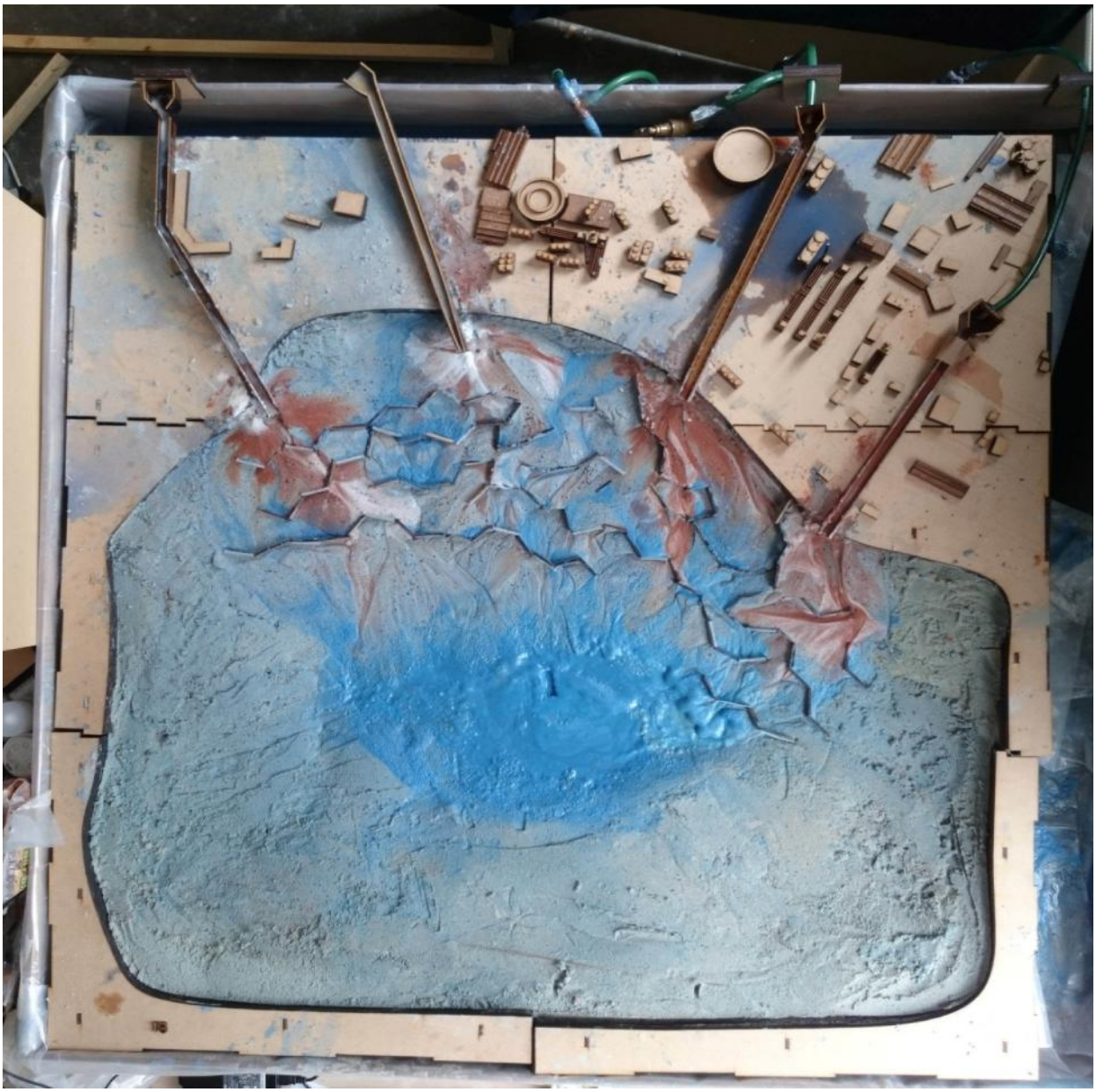

Fig 2.49: *Proxy Model*

This project studies how the by-products of mining industry could form the blueprint for new land uses once the extraction and decontamination processes are over. It uses the case study of oil extraction from tar sands in Canada, working with the generation of tailing ponds in the proximity of Fort Mcmurray, Alberta.

Fig 2.50: *The Site Area*

These tailing ponds are formed by the deposition of slurry formed by water, oil and sand deposited into the ponds and present structures similar to those of river entering lakes, which are generally known as a Gilbert Deltas. The project develops a series of strategies that try to turn the typical formations of shallow sand wedges that would take place in the tailings into a series of artificial topographies which can later be used in the expansion of the city.

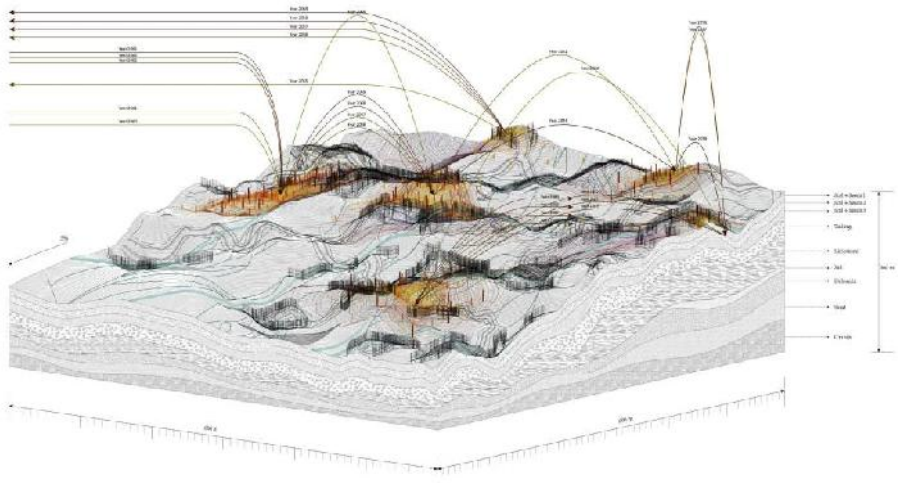

Fig 2.51: *The Site Area*

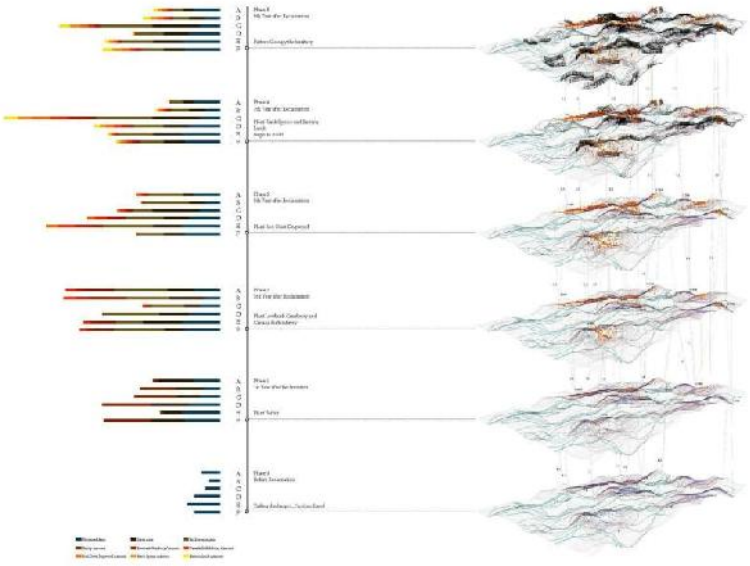

Fig 2.52: *The Site Area*

The different working strategies are generated with the help of physical scale models of deltas approximating the behaviour of their large scale natural counterparts an act as a proxy of the real territory of intervention. The use of small scale physical models developed in laboratory has, as said previously, a long history in engineering disciplines using general dimensional theory in order to predict complex behaviours of natural phenomena. In the case of sediment dynamics, physical models offer a good qualitative basis for understanding of morphological dynamics.

While the detailed result of the models is compromised by the difficulty in finding materials with scaled properties, they offer nonetheless a precious mean to generate forms of thinking about design that are connected to the passage of time and detailed morphological dynamics of the landscape.
'The objective of the proxy models is the generation of physical formations which are neither the real delta nor the outcome of a predetermined test. The idea would be for the designer to follow a design protocol, generating a path dependent series of interventions which deviates the outcome from its natural state without being fully predetermined as by a fully artificial diagram[22].'

[22] Rico E. and Llabres E., *Op. Cit.*

The results therefore cannot be fully foreseen or preconceived, as the complexity theory teaches us, but 'they have to be 'arrived at' through a process of human intervention and natural sedimentation[23]'.

Moreover, the use of proxy models, due to their inherent dynamic character, can generate design approaches which cannot be thought about by the observation of fixed finalised forms but require the permanent engagement with the flux of events in the simulation. In Chapter 1.2.4 we have denominated this form of thinking a "tacit" approach to design, since this form of thinking rests on the idea that responses to permanent change requires forms of action and knowledge that cannot be initially codified, but rely more in what Michael Polany calls "tacit" knowledge.

In this project, the students managed to generate a tacit form of design response to the material dynamics of tailing ponds, turning them into an artificial archipelago of raised areas and artificial ecologies.

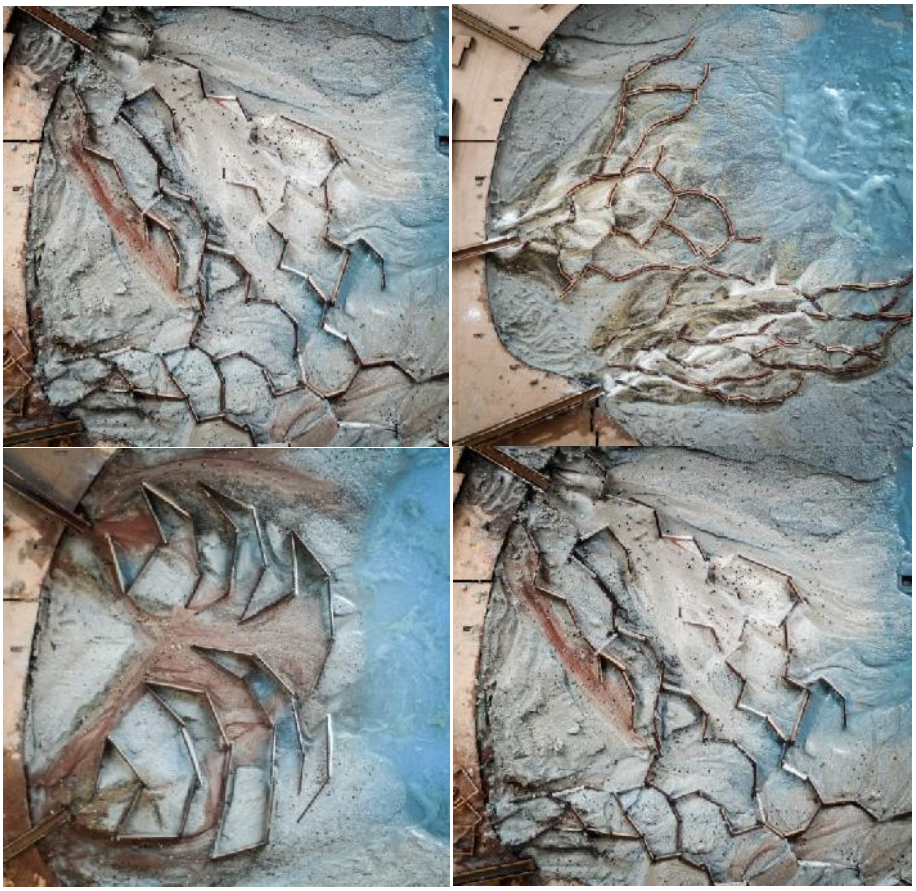

Fig 2.53: *Proxy model at work*

[23] Rico E. and Llabres E., *Op. Cit.*

The work helped to think about the generation of networks, topographies and urban structures derived from the industrial processes that nowadays transform radically the landscape of Alberta. The students also helped to push the idea of proxy modelling by developing a series of techniques that turn the physical results of the model into digital tools of design, which helped to enrich the project through the addition of a wide range of ecological concerns (ideas of ecological succession, restoration etc)

The proxy model became then just one part of a much more articulated and integrated design and organizational protocol.
Physical model, data, computer based algorithms, infographics and interactive platforms were all interrelated tools to manage the complexity of a territorial project, where for territory we mean 'lived experience and environmental performance[24]'.

Fig 2.54: *Proxy model at work*

This type of models ultimately represents the opportunity to overcome the traditional forms of static representation of ever changing territorial processes. They allow to fully embracing fluid and dynamic concepts often characterised by uncertainty, unpredictability and variability such as time, ecological and social processes.
And they do it, creating a real emotional and aesthetic engagement with the user who *tacitly* 'activates his/her self'.

[24] Rico E. and Llabres E., *Op. Cit.*

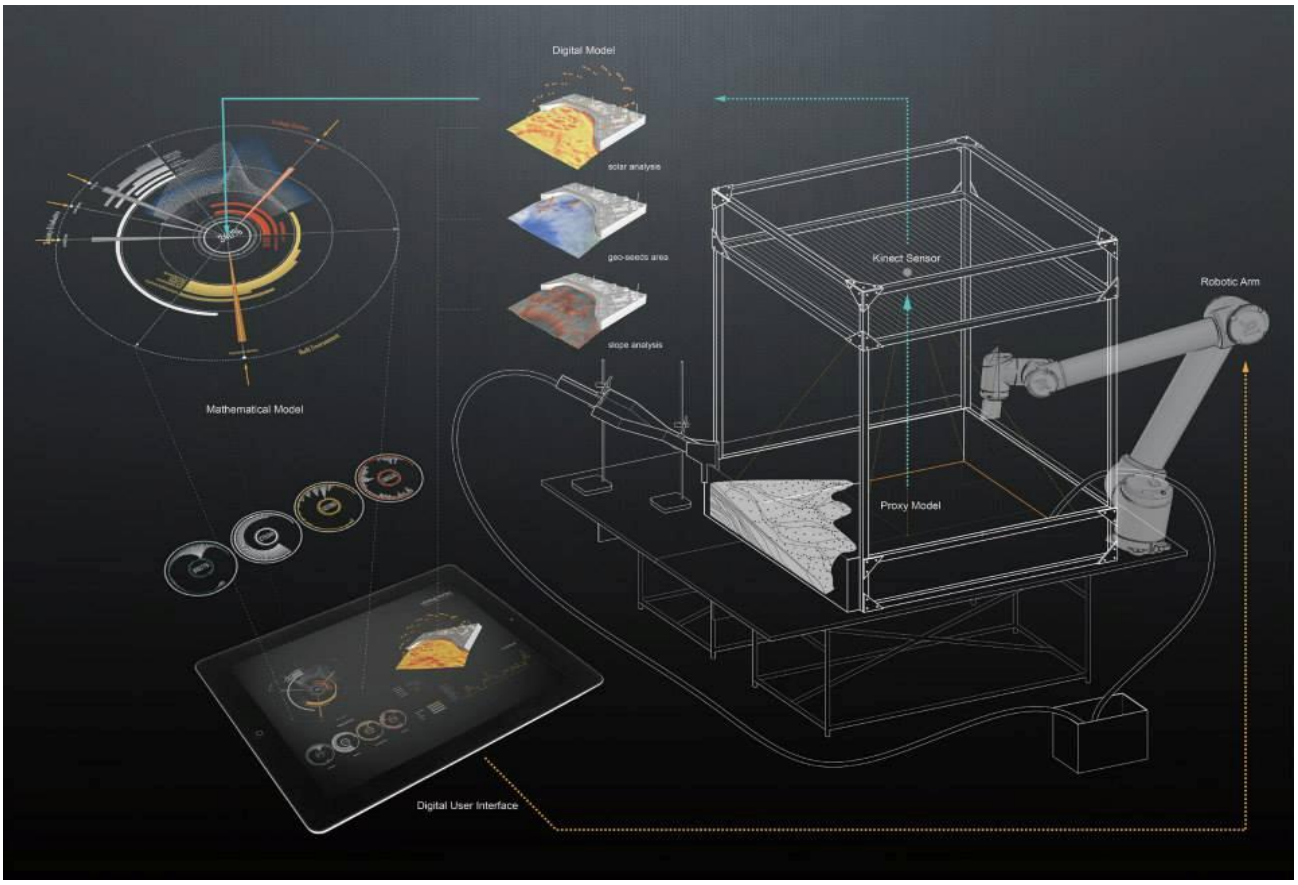

Fig 2.55: *Proxy model components and interface*

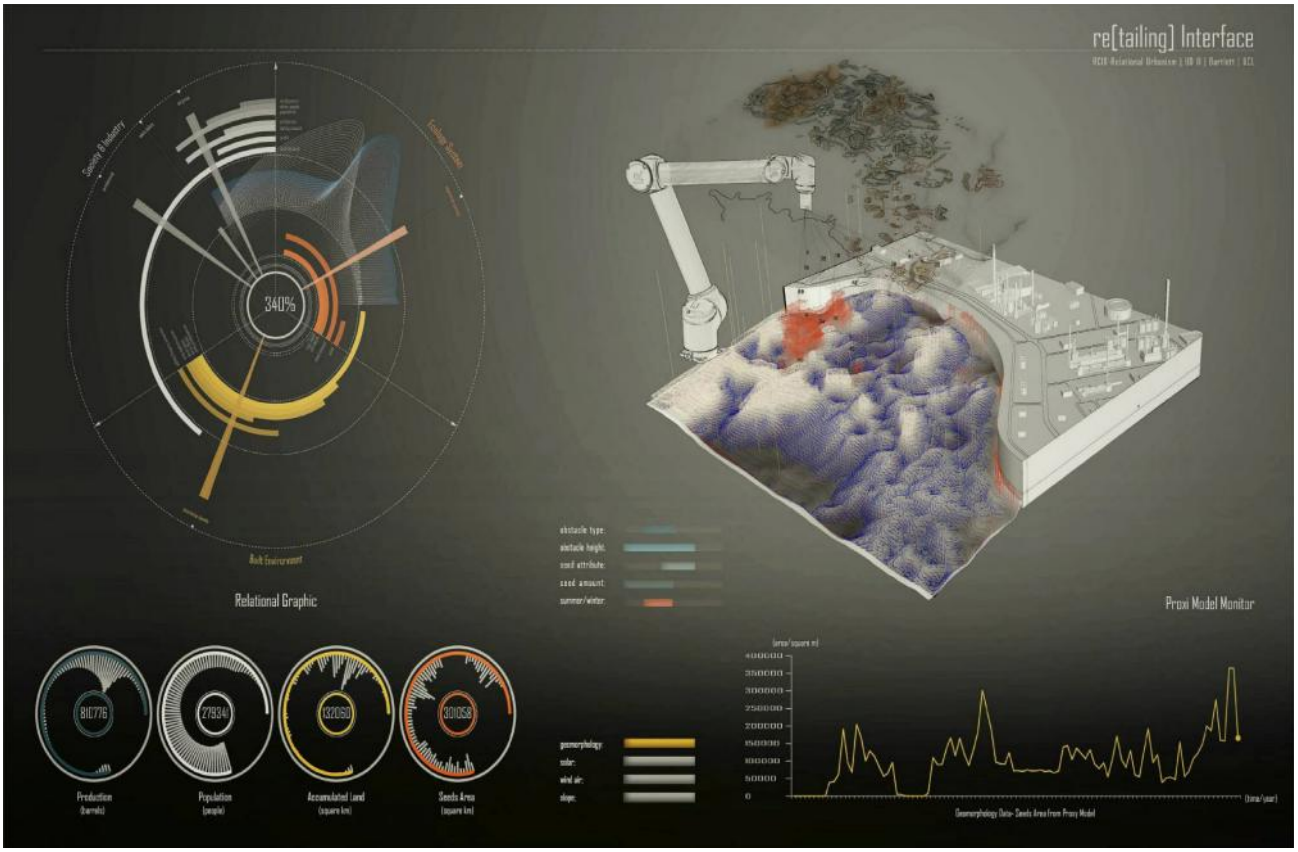

Fig 2.56: *Proxy model at work*

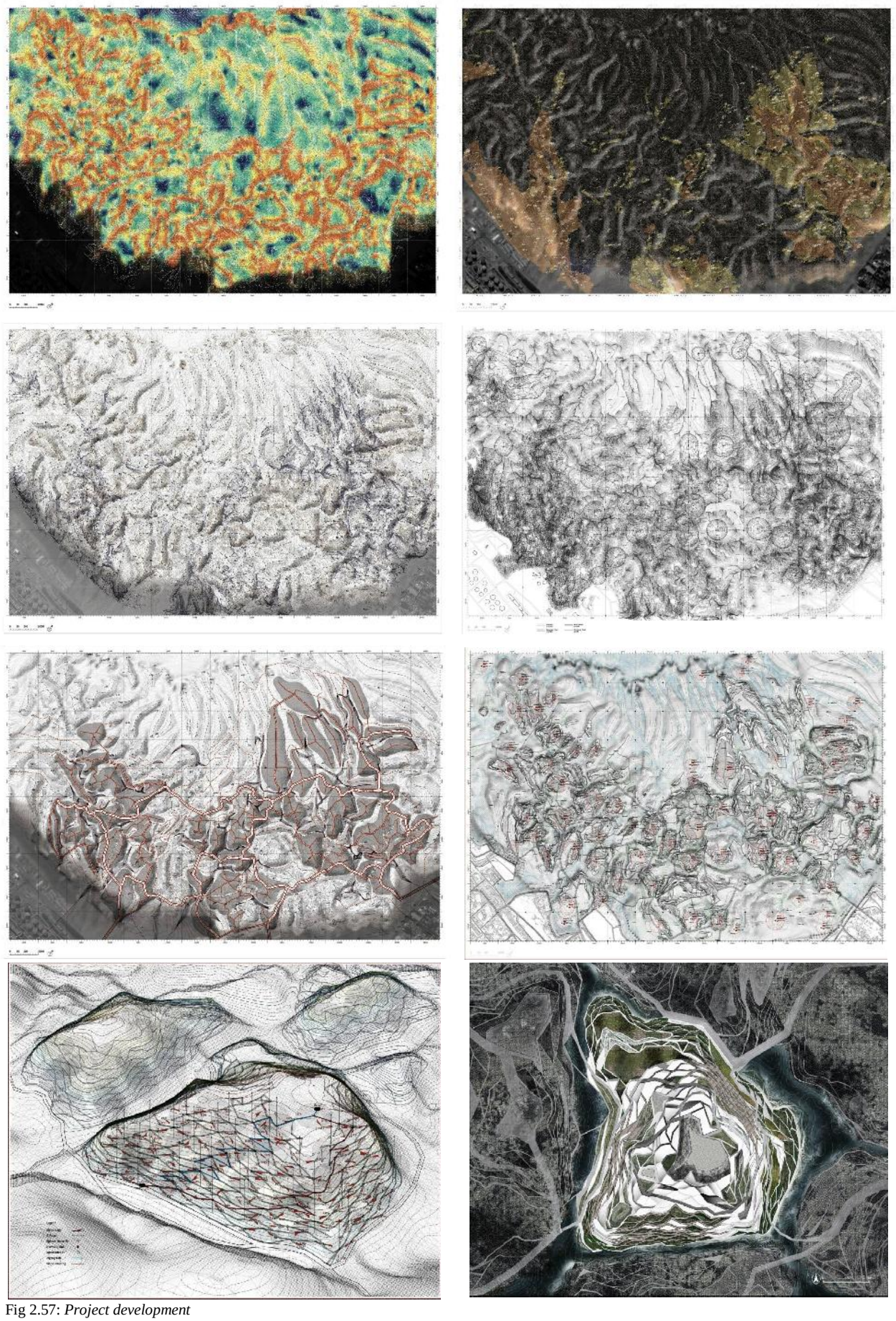

Fig 2.57: *Project development*

2.5 Borrowing from STATISTICS

Statistics is the study of the collection, analysis, interpretation, presentation, and organization of data.
Originally conceived as the 'science of the State', as it was the collection and analysis of facts about a country (its economy, land, military, population, and so forth), it was later on applied to the most diverse fields, not last the world of visual arts and music (just think of the *statistical* or *stochastic music* invented by Iannis Xenakis).

In the past years there have been many attempts to give mathematical characterizations of a city through statistical descriptions of the distribution of spatial or functional properties of cities, but in abstract statistical space rather than real space. This way of working though omits by definition how elements with these properties connect to each other in real space, and so omits any account of the structure of the system.[1]

However statistical and numerical characterizations of cities can be turned into structural characterizations. *Statistical properties* of cities, such as for instance segment length distribution, can be looked *probabilistically* to convert mathematical models into structural patters.
This is what *Space Syntax* models and algorithms do.
They are a formal way of looking at cities based on the study of the network of space – streets and roads – that holds the system together, rather than from an assemblage of 'discrete zones' as in usual practice.

The Space syntax modelling approach seems to propose a new *universal* definition of a city as 'a *network of linked centres at all scales set into a background network of residential space*[2]*'*.
The phases giving rise to this universal pattern are basically two, conceptually detachable but very much intertwined:

_A *spatial process* where 'simple spatial laws govern the emergence of characteristically urban patterns of space from the aggregation of buildings;
_A *functional process* where 'simple spatio-functional laws govern the way in which aggregates of buildings become living cities'.

According to Hillier, the iteration of the above processes could lead in the direction of finding a possible 'genetic code' for the cities.

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[1] Hillier B., The *Genetic Code for Cities: is it simpler than we think?, in Complexity Theories of Cities have come of age*. Springer : Complexity, Berlin, 2012 .
[2] Hillier B., *Op. Cit.*

2.5.1. Space Syntax models for Analysis of Spatial Patterns

Projects Credits:
- *Space Syntax:* Prof. Bill Hillier, Prof. Alan Penn, Prof. Laura Vaughan
- *Project Title* / *Project Director*: Ljubliana, Smartinska / Anna Rose;
- *Project Title* / *Project Director*: Jeddah, Unplanned Settlements / Kayvan Karimi;
- *Project Title* / *Project Director*: London SkyCycle / Anna Rose;
- *Project Title* / *Project Director*: Trafalgar Square / Tim Stonor;

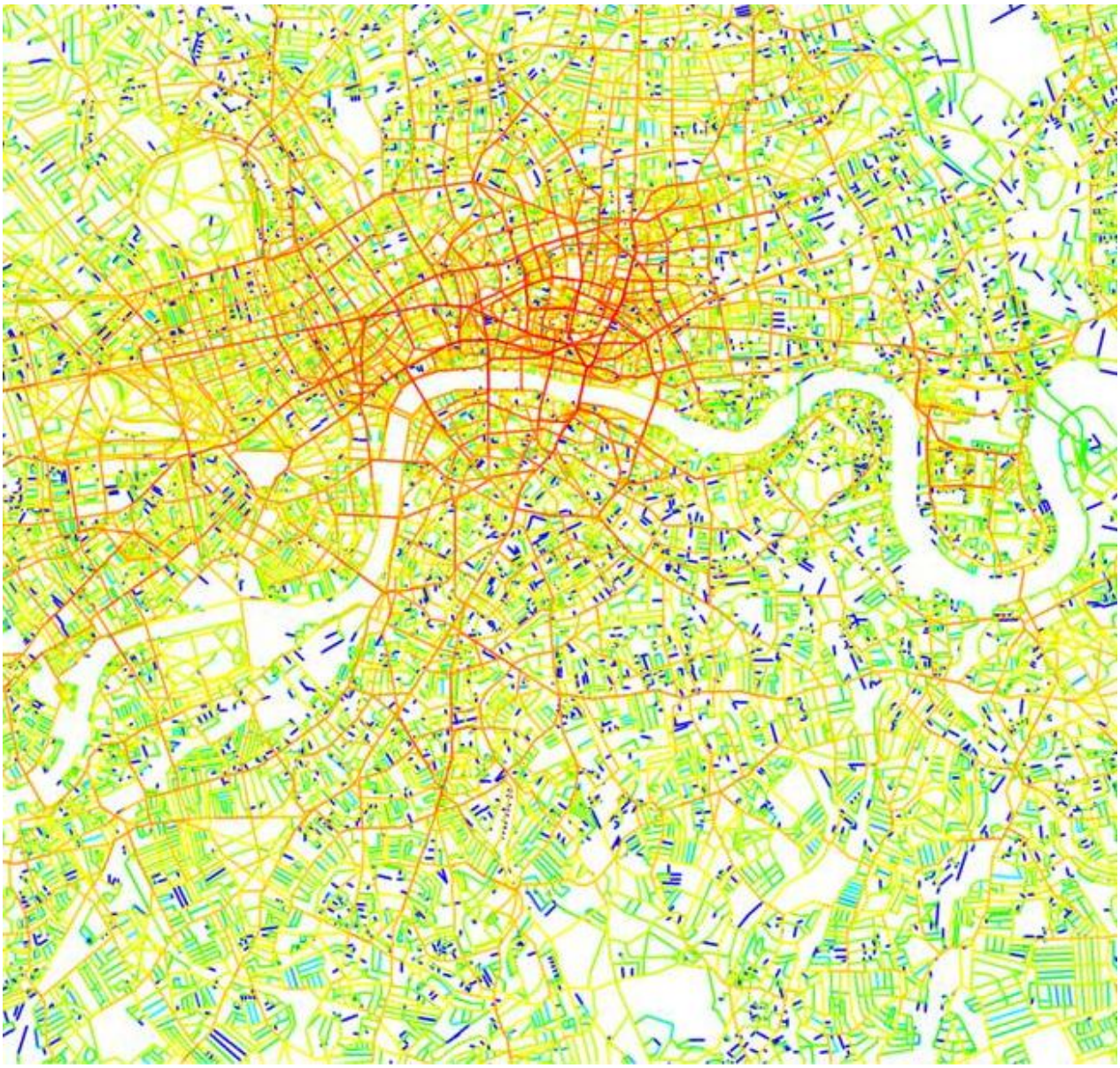

Fig 2.58: Space Syntax Least Line Map : Central London

Space Syntax, as it has been described by Bill Hillier, one of pioneer of this method, is a formal basis for the analysis of spatial networks in cities. This method has developed different types of tools to deal with the description of the network of space.
Probably the most famous one is the *Least Line Map (LLM)* of cities which dates back to 1994. It is the simplest consistent representation of urban grids and since 2002 can be created algorithmically by using the UCL Depth Map software.
The analysis of real cities done with the LLM has unveiled some remarkable consistencies common to both Top Down and Bottom Up cities.
First of all, at all scales, from the local area to the whole city, LLM are formed by a very little number of long lines and a very big number of short lines. 'Line length distributions are of course a statistical property of cities and in themselves they say nothing about structure. But looking at the patterns formed by lines […] probabilistically, we can say the longer the line, the more likely it is to end in a nearly straight connection to another line. […] the shorter the line, the more likely it is to end in a right angle or near right angle [3]'

Fig 2.59: *Analysis of spatial patterns highlights distribution of social centers. Ljubljana, Slovenia*

[3] Hillier B., *Op. Cit.*

In other words, the Space Syntax LLM of different cities has documented that despite the type of city network (organic vs. geometric) and throughout different scales, cities acquire a kind of *dual* structure: a dominant *foreground network*, characterised by linear continuity and a *background network* marked with less linear continuity.
The interesting thing about those patterns of spatial networks is that not only they represent the structure of cities but also what Hillier calls *movement potentials.*

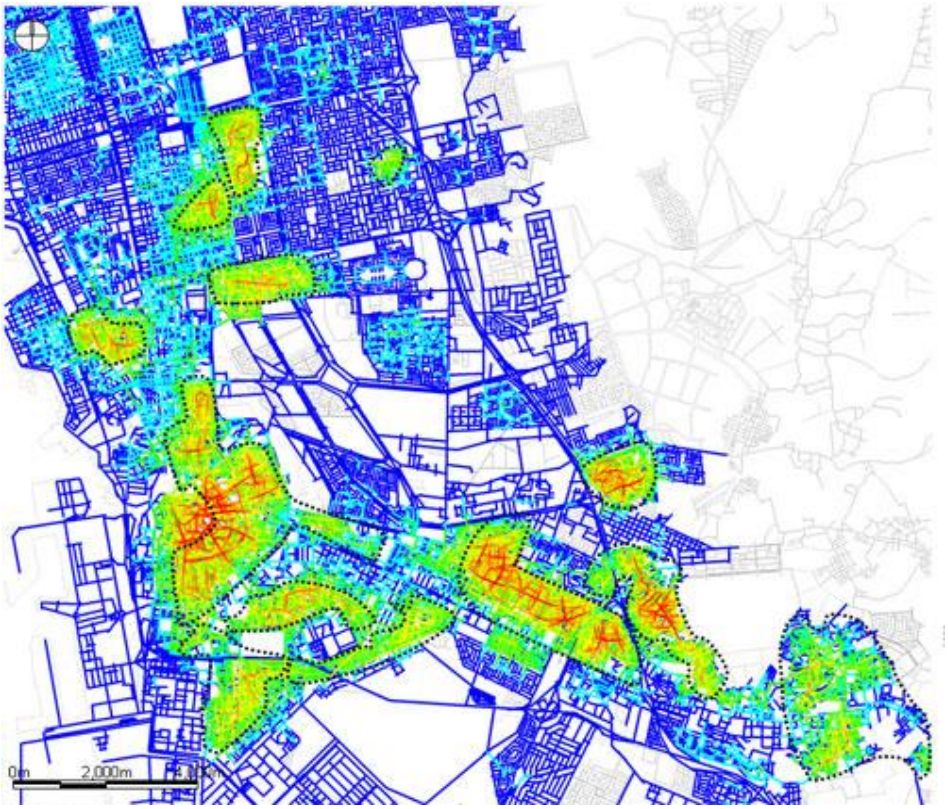

Fig 2.60: *Analysis of spatial patterns : spatial accessibility. Jeddah, Saudi Arabia*

The DepthMap software (DMs), using statistical mathematics, has developed an algorithm capable of telling us what type of movement is related to a specific network. The DMs uses three definitions of distance between each segment and its neighbourhood: *metric*, distance in meters; *topological*, change in values (1 – 0) when there is a change in direction; *geometric*, the degree of the angular change of direction.
'So using the *metric* definition of distance we find the system of *shortest path* maps for integration and choice, with the *topological* definition we find the system of *fewest turns* maps , and with the *geometrical* definition we find the system of *least angle change* maps.[4]'

[4] Hillier B., *Op. Cit.*

From the study and the analysis of the statistical output of the above mentioned measuring criteria, Space Syntax has given a new definition of *integration/destination* and *choice*/*route:*
Integration is the measuring tool of a *to-movement potential* of a segment as a *destination* (it describes its accessibility);
Choice instead is the measuring tool of the *through movement potential* of a segment, it measures its potential as a *route* (it describes how likely you are to pass through it).
Now, destination and routes are two main components of any trip therefore any tool capable of analyzing and predicting them is a 'strong set of techniques for identifying movement related structural pattern in cities.[5]'

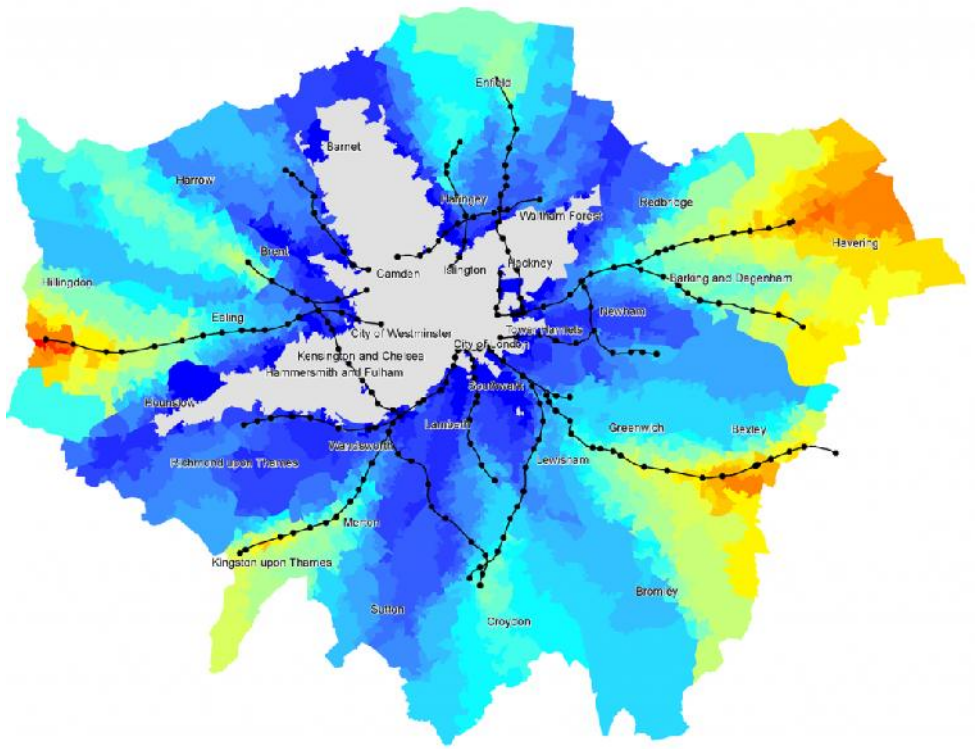

Fig 2.61: *Analysis of spatial patterns : Sky-Cycle. London, UK*

The concepts at the base of the above mentioned modelling approach are basically three and are meant to codify a '*genetic code'* for the cities:

_the notion of *Pervasive Centrality,* centrality functions diffuse throughout the network at all scales, from the global structure of the city to its local network of streets. This concept according to Hillier seems also spatially sustainable because 'it means that wherever you are, you are close to a small centre and not far from a much larger one.[6]'

[5] Hillier B., *Op. Cit.*
[6] Hillier B., *Op. Cit.*

_the notion of *Spatial Emergence* according to which the network of space that links the buildings together into a single system acquires emergent structure from the ways in which objects are placed and shaped within it; What is interesting here is that to be analysed as absolutely critical is how they city is *physically built.* The *act of building* is considered within its socio-economic environment, but not disjointed from it. It is again the idea of the city as a *techno-construction*. (See Chapter 2.1.1.)
_and finally the one of *Spatial Agency*, the capacity of the emergent spatial structure in itself to affect functional patterns of a city (movement flows, land use patterns, etc..).

In our particular framework the most interesting of all is the concept of *Spatial Emergency*.
What are really investigated here are the relationship between space in cities and the actions of *seeing* and *moving*: our bodies interact with the space network through moving in it and our minds through seeing it. So what has been argued is that what is required in order to understand the emergence of a spatial form in a city is a system of *visual distances*.
This system is governed by what in Space Syntax they call the *squaring law:* $2n^2 < (n-1)^2 + (n+1)^2$ where *n* is a number of points on either side of the blockage.[7] It is the law 'through which the placing and shaping of objects in space creates emergent patterns.[8]'
This is a very crucial step in the action of modelling because it recalls and algorithmically includes concepts typical of the language and philosophy of the Situationist International movement and in doing so it encapsulates a strong link with aesthetics and emotions.
La *dérive*, "drifting", of Debord's psychogeography was in fact the exaltation of moving and seeing through the city in an unplanned journey, journey that would bring to the 'drifter' feelings and emotions evoked by the surroundings through what Debord considered the only authentic aesthetic experience.
Although the 'moving' action as recorded and dealt by Space Syntax is never 'unplanned' but on the contrary it has always, algorithmically speaking, an origin and a destination component, and the 'seeing' action is not just about 'contemplation' but it is rather an inter-visibility applied from all points to all others, they both nevertheless convey that sense of 'experiencing' the space which is very much linked to the Greek concept of *aisthénomai* (knowing through experience).

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[7] For more details on the *squaring law*, please see Hillier B., *Space Syntax and Spatial Cognition*, Proceedings of the Workshop held in Bremen, 24th September 2006, available on web @ http://www.sfbtr8.spatial-cognition.de/papers/Space_alles.pdf
[8] Hillier B., *Op.Cit.*

According to the *Space Syntax* approach to network modelling all the above mentioned linked concepts set in train the self-organizing processes through which cities acquire their more or less *universal* spatial form, as they come into existence as both spatial and functional systems, reflecting the differences between micro-economic and socio-cultural-mental forces.

One of the main problematic aspects of dealing with cities, as we have already highlighted in this research, is their complex nature, and the difficulty of a discipline like urban planning to be able to properly and meaningfully address the interactions between so many different processes (physical, spatial, social, cultural, economic and cognitive).

We believe that the great achievement of the Space Syntax approach has been, in the best transdisciplinary practice, to be able to establish plausible relations between all those processes and in doing so it obtained also another merit: it succeeded to reflect in a quite precise way the commonsense in which we perceive and use cities.

This theory has somehow indexed the mental interactions between humans and their physical and spatial world.

It has indexed mental perceptions and as such it has partially decoded an *aesthetic knowledge* of the city, whereby for aesthetic knowledge we mean the knowledge of the city through perceptions.

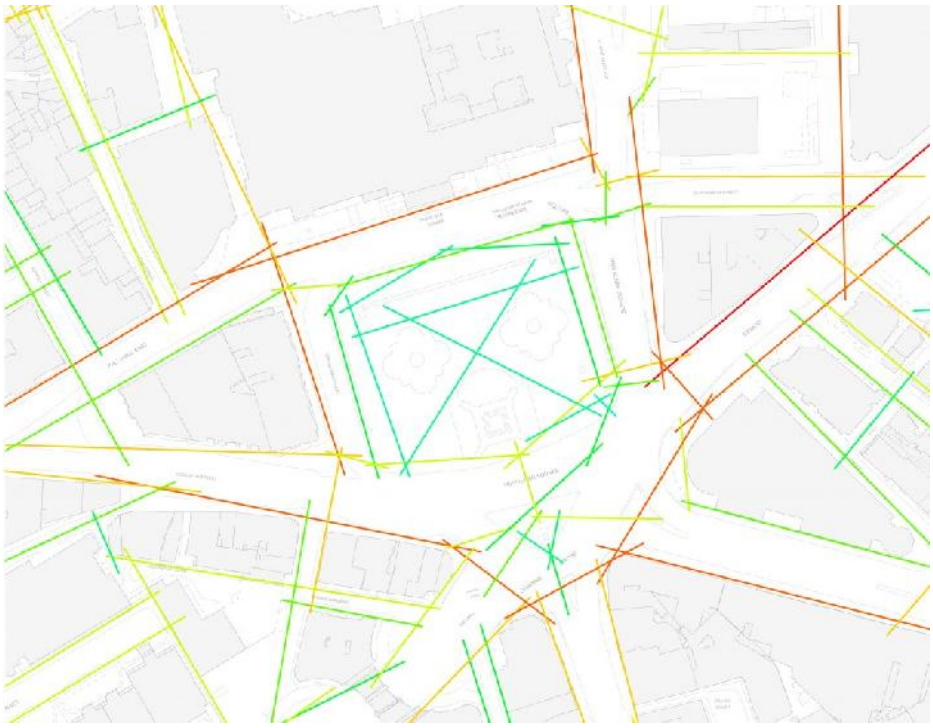

Fig 2.62: *Analysis of spatial patterns: spatial accessibility. Trafalgar Square, London, UK – BEFORE -*

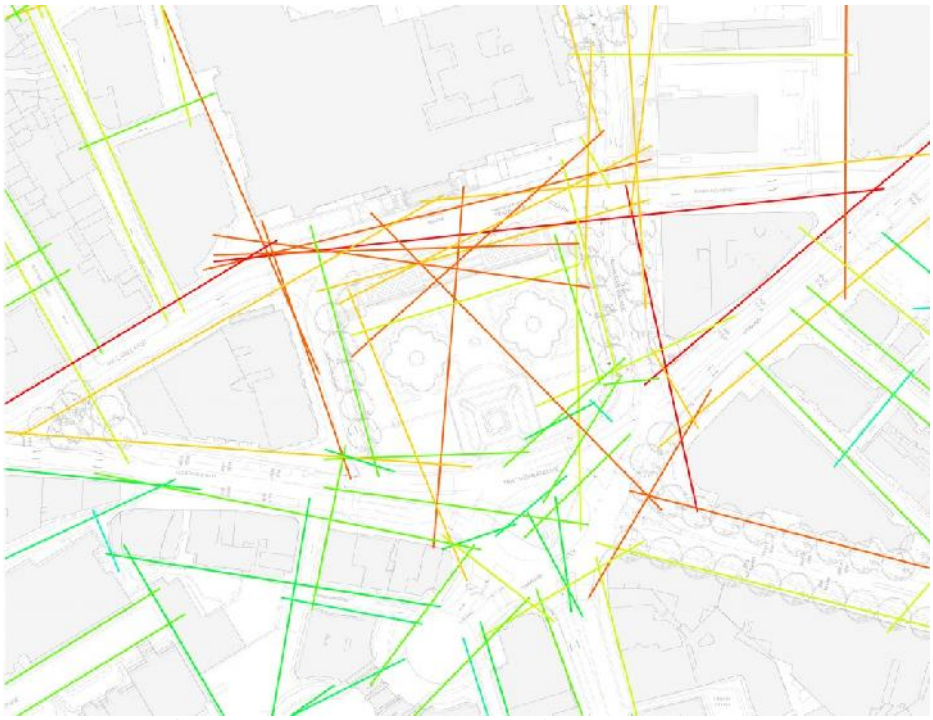

Fig 2.63: *Analysis of spatial patterns: spatial accessibility. Trafalgar Square, London, UK – AFTER –*

Fig 2.64: *Analysis of spatial patterns: spatial accessibility. Trafalgar Square, London, UK – PEDESTRIAN MOVEMENT –*

2.6 Borrowing from MATHEMATICS

The expression 'Borrowing from Mathematics' when speaking of Architecture and Urban Design could sound like an oxymoron. Mathematics has been implicitly and explicitly always part of the discipline: geometric rules, static equations, order of magnitudes, rules of proportions, etc…but somehow it was often playing soft-pedal.
But, in fact, 'Mathematics holds the key to simulation of many kinds. [9]'
In the last few years, instead, with the ever increasing use of digital technology and parametric software and in specific with the deployment of genetic algorithms, it became THE new language to master in order to keep the pace with the contemporary architectural discourse.
It is through Mathematics that *iconic* models, superficially similar to material reality and originally quite separate from mathematics, have merged with *symbolic* models, representing how function generates form, into digital representations[10].

'[…] Thus, architects wishing to use the new tool of genetic algorithms must not only become hackers (so that they can create the code needed to bring extensive and intensive aspects together) but also 'to hack' biology, thermodynamics, mathematics and other areas of science to tap the necessary resources.[11]" This sentence by De Landa, besides being a call for a *transdisciplinary approach* to the design process, it is significant because it puts mathematics and its ancillary sciences on the front line of the genesis of form.
In particular the re-discovery of *differential equations* and their link to concepts such as the one of *topology* has been at the base of much of the contemporary concepts of praxis and style in design.
In planning, however, it has been a set of *nowhere differentiable equations* one of the most interesting examples of mathematical models applied to urban processes. These mathematical equations represent also a natural phenomenon and are better known as *Fractals.*
They exhibit a repeating pattern that displays at every scale and if the replication is exactly the same at every scale, it is called self-similar pattern.

Prof. Mike Batty and CASA (Centre for Advanced Spatial Analysis at UCL) have been studying for many years now the power of fractals and their equations applied to urban planning and transport.

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[9] Batty M., *Model cities,* TPR 78 (2) , 2007
[10] Batty M., *Op. Cit.*
[11] De Landa M., *Op.Cit.*

In Batty’s and his team’s work fractals become a new form of representation at a fine spatial scale, where units of space are conceived as cells and populations as individual agents where the emphasis is no longer on spatial interaction but on the dynamics of development and local movement. Within this framework cellular automata highlight rules of development and agent based models focus on how agents respond to attributes of their environment often encoded in cellular landscapes.

2.6.1. Fractals Models for Land Use and Transportation Studies

Projects Credits: · *Centre for Advanced Spatial Analysis (CASA):* Prof. Mike Batty, Prof. Andrew Hudson-Smith, Prof. Alan Wilson, Prof. Sonja Curtis

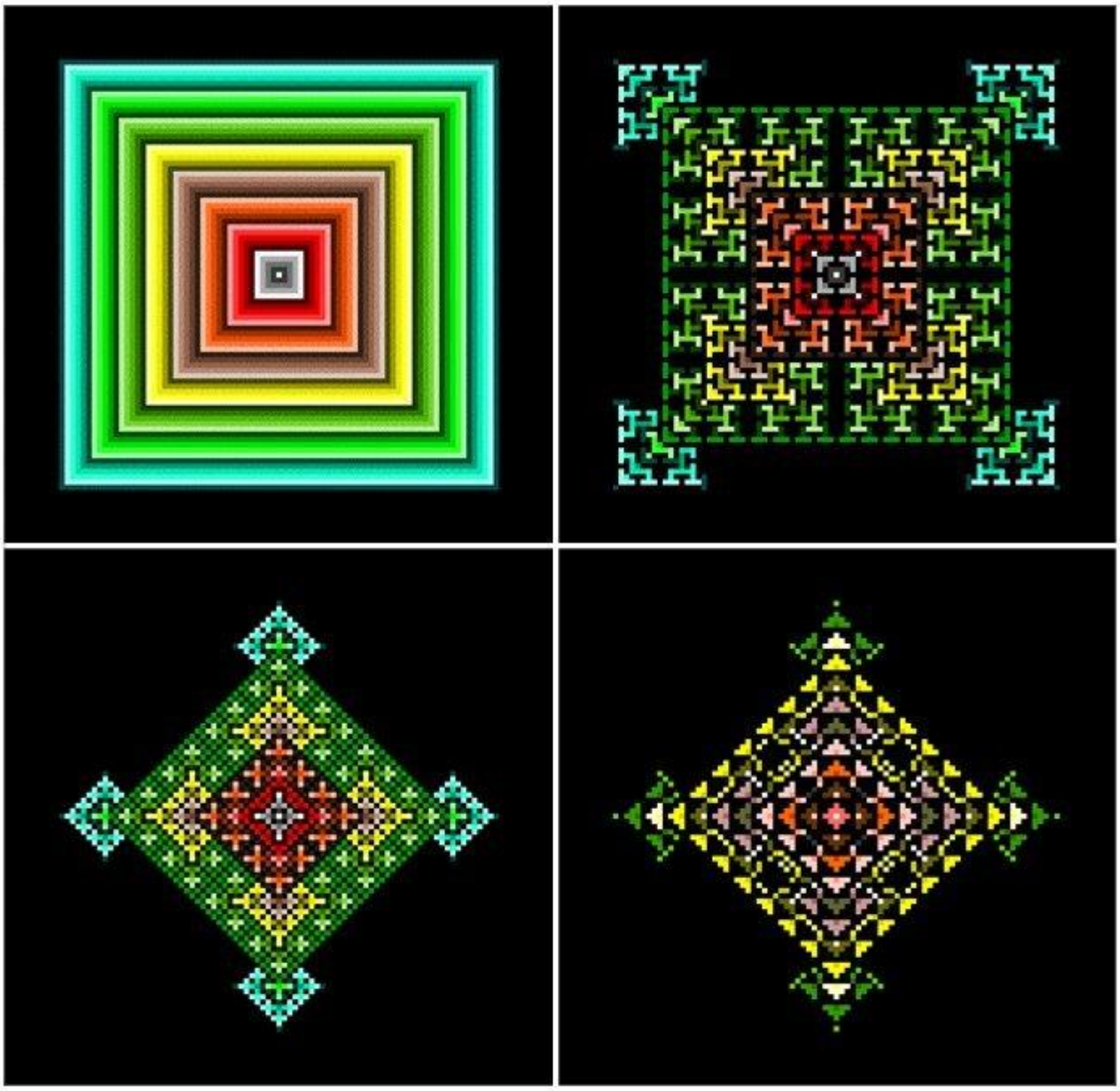

Fig 2.65: Idealized Urban Patterns Generated from the Bottom Up Using Modular Rules for Constructing Development Amongst Nearest Neighbours

‘Cities are fractal structures and much progress has been made on measuring their form although we still await the highly promising *grand synthesis of form* with function which seems ever nearer as urban economic theory begins to fuse with social physics[12]’

One of the main concepts of Batty’s ‘fractal approach’ to cities, stitching somehow different ideas together, is the one of *Scaling*.
‘Scaling pertains to how the elements as well as the entire system in question – the city – change in shape and size as their elements and their wholes grow and change [...]. Scaling is the skeleton around which we can build such a science (ed.: *grand synthesis of form*) and it provides us with the focus for new forms of simulation and visualization models consistent with such bottom up thinking[13].’
The *scaling* process operates, as the word itself says, across scales and it is strongly linked to the notion of *patterns, processes and their self-similarity and invariance* in urban environments.
The lack of a more refined, rather coarse and less abstract representation of locational patterns (ex.: density profiles, patterns of accessibility, etc..) that for many years had been at the core of urban pattern analysis had somehow brought to the loss of a sense of the morphological structures that locational patterns actually represent.

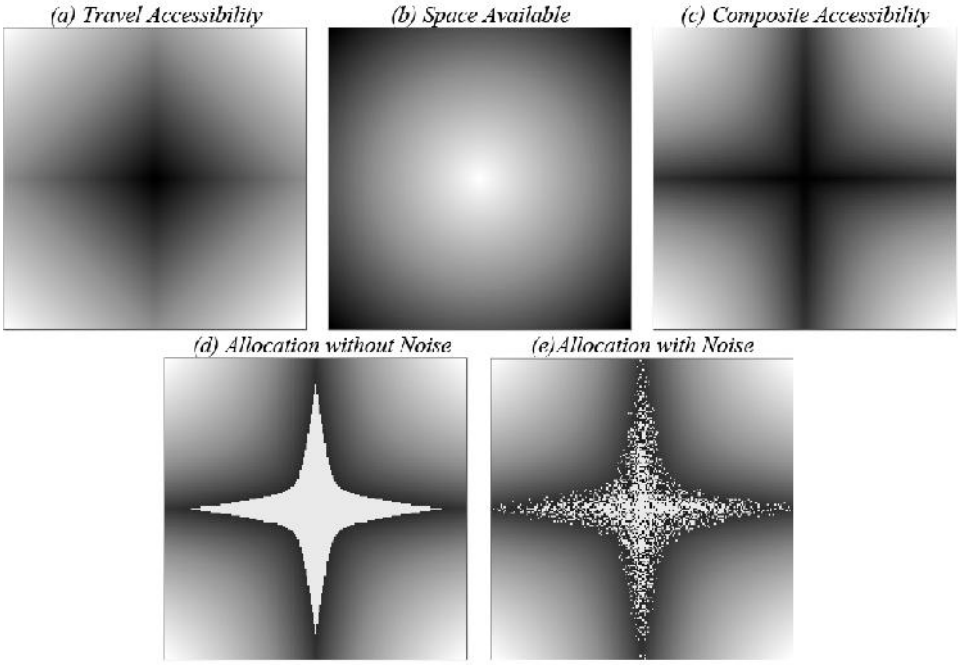

Fig 2.66: Hanesen’s (1959) Accessibility Model Implemented as a Cellular Automata with and without noise

[12] Batty M., *Model Cities, A science of Cities*, 2007 available on line @ http://www.complexcity.info/files/2011/06/batty-tpr-2007.pdf
[13] Batty M., *Building a Science of Cities*, UCL Working Papers Series, paper 170, 2011

Urban researchers had been missing out the opportunity to read modular patterns in cities structures across scales. What Fractal structures actually do is to begin to reinterpret the city using ideas about self-similar process of development in order to recover that missing opportunity.

It is the idea of 'using morphology as a signature to detect the different underlying processes at work in cities. [...] It relates very strongly to notions about how individual spatial decisions determine how cities grow from the bottom up and how patterns repeat themselves at different spatial scales[14].'

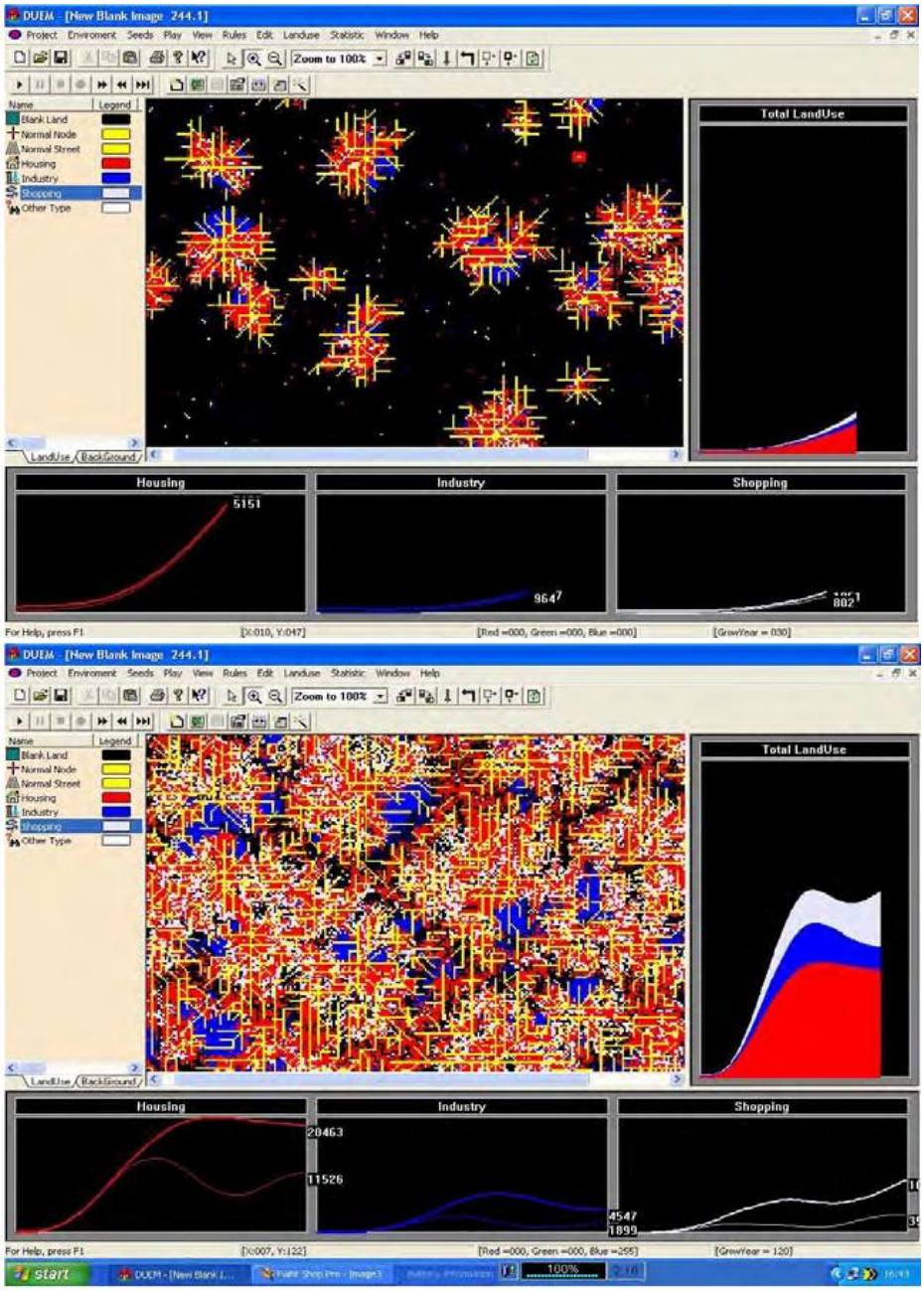

Fig 2.67: Cellular Growth using DUEM model

[14] Batty M., *Op. Cit.*

In specific, urban development rarely fills the entire space which defines the wider hinterland of a settlement or a city and in this sense, it is regarded as space-filling in the same way that fractal forms fill space between the Euclidian dimensions. 'A means for classifying cities using their relative densities and accessibilities is through their fractal dimensions that determine the extent to which they fill the space that they occupy.[15]'

It is a discourse very much related to how cities agglomerate and sprawl, in other words, to quote Jane Jacobs, how they 'connect people', and how their network structures develop together with adjacent land uses, agglomeration economies and scaling effects based on the idea that physical and social networks tend to mutually reinforce one another as they build up through processes of segregation and diffusion.

'The key to understanding how networks fracture and split, how economies of scale and innovations are realised through the way different networks relate, and the ways in which prosperity and the creation of wealth is linked to these network effects, is a central question that our science needs to address. *Scaling* ties these ideas together.[16]'

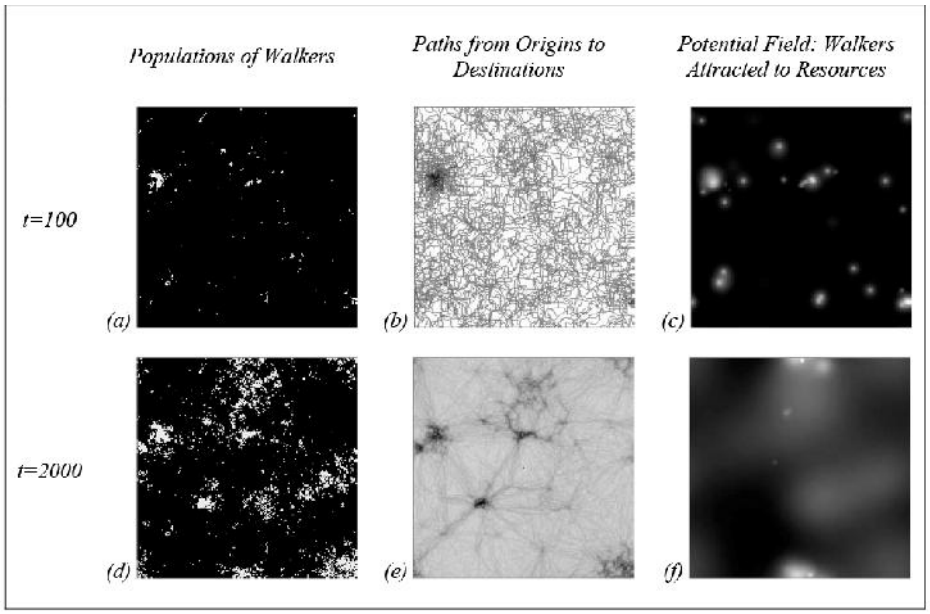

Fig 2.68: Generation of a Coupled Active Urban Landscape

Another interesting mathematical approach of the group C.A.S.A. on multi scale urban dynamics is the research on *Cellular Automata (CA).* These new forms of representation at a fine spatial scale, where units of space are conceived as cells and populations as individual agents,

[15] Batty M., *Op. Cit.*
[16] Batty M., *Op. Cit.*

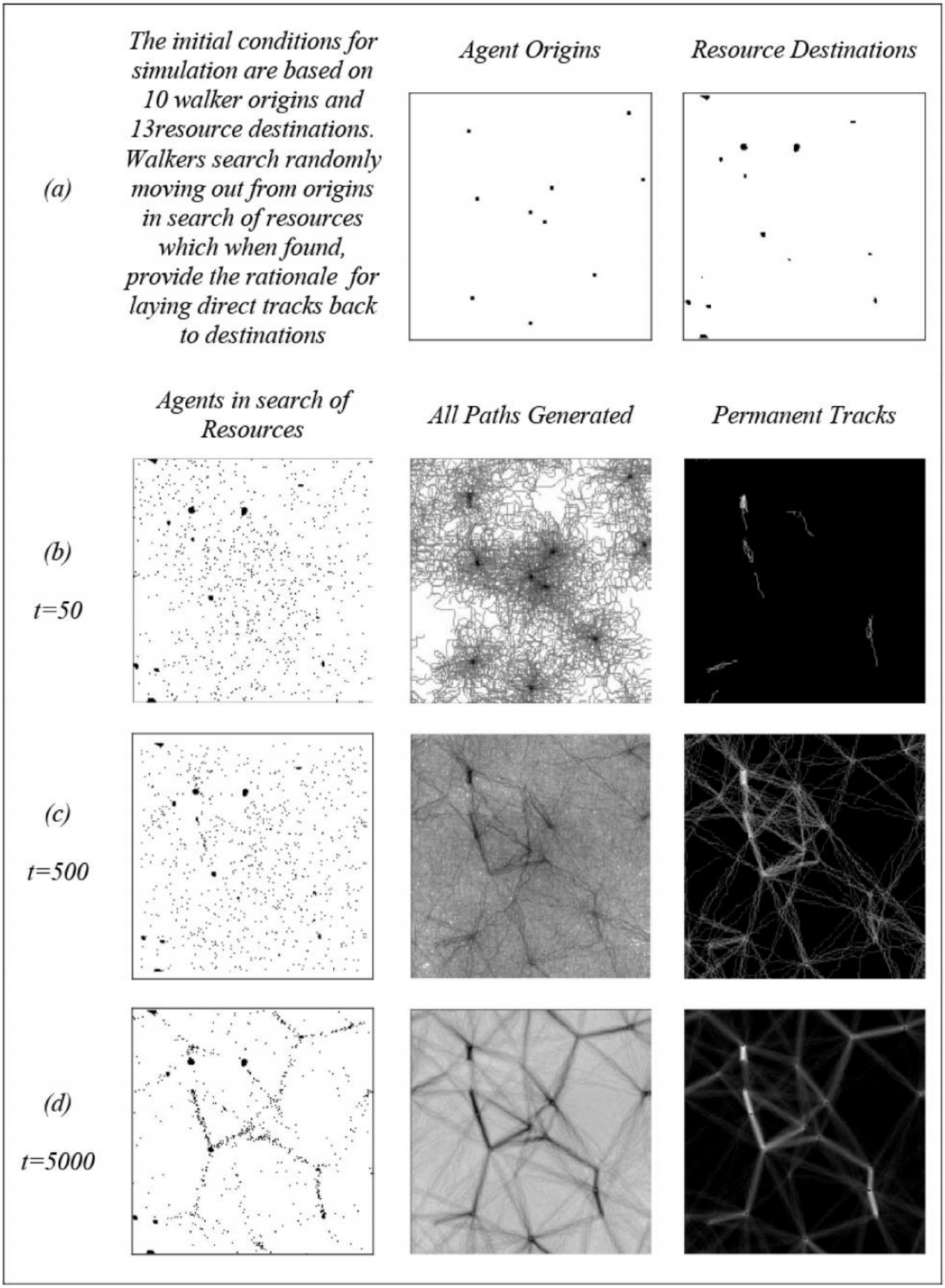

Fig 2.69: Generation of a Coupled Active Urban Landscape

are currently changing the way we are able to simulate the evolution of cities and related systems.
The emphasis is no longer on spatial interaction but on the dynamics of development and local movement.
They are agent-based models which focus on how individuals respond to environmental attributes encoded in cellular landscapes and they can be applied in very different spatial scales such as pedestrian movement, evolution of systems of cities at a regional scale and urban growth at the city scale.[17]

Besides the particular operational (fractal + CA) approach what is really engaging in the research conducted by Batty and the C.A.S.A. team is their idea of *models* and models use: models should 'contain what we consider important to how cities function rather than seek the most parsimonious ways of distilling our knowledge into testable propositions that we match against data' and most of all 'there needs to be a dialogue between model builders and model users however they might be constituted. Models are being used increasingly to 'inform' rather than 'predict' as a new relativism sweeps the field.[18],
This is a paramount concept that we will investigate much more in depth in Chapter 3.

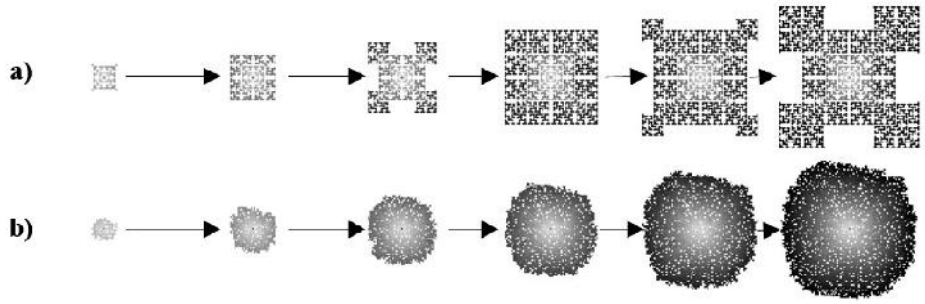

Fig 2.70: Growth from the bottom Up:
a) deterministic growth based on developing cells if one and only cell is already developed in their 8 adjacent neighborhood
b) stochastic growth based on developing cell if any cell is developed in the adjacent neighborhood according to a random probability

[17] Batty M., *Agents, cells, and cities: new representational models for simulating multiscale urban dynamics,* Environment and Planning A , volume 37, pgg. 1373-1394, 2005
[18] Batty M., *Op. Cit.*

2.7 Borrowing from COMPUTATIONAL SOCIOLOGY & SOCIAL SCIENCES

The power of Internet, the access to portable technology and the self - organized social systems that emerge from them have all contributed to create a new dialogue between such systems of real time communications and the built environment. Models normally used in computational sociology to understand, track and anticipate trends and social changes have been applied to describe and understand cities.
An example: *Sugar-scape models,* agent based social simulations or registrations that make possible to explore the connection between the micro-level behaviour of individuals and the macro-level patterns that emerge from the interaction of many individuals.

SENSEable City Lab at MIT, directed by Carlo Ratti, has been trying to address issues of urban mobility, in terms of people-goods and information mobility, starting from a bottom up data feeding mechanism coming from portable hand held electronics and ending in the real time evaluation of the patterns produced by such processes in order to direct simultaneous changes in the environment: sometimes allowing emergence, sometimes using top down organizational apparata.
Their work deals with the transformation of large amount of data coming from portable devices and wireless connectivity into meaningful information in the form of a new stylistically innovative series of maps. These cartographies register the real time behaviour of many single individuals depicting it as macro patterns over the city, recording at the same time the 'pulse' of the city itself: its patterns of uses and its flows.
Such visualizations of digitally bred sugar scape models are, as any innovative style of cartography, extremely valuable to generate new perspectives on the city and to radically transform the way we live in it.

The FAb Lab at IAAC headed by Tomas Diez instead created the Smart Citizen Initiative in Barcelona where individuals can use open source technology to upload live data about the air quality in their community which remains publicly accessible. These projects can generate awareness about certain issues or act as checks on environmental governance but, more importantly, point to a key challenge of digital design which is the question on how parameters (either formal or environmental) start to build shared values.

In the both cases above mentioned the truly innovative aspect of their models resides in placing the emphasis not so much on the 'intelligent/smart systems' used to address the process, but on the 'intelligent/smart user'. It is a critical passage because it records the

fundamental shift, within the search for a sustainable future, from *smart cities* to *smart citizens.*

It entails an implication of the general public as active, not only as a controller of change but also and most of all as a leading actor and success factor.

The measure of the model achievement is directly dependent on the participation percentage: the higher the number of users taking part to the project and of feedback loops delivered and the most precise and thriving develops the model. In both these models the involvement and engagement of the masses equals success.

On top of that citizens become the connecting tissue between the real space of the city and the virtual space of the net: they 'have an active stake in their habitation ecosystem and are empowered to 'hack' the urban source code surrounding them[19]'and they do so following what Harvey called their *relational construction domains*[20], different group of people sharing common features and similar values.

These choral intervention models are in a way also a form of *re-information:* creating something anew using information as the basic raw material[21].

'Urban *re-information* invests effort in precisely finding out (in real time) the social, environmental, physical, functional, economic and cultural information of a city with a view towards taking action in it. [...] To do this, it is necessary to analyse the information emitted by the city, according to multiple parameters and to design ways of increasing complexity without a corresponding increase in the 'quantity' of chaos.[22]'

[19] Ratti C. & Claudel M., *Dimensions of the Future City*, in Cities in the 21st Century. Academic Vision on Urban Development, ed. By Nel-lo O., Mele R., Routledge, 2016

[20] Harvey D., *Justice, Nature and the Geography of Difference*. Oxford: Wiley-Blackwell, 1996.

[21] Guallart V., *Re-information,* in The Metapolis Dictionary of Advanced Architecture. City, technology and society in the information age, ACTAR, Barcelona, 2003

[22] Guallart V., *Op. Cit.*

2.7.1. Sugar-scape models for Urban System Analysis

Project Credits:
- *Course:* MIT Seanseablecity City Lab
- *Project Title*: Real Time Rome
- *Team and Image Credits*: Burak Arikan, Assaf Biderman, Francesco Calabrese, Filippo Dal Fiore, Saba Ghole, Daniel Gutierrez, Sonya Huang, Sriram Krishnan, Justin Moe, Francisca Rojas, Najeeb Marc Tarazi
- *Curator:* Andres Sevtsuk
- *Director*: Carlo Ratti

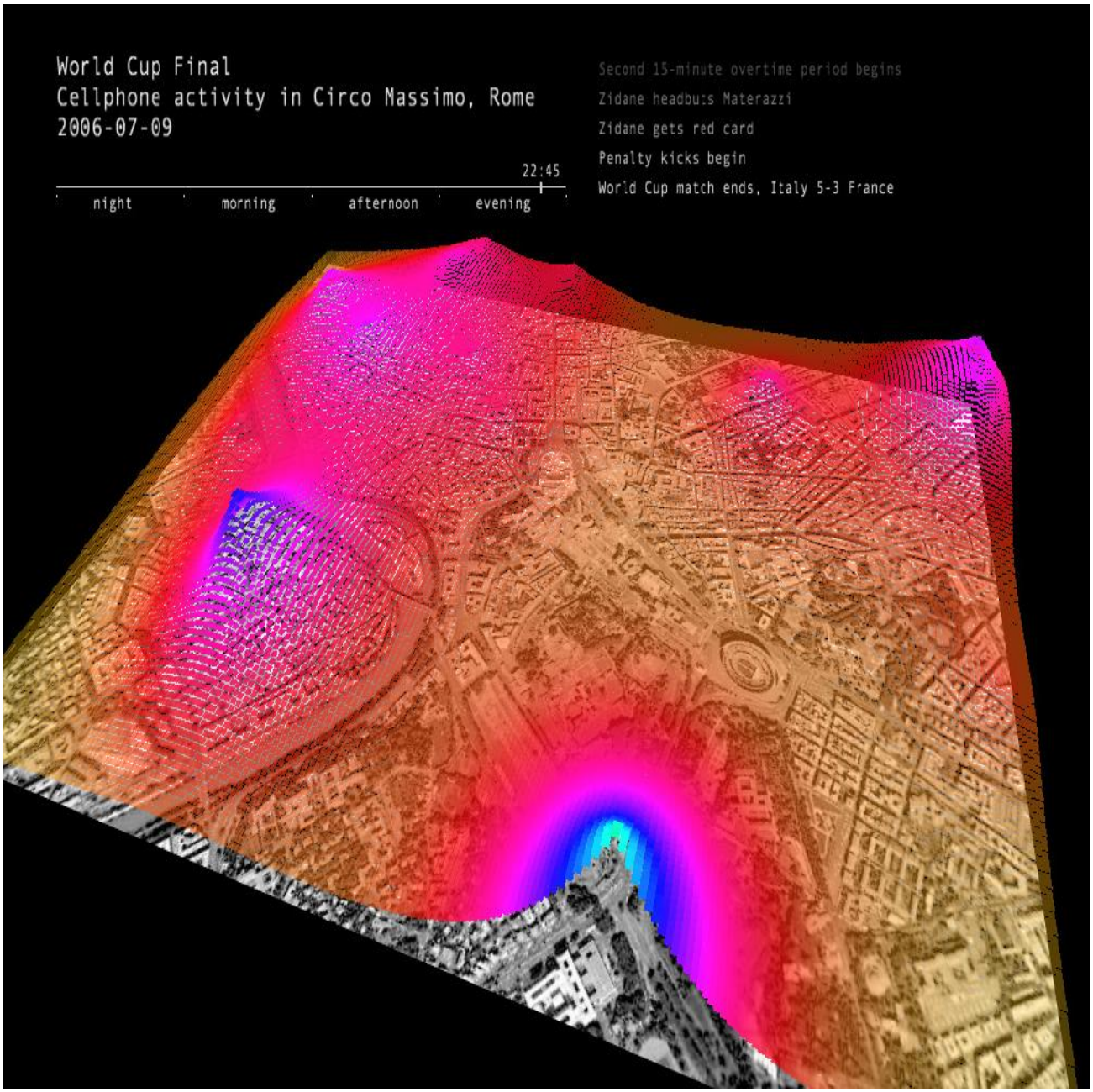

Fig 2.71: World Cup Final , Cellphone activity in Circo Massimo, Rome

Real Time Rome is a project that aggregates data from cell phones (obtained using Telecom Italia's innovative Lochness platform), buses and taxis in Rome to better understand urban dynamics in real time. The project synthesizes data from communications and transportation networks into visualizations that help us decipher patterns of daily life in Rome. It interpolates the combined activity of people and presents it synchronously with the flux of public transportation and taxis.
'By overlaying mobility information on the geographic references of a city, *Real Time Rome* unveils the relationships between fixed and fluid urban elements[...]and by revealing the pulse of the city, the project aims to show how technology can help individuals make more informed decisions about their environment.[23]'
These real time maps are de facto sugarscape models where the agents used for social simulations are not 'artificially intelligent based' but 'real intelligent' ones, as the model is rather a registration of micro-level behaviours of individuals than a simulation.

The result, a macro-level pattern that emerge from the interaction of many individuals, depicts all sort of integrated information: from the distribution of public transport according to its usage and therefore according to the distribution of people densities, to the understanding of the different uses of a neighbourhood during the various hours of the day, from learning how dissimilar social groups inhabit the city to how goods and services are distributed in the city, etc...
Such registrations are not just ends in themselves but, helping individuals to make more informed decisions about their environment, they could definitely reduce existing inefficiencies of the urban systems.

The winning recipe lays in the particular nature of its interface: it combines real-time data, GIS data and raster images in one single representational map. In doing so it offers to any public, even to a non expert one, an easily interpretable tool to read how the city is actually performing in different situations/conditions/events and consequently stimulates dialogue on the output of such data.
The fact that the models are 'real time based' and that the agents are actually intelligent and therefore heterogeneous individuals are the true significant innovations in the common use of sugar scape models in Social Sciences.
In fact in many approaches to modelling human society the tendency is to build the approach on a homogenous model of the individual. These attempts build a single model of a human being and then replicate it in large numbers to examine social behaviour. Such an approach naturally

[23]From 'Real time Rome' available @ http://senseable.mit.edu/realtimerome/

sacrifices heterogeneity of the human actor in its models/scenarios. On top of that they tend to study static worlds or worlds frozen at a particular point in time, therefore such snapshots ignore the dynamics of time and its influence on their models.

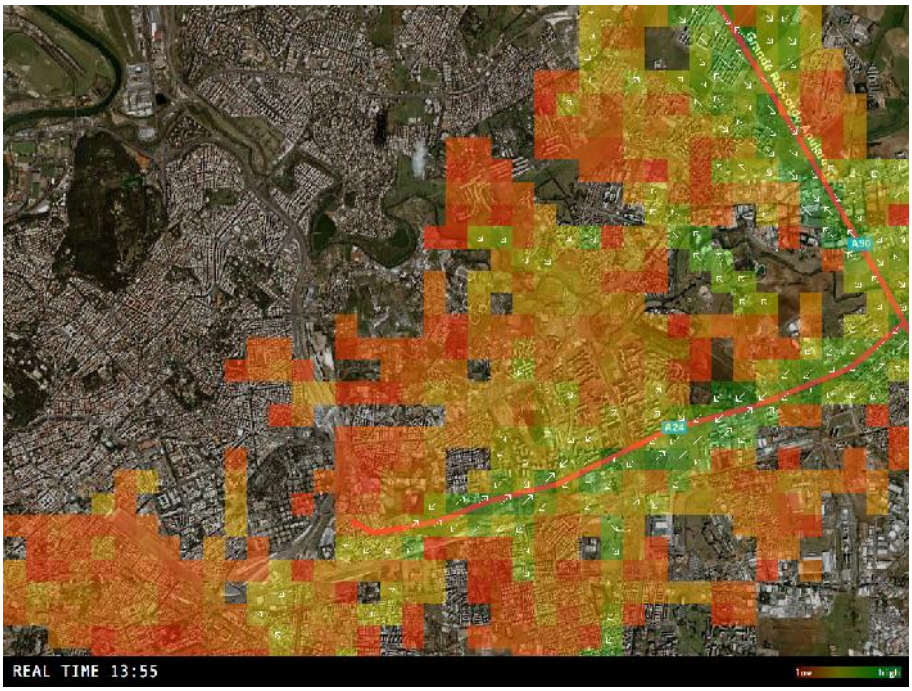

Fig 2.72:Flow: *This* software visualizes the movement of mobile phone callers travelling in vehicles. Red indicates areas where traffic is moving slowly, green shows areas where vehicles are moving quickly, and the arrows represent the dominant direction of travel

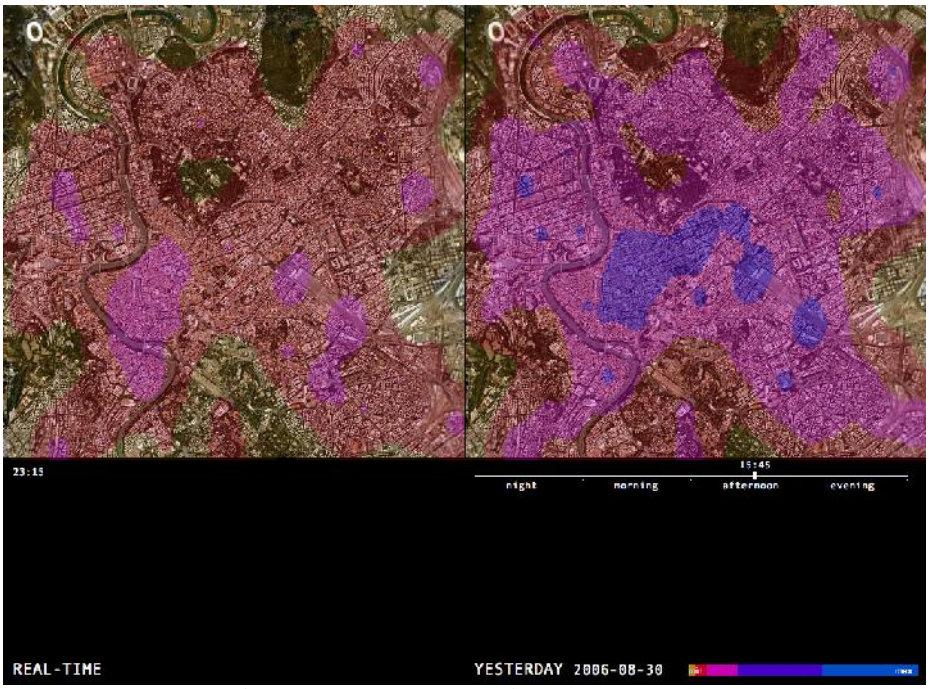

Fig 2.73: The Pulse: *This software visualizes the intensity of mobile phone calls in Rome at the present moment and compares it to yesterday's data.*

As said above *Real Time Rome* has been built in a complete different way, not only allowing heterogeneity and time within the model, but even turning them in the success factors.
As a matter of fact, it is indeed the 'time feature' of those maps, the registration of the events through time as it happens and not as a frozen snapshot that constitutes the engaging factor with the audience.
In the digital area anything which is 'alive', active, dynamic, heterogeneous and in the best cases even responsive attracts much more interest and participation than a static representation.
'Maps tend to represent the ages in which they are made, shaping our understanding of the environment and eventually its construction. These real-time visualizations of otherwise invisible networks are fundamental to our understanding of a digital culture where information and communication technologies are integral to our everyday lives. [24],

Fig 2.74: Connectivity: *This software shows the changing positions of Atac buses, indicated by yellow points, and the relative densities of mobile phone users, represented by the red areas*

[24]From 'Real time Rome' available @ http://senseable.mit.edu/realtimerome/

2.7.2. Social network Models for Open Source citizens' political participation

Project Credits:
- *Course:* IAAC Fab Lab, Barcelona
- *Project Title*: The Smart Citizen project
- *Team and Image Credits*: Alex Posada, Guillem Camprodon, M.A. Heras, Alexandre Dubor, Leonardo Arrata, Aitor Aloa, Angle Muñoz, Xavier Vinaixa, Gabriel Bello-Diaz, Francisco Zabala, Jorren Schauwaert, Alejandro Andreu
- T*eam Leader*: Tomas Diez

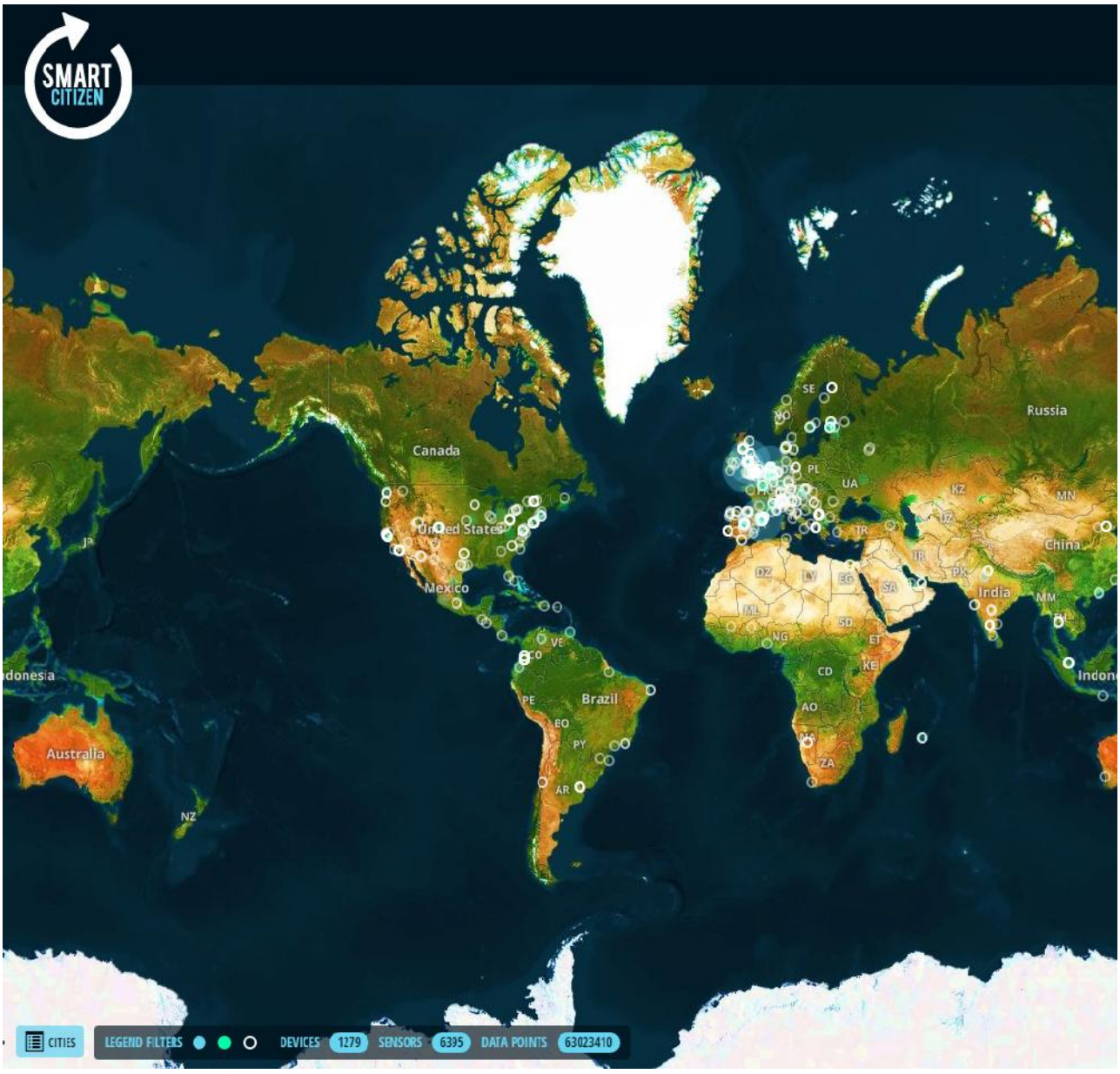

Fig 2.75: Smart Citizens Interface on the web

‘A new ‘mental map’ related with [...] a more effective, more unprejudiced and more relational spatial formulation –and a vehiculation– of information (meant in its wider connotation of active vector of interchange).
A new relational and ‘informational’ logic definitely connected with its own understanding of our environment.[25]’
This definition of the new mental framework offered by the Complexity Theories to our discipline is given by Manuel Gausa in his seminal book ‘Open’ and it perfectly summarises the contents and goals of *the Smart Citizen Project.*
The project in fact materializes one of the most critical factors in the Complexity Theories, the one that is the mostly researched in the field of social networks: the power of the ‘relational logic’.
The proposal is basically a full set of tools set up as platform capable to generate participatory processes among global citizens and consists of a geolocation engine, free software and hardware for data collection and sharing and, of course, the Internet.
The goal of this platform is to harvest environmental indicators such as air and noise pollution, humidity, light intensity, etc..., share them instantly in real time on the net and compare them with other places, in the same city or in other countries, raising, through collective participation, people awareness on the real conditions of their ‘habitat’. It does it using, as we said, the relational logic: connecting data, people and knowledge, optimizing relationships between resources, technology, communities, services and events in the urban environment.
Their Smart Kit is a small, slim, colourful, low power consumption (provided by a solar panel and/or battery) device that can be placed on balconies and windowsills and is compatible with Arduino and all the design files are Open Source. More in specific it is ‘a piece of hardware comprised of a sensor and a data-processing board, a battery and an enclosure. The first board carries sensors that measure air composition (CO and NO2), temperature, humidity, light intensity and sound levels. Once it’s set up, the device will stream data measured by the sensors over Wi-Fi using the FCC-certified, wireless module on the data-processing board. [26]’
The project is based on a real bottom up approach to urban interventions and includes a varied group of users: from university researchers who employ it to build experiments in order to understand the relationship between people, environment and technology (examples are the Architectural Association, the University College of London and the

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[25]Gausa M. , *Open. Espacio Tiempo Información. Arquitecture, Vivienda y ciudad contemporanea. Teoria e Historia de un cambio,* Actar, Barcelona, 2010
[26]As described on their website: http://beta.smartcitizen.me/about

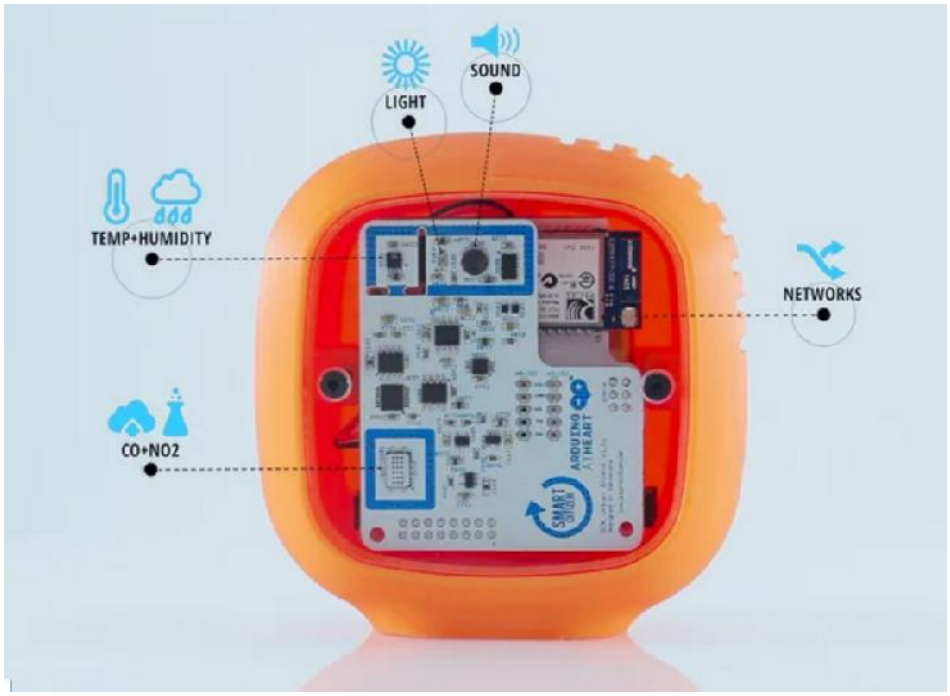

Fig 2.76: The Smart Kit

University of Glasgow) to cities, like Amsterdam[27], Manchester[28] and Barcelona[29], which utilize it to co-create with their citizens including them in the political life of their city; or again, communities wanting to take direct action in monitoring their environment and report back to their city in order to prevent environmental disasters or health related issues, like the 'Kosovo science for change[30]' project.

Fig 2.77: The Smart citizen interface as appears on the Amsterdam smart city Project

[27]http://amsterdamsmartcity.com/projects/detail/id/69/slug/smart-citizen-kit?lang=en
[28]http://futureeverything.org/projects/smart-citizen/
[29]http://us2.campaign-archive1.com/?u=d67ba8deb34a23a222ec4eb8a&id=439df431b6&e=06fb8b7939
[30]http://www.internetartizans.co.uk/kosovo_science_for_change

The Smart Citizen project is eventually a complex *open apparata* with a dynamic structure: it is at the same time a device, a mechanism, a tool, an operating system, a strategy and a tactic as well.
It is an actual system with many virtual subsystems.
The interactive union among information, relations and transversal interconnections, tells us about a new 'nature of the contemporary project, conceived not as a productive object but rather as a co-productive, relational environment.[31]'
This concept implies a high degree of openness both in terms of the configuration/organization of information and in terms of the authorship agency.
The project is an open-ended process that does not aim to offer solutions, but rather to foster debate and further exchange of information.
It is a relational process the success of which is not determined by the construction of a final product/result but by the highest possible participation of the users and their exchanges.
As a matter of fact its success lies in its capacity to foster interactions.
This Social Open Source model at the end deals with relational and communicative logics and it becomes even more interesting if analysed through the concept of *network* and its power to generate interactions at different levels. As the complexity theory teaches us, it is by multiplying interactions, relations, links and articulations that reality can be relaunched and not indefinitely recreated or redefined.
Borrowing Gausa's categories[32] we could investigate the project through four different degrees of interactions:
- interactions between *structures and simultaneous events* as the capacity to combine and activate at once multiple not always concordant information in the same infrastructural framework of relations;
- interactions between *different systems of 'generation'* with interchanges of information and possible hybridization of actions among researchers, citizens, city government, schools, communities and developers ;
- interactions between *the above mentioned systems and the context*, not just physical but also cultural, economical and political, locally based but globally sensible;
- interactions between *the generated system and its own superior 'meta-system'*: city, territory and landscape
According to Gausa it is in the acceptation of these interactions and mixture, of interchanges and crossings of energies that we could finally detect one of the fundamental key of the contemporary culture of complexity and systemic thinking: not anymore the old notion of quality

[31]Gausa M. , *Op. Cit.*
[32]Gausa M. , *Op. Cit.*

as an essential, pure identity related to cathartic categories such as the Beautiful and the Sublime, but rather a more diffused and *impure* one[33].
This is an important aesthetic statement: it seems to suggest that, in a dynamic system where reality is based on the permanent condition of recombining, articulating and connecting different organizations in an always evolutive, ever-changing, mutating tendency, quality is not so much related to pureness, homogeneity, uniformity and refinement but rather to a more complex meaning of sophistication by acceptation, negotiation and exploitation of multiple resonances and superimpositions.
To quote Guattari describing the search object of ecological praxes, it could be 'some quality that runs counter the 'normal' order of things: a discordant repetition, information of particular intensity which summons up other intensities to form new existential configurations'[34].
It is an impure Aesthetics based on relations of different kinds where human interactions and social context are more important than individual and private actions.
It reminds us of the concept of '*Relational Aesthetics'* (see Chapter 1.2.5.) and its tie with social systems based on collaboration and openness.
According to Relational Aesthetics the value, the quality of the project lies exactly in the exchange of information among the participants of the event. Information that can not only be exchanged but that can also be used further to create again. That is why in relational art often the art work is actually an event which actualizes as platforms, meetings, dinners, dialogues, etc.....(a good example of relational art is the well known piece '*The artist is present*' by Marina Abramovich, held at MOMA, NY, 14-31 March 2010).
Following Bourriaud's theory of form ('Relational Aesthetics does not represent a theory of art [...] but a theory of form[35]') the *impure* is then that *formal disorder* which is inherent to dialogue, introduced into the aesthetic arena by the idea of *transitivity.*[36] (For more on this subject see also Chapter 1.2.5)
It is the same disorder that Francesco Milizia, though being one of the most rigid obedient to classical rules, rigorous theoretician of the Neoclassicism and vigorous critic of the Baroque, defended as one of the quintessential qualities of the City: '[...] The more in this (ed. of the city) composition reigns choice, abundance, contrast, and up even *some*

[33]Gausa M. , *Op. Cit.*
[34]Guattari F., *The three Ecologies,* Continuum International Publishing Group – Athlone, July 2000
[35]Bourriaud N. , *Relational Aesthetics,* Presses du Reel, 1998
[36]Bourriaud N. , *Op. Cit.*

disorder, the more picturesque will be, and the more sexy and delicious beauties will contain.[37]'

We could thus paraphrasing Jean Luc Godard who, trying to rebel against the closed conception of artistic practice, explained that 'it takes two to make an image', and affirm that in the ecosystem of activities, networks and knowledge enabled by internet *it takes many to make a project* as the Smart Citizens Project actually does.

[37]Milizia F., as quoted by Paolo Portoghesi in *Natura e Architettura*, Skira, Milano, 1999

3. THE SELF-ORGANIZED CITY: EVALUATION METRICS

3.1 The role of the Architect in the self-organised city and *the interface [i/f]* device.

"[…] *if we are to understand the interactions between ecosystems, the mechanosphere, and the social and individual universes of reference, we have to learn to think 'transversally'."*
(Guattari F., The three Ecologies)

"[…]we should first of all think of *interfaces,* and nothing should be excluded *a priori.* "
(Simondon G., On Techno-Aesthetics)

3.1.1. The science of multiplicities and the authorship question

The Bottom–up logic, as we mentioned previously, needs to be situated in the neo-Darwinian framework of evolutionary thinking.
Deleuze and Guattari remind us that 'Darwinism's two fundamental contributions moved in the direction of a science of multiplicities: the substitution of population for types and the substitution of rates or differential relations for degrees[1].'
It is what Ernst Mayr, one of the fathers of evolutionary thinking, would later describe as 'Population thinking versus Typological thinking': 'For the Typologist, the type (eidos) is real and the variation an illusion, while for the Populationist the type (average) is an abstraction and only the variation is real[2].'
Variations, *differentiations*, and *multiplicities* are categories of paramount importance within the evolutionary paradigm. They differ from the term *variants*, acceptation more proper to typological thinking, as they imply the replacement of visual sameness with similarity. In fact while variants represent modifications to an original artefact/model, variations do not imply the existence of a primitive, a matrix or an archetype, they rather indicate marking differences of one individual from another of the same species. Most importantly, shifting from biology back to architecture, they embody the passage *from typicality to non standard seriality*[3]. It is the passage from the science of models

[1]Deleuze G. & Guattari F., *A thousand plateaus: Capitalism & Schizophrenia,* The Athlone Press, London, pp. 48, 1999
[2]Mayr S. E., *Evolution and the diversity of life: Selected essays*, The Belknap Press of Harvard University Press, Cambridge, Massachusetts, USA 1976
[3]Carpo M., *The Alphabet and the algorithm,* Writing architecture series, The MIT

characteristic of a series, where, by models, we mean rules, to the science of codes, where by codes, we mean rules; in other words, from types to variables.

Sanford Kwinter perfectly summarized this process when stated that 'The relation of matter and forms are temporal and it is related to the path they have done to get there[4].' In computational terms that path is an algorithm.

Within this scientific framework of complex, emergent, bottom up logics algorithmic models are being organized to digitally breed cities, dealing with the 'organization, quantification and systematization of quanta of data[5]' and their advent implies a revolutionary approach for what concerns one of the most controversial and debated issues in the discipline of architecture and urban planning: the notion of *style* and *authorship*.

On the side, as Valerie Châtelet points out, communication networks and widespread calculation capacity combine to become centrifugal forces, pushing towards the decentralization and democratisation of control. 'Whereas bureaucracy assimilates information, the networks distribute it. [...] Individuals are regaining control of their institutions and social organisation. Lower costs and widespread information and communication processing tools promote the emergence of new decision-making methods, as well as new methods of co-operation[6].'

In a field like the one of algorithmic morphogenesis, self-organizing and emergent systems are playing a major role in challenging the 'modern notion of architect's full authorial control and intellectual ownership of the end product[7]' and the contribution of the designer to the process could run the risk of being downgraded to a simple breeder[8].

However, we believe that it would be worthwhile to dwell a bit more on a couple of points in order to better understand the implications that concepts like subjectivity and agency could have in morphing the discipline's future and aesthetics.

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press, Cambridge, Massachusetts, USA, pp. 81-120, 2011

[4]Kwinter S., Proto_E_cologics Symposium, 2011, on line @ http://vimeo.com/28810672

[5]Parisi, L., *Contagious Architecture: Computation, Aesthetics, and Space*, The MIT Press, Boston, 2013

[6]Châtelet V., *Moving towards Control Tensegrity*, available on line @ http://www.editions-hyx.com/sites/default/files/anomalie6_chatelet.pdf

[7]Carpo M., *The Alphabet and the algorithm*, Writing architecture series, The MIT press, Cambridge, Massachusetts, USA, pp. 81-120, 2011

[8]For more details on this theme see De Landa M., *Deleuze and the use of genetic algorithm in architecture*, on line @ http://www.egs.edu/faculty/manuel-de-landa/articles/deleuze-genetic-algorithm-in-architecture/

First, the same notion of complexity, as it has been developed in different disciplines and not only in architecture and urbanism but also in other fields such as artificial intelligence, urban physics, climatology, economy, ecology, civil engineering, information and data study, software programming, art, etc. has been modelled and applied initially through the use of *Parametric Algorithms* (PA) and more recently through *Interactive Genetic Algorithms* (IGA) and they imply a sort of dialogue, a notational code, between man and machine.
This dialogue would be better described as an *interface [i/f]*, a physical/virtual device enabling communications among entities of different kind (what Harvey used to call *relational domains*[9]) each one with its own particular protocol of communication and values, and has a particular privileged role to play in the production and use of subjectivity as we find it in the definition of the aesthetic paradigm of Guattari's *Chaosmosis*. An idea of subjectivity strictly linked to the concept of ecology and virtuality.

3.1.2 The interface *[i/f]* as a device for collaborative rationality

The *interface [i/f]* recalls indeed the designation of *machines of virtuality*: 'blocks of mutant percepts and affects, half-object half-subject. […]Not a gestalt configuration, crystallizing the predominance of good form. It's about something more dynamic, that I would prefer to situate in the register of […] the autopoietic machine to define living systems[10]'.
From a semiotic and ontological point of view the interface [i/f] and its autopoietic, self-organizing assemblages are '*incorporeal ecosystems*'[11], de facto resembling the notion of *virtual ecology*, or ecology of values, wished for by Guattari: 'a speech between men and machines that would mark the change from the contemporary world […] to a world characterized by a generalized ecology – ecosophy - […] as a science of ecosystems, as a bid for political regeneration, and as an ethical, aesthetic and analytic engagement[12].'
The very notion of the interface, together with the one of bottom up systems, entails concepts like open-endedness, participation, interaction and mass collaboration and reconnects to the concept of Population thinking as the method of reasoning which reminds us that the

[9]Harvey D. *Justice, Nature and the geography of Difference,* Wiley- Blackwell, Oxford, 1996
[10]Guattari F., *Chaosmosis. An Ethico-Aesthetic Paradigm,* Indiana University Press, pp. 90-91, 1995
[11] Guattari F., *Op.cit,* Indiana University Press, pp. 90-91, 1995
[12] Guattari F., *Op.cit,* Indiana University Press, pp. 90-91, 1995

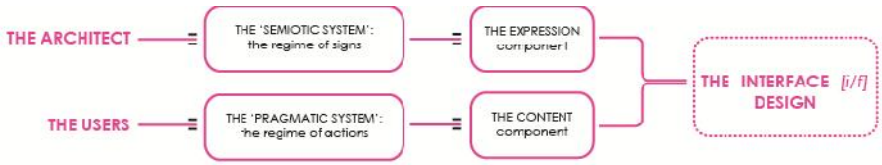
population, the group, the society is the medium for the production of forms, not the single person.
This position in the history of art is neither new nor revolutionary as even in the XVth century Leon Battista Alberti, 'master builder of the Italian Renaissance'[13] committed to achieve personal recognition through the affirmation of 'his role above the others' in the construction of a building, believed that creativity was a social and not an individual process[14].
In this new paradigm, we see the architect with an additional *curatorial* role and his/her output is no longer a finite, controllable project but a medium, the *interface* [i/f] indeed which, engaged in processes of *heterogenesis,* allows a *collective choice,* hence Complexity can be seen as a device for 'collaborative rationality'[15].
In this sense the *interface [i/f]* would perfectly resemble the 'collective management and control' needed to 'orient sciences and technology towards more human goals'[16]: not a 'blind reliance on technocrats' but a coral and collective form of intervention.
It would be a clear departure from an *authorial* attitude based on the concept and modes of *typicality* towards a *poliarchic* assemblage based on *seriality*.
At this point it becomes an urge to speculate on what would then happen to the role of the architect and the notion of style and authorship.

3.1.3 The role of the architect and the notion of style and authorship: *the cartographer of subjectivity*

The architect, with his personality, character, poetry, passions, skills and intuitiveness, in other words with his/her own style and capabilities, will maintain complete control on the *interface [i/f]* design and in particular, using Deleuze vocabulary, on the 'semiotic system', the regime of signs which represents the *expression* component of the interface assemblage. The 'pragmatic system' instead, actions and passions, representing the *content* component, will have to be directed by the users.
In doing so, the consequence will be that the architect will have to lose control over the end product which will be informed, activated,

[13]Grafton A., *Leon Battista Alberti, Master Builder of the Italian Renaissance,* Hill and Wang, New York, Usa, 2000
[14]Carpo M., *Op.cit,*
[15] Batty M., The origins of Complexity Theory in cities and planning, in *Complexity Theories of Cities have come of age*. Springer : Complexity, Berlin, 2012)
[16]Guattari F., *The three Ecologies,* Continuum International Publishing Group – Athlone, July 2000

manipulated by an empowered collectivity, with its own passions, emotions, traditions and aesthetics. This will be done through an algorithmic dialogue, initiated by the architect, where the final output of the *abstract machine* will be the result of a mutual feedback between the architect, the users and the context.



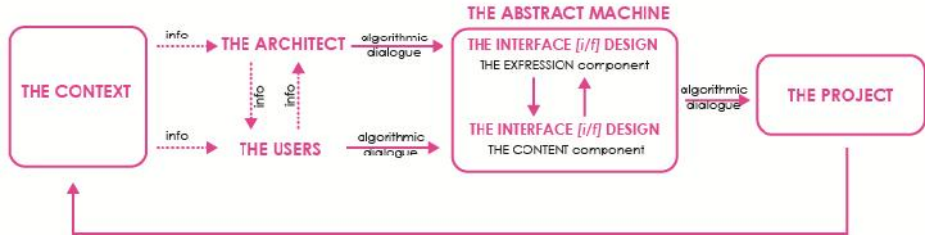


Fig 3.1: *The Architect, the Users and the Abstract Machine: diagram of the Interface [i/f]*

The Architect will become that *cartographer of subjectivity* already mentioned in Chapter 1.1.2.: capable of conceiving and designing new perspectives 'without prior recourse to assured theoretical foundations or the authority of a group, school, conservatory or academy'[17] as per the best transdisciplinary practice.

The cartographer of subjectivity is in our view the best definition of *Author* as borrowed by Alessandro Baricco: "[…] the ability to compose figures of meaning through the assembly of rather modest fragments of the real, […] the ability to trace an elegant and precise map of lands of which we know too much and therefore nothing; […] the skill through which one can merge into a single narrative scattered fragments of real existence that one had long since given up tidying." [18]

The narrative element of this new definition of authorship is strictly linked to the word *subjectivity*, which represents mostly the society's mental and aesthetic ecology, however, the capacity of 'forming, deforming and informing visions of the world[19]' belongs to the word

[17] Guattari F., *Op. Cit*

[18] Baricco A., *Con i miei occhi,* article published in La Domenica di Repubblica, number 539, 5 luglio 2015, pag.26

[19] Gausa M. et al., *Beacons (maps of beacons), definition,* in The Metapolis Dictionary of Advanced Architecture. City, technology and society in the

cartographer and in this light the informal domain constituting the *interface [i/f]* represents the new concept of *Style.*
The cartographer is not just the person engaged in the science or practice of doing maps, but he is an artist that owns the gift, the skill and the expertise to order, recompose, choose, edit, rearrange and catalogue the world, in order for us to understand it better and hence to be allowed to participate to it fully.
Nowadays we suffer of an overexposure to meaning; it is a form of dazzle: we are grateful to who succeed to give us back, with lightness and elegance, a form of order, 'to see the lines, to measure distances, to trace perimeters[20]' and if we are involved and contribute to the process, we enjoy it in a deeper and most endurable manner.
This opportunity, to be part of the process of creation (and in this specific framework we could say, creation of an aesthetic experience), is due to the very inner quality/essence of what the cartographer draws: maps.
Maps are understood as ''tactically operative' rather than static drawings – or descriptions[21]' and are therefore an open-ended device, an open system of thinking and describing, just as the *interface [i/f]* is.

Besides the capacity described above, there is another important gift the cartographer of subjectivity needs to possess and master: the ability to draw from the "the future to come", *l'avenir* (as by the definition given by Marc Augé - see Chapter 1.3.4), the internal desires and dreams of society in order to organize the project. It demands the capability and talent, in the more appropriate connotation of *sensibility,* to reach for the unknown, the mystery and yet the desired, the craved, the aspired, the yearned, the lusted.
He/She needs to seduce us.
He/She needs to become the ferryman of dreams capable to overcome the urgency of the immediate future, to lead society to reach once again the land of 'dreams and revolutions'[22].
He/she needs to be visionary.
It is in other words the capacity to tie back the notion of space and time, our relationship with them, which is "the essential element of the symbolic activity that defines the essence of man and that of humankind.[23]"

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information age, ACTAR, Barcelona, 2003
[20]Baricco A., *Op. Cit.*
[21]Gausa M. et al., *Op. Cit.*
[22]Augé M., *Futuro*, Bollati Boringhieri, 2012
[23]Augé M., *Op. Cit.*

That is why the work of the cartographer of subjectivity is definitely not just mapping the encountered/experienced as, for instance, someone like an archaeologist would do. He/she is a much more dynamic and active character.
In fact while the work of an archeologist is to bring back to light fragment of the past and knit them together to form a story about the past which can have an impact on our society just as a retroactive reading, the cartographer of subjectivity is dealing with fragments of time (past, present and future), space and materiality using his/her own subjectivity to make sense of them, creating stories which are rooted in the past, based on the present and thriving on the future.
He/She does certainly not just map the encountered and the experienced; to be of value he must also map the desires and dreams projected into the future by the society as well as all the big '*anthropologic themes'* (Life, Eros, the Sacre, Death, etc..) with their new dramaturgies[24], but he/she does so leaving the process open for others to add on.
He/She sets up the process, creates the organization, instantiate the models and orchestrates the external inputs back into his/her organization (project), but the final organization is the result of an open process.

In the world of art, a great example of such cartographies can be encountered in the work of the artist Jorinde Voigt. Her artworks are fundamentally maps and cartographies in the form of diagrams, notational procedures, 'icons of relations'[25], those very vehicles that 'transport a certain form of thinking and depicting that otherwise would not be visible[26]'
'Impression are grasped, structured and systematised in their very essence. Objects, daily routines, natural laws and personal thoughts appear in a context that makes clear how the various parameters of perception and of the experiencing of reality are linked. [27]'
In her search for the conditions of imagination, the artist is more concerned with the process, with the establishment of relationships, the

[24]Branzi A., as written in the papers of the installation '*Anime*' exhibited at la Fondazione VOLUME!, Rome, 23rd January -4th March 2016
[25]Vellodi K., *Diagrammatic Thought: two forms of constructivism in C.S. Peirce and G. Deleuze*, in Parrhesia, n°19, 2014
[26]Leeb S., *Wissensorganisation und Diagramm – Form in der Kunst der 1960er Jahre: Mel Bochner, Robert Smithson, Arakawa*, Materialität der Diagramme, Berlin, 2012
[27]Klüser J. & Wipplinger H. P., *NOW. Jorinde Voigt*, catalogue of the exhibition NOW at the Kust halle Krems, Kőnig, 2016

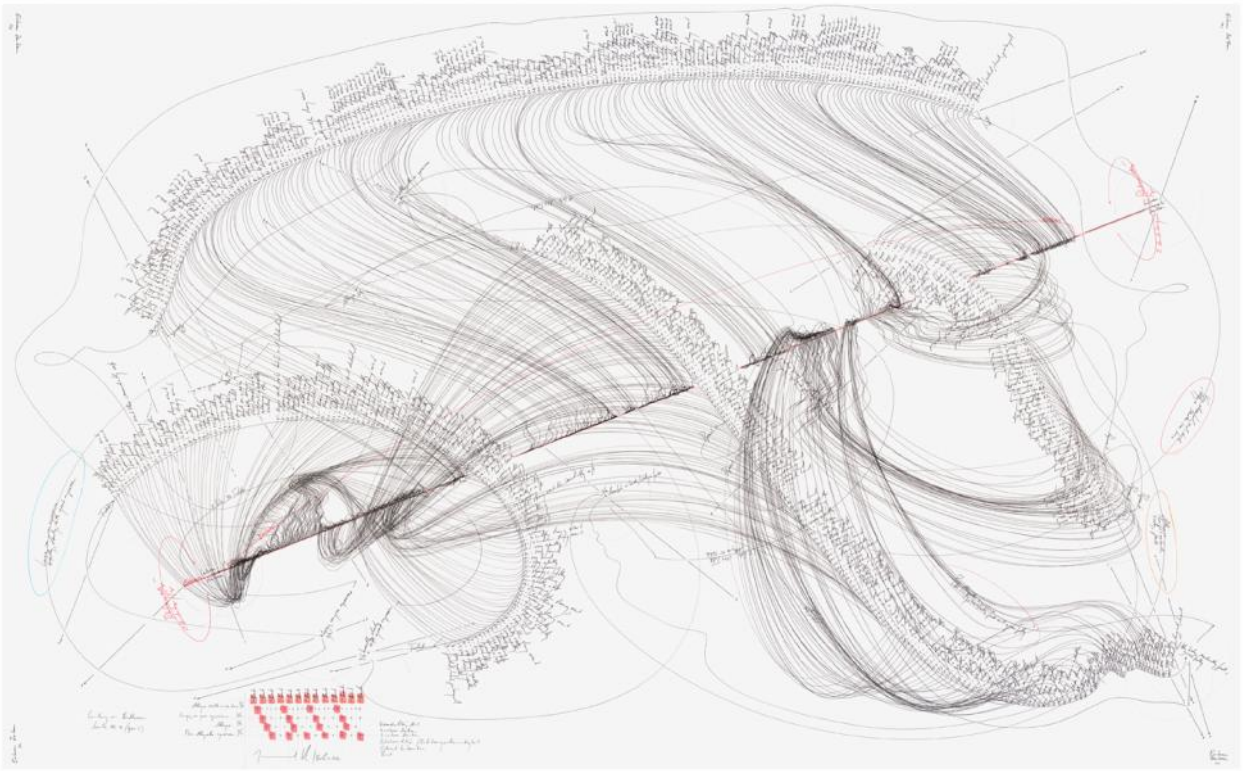

Fig 3.2: *Jorinde Voigt: Ludwig van Beethoven Sonate 4 (opus 7), 2012*

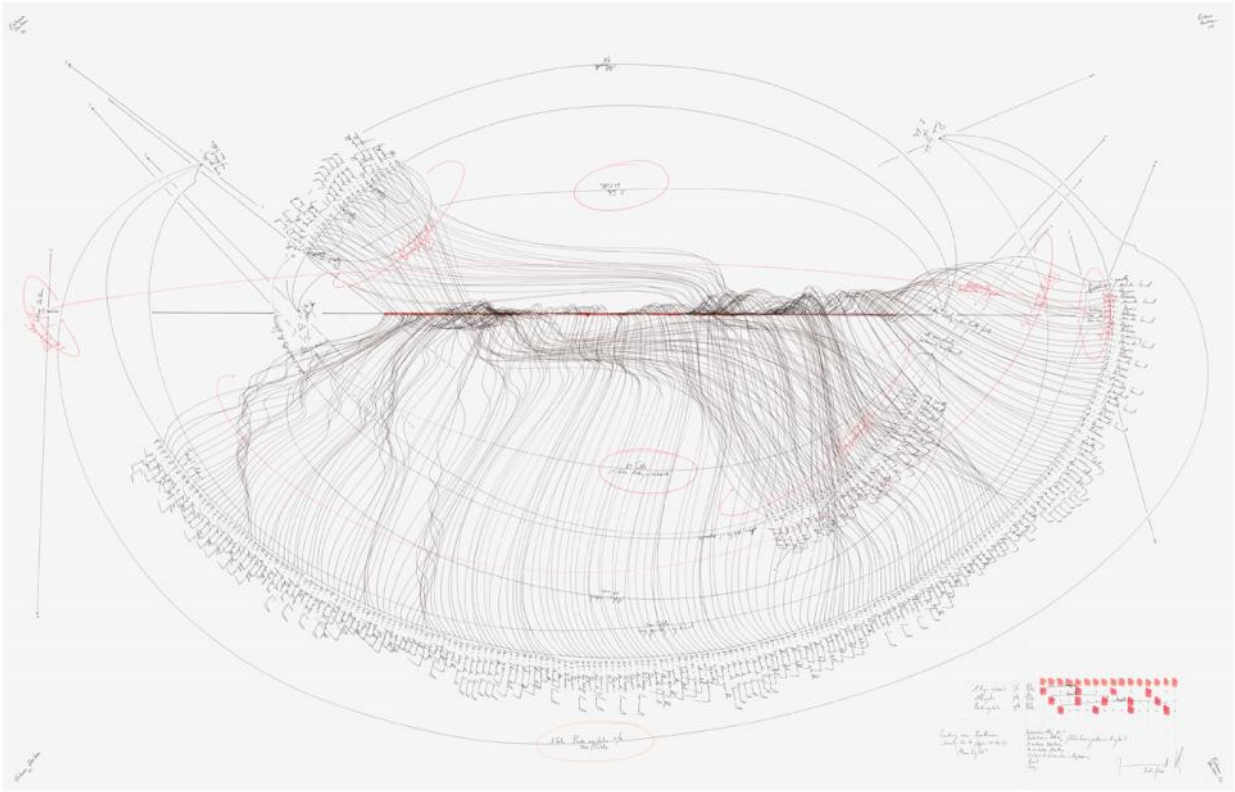

Fig 3.3: *Jorinde Voigt: Ludwig van Beethoven Sonate 14 (opus 27, n°2), 2012*

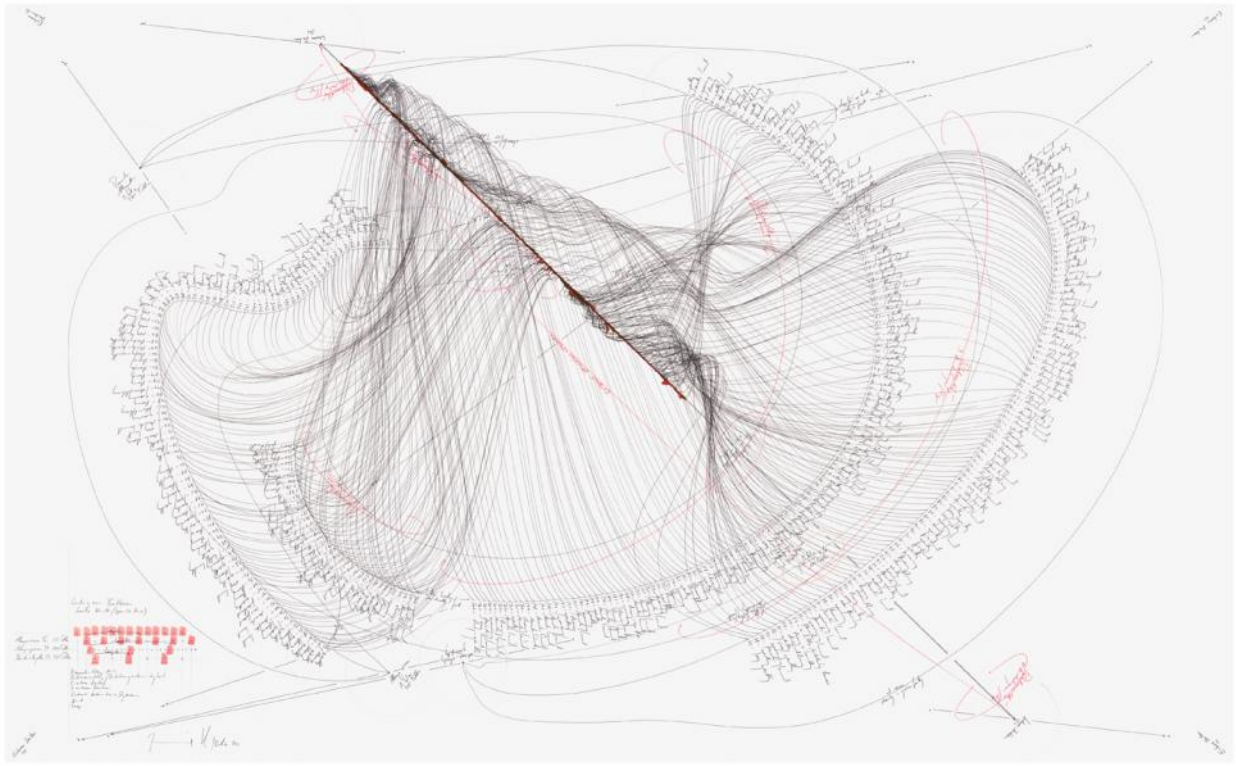

Fig 3.4: *Jorinde Voigt: Ludwig van Beethoven Sonate 16, (opus 31, n°1), 2012*

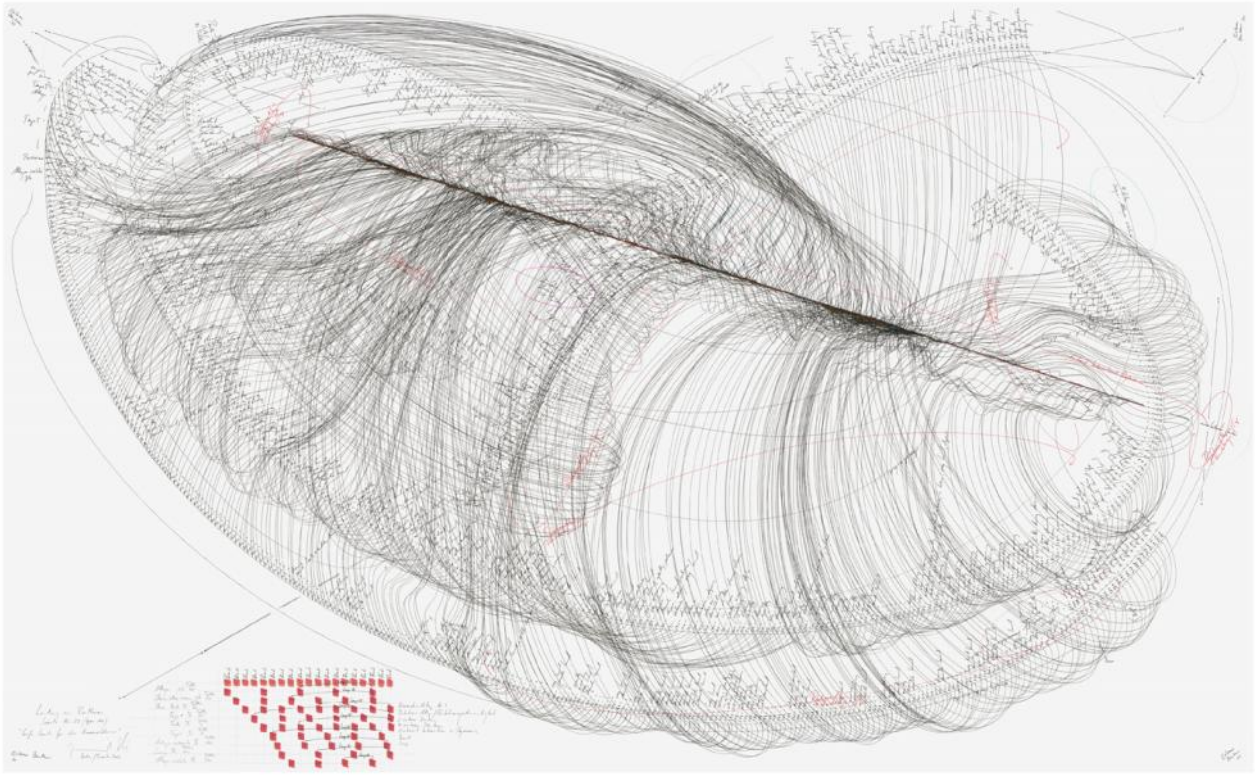

Fig 3.5: *Jorinde Voigt: Ludwig van Beethoven Sonate 29 (opus 106), 2012*

creation of actions and thus with the diagram as a 'figure of descriptive thoughts[28]'.
Her aesthetics of dry but convoluted and voluptuous lines is actually an expression of diagrammatic thought processes.
'[...] A vibrating structure in which the processes, following specific algorithms, enter into relationship with each other. Unlike a linear progression, the individual elements within the series develop their own logic of growth so that not the beginning and end of a genesis is visualized but rather an infinitely conceived process of change[29]'
In many of her works like *STAAT/Random* of 2008 or in *Ludwig van Beethoven Sonate 1-32* of 2012 for example, the entire series, an open system of thinking and describing based on multiplicities and constant variations, does not deal so much with 'depiction, order and classification[30]' but rather with the 'infinitely conceived movement of the parameters[31]', in other words, with the concept of seriality.
Voigt's notations clearly acquire an operative aspect, the same one intrinsic in the concept of the *interface [i/f]*.
They do so by documenting and orchestrating various processes of perception, imagination and thought. Such 'operative medium mediates between the sensual and the sense, as non-sensual elements such as abstract objects and concepts are embodied in the form of spatial relationships, which makes them not only conceivable and comprehensible but provides the foundation that they can be generated in the first place[32].'
At the same time her highly unstable, dynamic, fluid, rhizomatic and meticulous maps disclose processes of movements that, allowing divergences and alterations, declare one of the fundamental characteristics of Voigt's symbolic system: openness.
According to Julia Klüser, one of the very first gallerists who discovered the work of this artist, this openness, although situated on an abstract level and with no depictive intention of the lines, also resembles 'a compelling representation of modern-day network societies. [33]'
Her artworks are characterized by potentially continuous mutations; they do not offer a closed and finished horizon of meaning, and therefore they permit and include the participation of the other, the

[28]Leeb S., *Einleitung*, Leeb, 2012
[29]Klüser J. & Wipplinger H. P., *Op. Cit.*
[30]Klüser J. & Wipplinger H. P., *Op. Cit.*
[31]Klüser J. & Wipplinger H. P., *Op. Cit.*
[32]Krämer S., *Operative Bildlichkeit. Von der ‚Grammatologie' zu einer, Diagrammatologie'? Reflexionen über erkennendes ‚Sehen'*, 2009 available on line @ http://userpage.fu-berlin.de/~sybkram/media/downloads/Operative_Bildlichkeit.pdf
[33]Klüser J. & Wipplinger H. P., *Op. Cit.*

viewer, in order to complete the composition: they are actually finalized just in the moment the viewer experiences them *aesthetically*, as Umberto Eco used to write in his prophetic 1962 work *Opera Aperta (The Open Work).*

Fig 3.4: *Jorinde Voigt: STAAT/Random-VII, 2008*

This idea of openness and the previous discourse about authorship and style, in fact, recall quite likewise the intentions and the methodologies described by Eco.
His work was proposing the concept of 'openness' as a new aesthetic, poetic (a work's artistic purpose) and semiotic framework for communication and production, insisting on the importance of elements of multiplicity, plurality, or polysemy and the emphasis on the role of the reader (in the case of literature), the viewer (in the case of visual arts), the performer (in the case of music) or more in general, the addressee (in the case of art or architecture) as an interactive process.
This sort of works 'appeal to the initiative of the individual performer [ed. read also as reader, viewer or addressee] and hence they offer themselves not as finite works which prescribe specific repetition along a given structural coordinates but as 'open' works, which are brought to their conclusion by the performer at the same time as he experiences them in an *aesthetic plane*[34],
Eco ennobles this process asserting that 'the form of the work of art gains its aesthetic validity precisely in proportion to the number of different perspectives from which it can be viewed and understood. These give it a wealth of different resonances and echoes without impairing its original essence. [35],
For Eco however, the modern open work is far from being entirely free since a formative intention, what he calls a '*modo di formare'* and what we have previously defined as *style,* is manifest in every work and such an intention must remain a determining factor in the interpretive process.
Here lies the power of the author, the authorship, and his specific 'modo di formare', the style.

3.1.4 Collaborative rationality: an aesthetic assemblage

This view reflects a definition of Aesthetics which is not only, nor first and foremost, the sensation of the "consumer" of the work of art. It is also and more originally so, the set of sensations, more or less rich, of the artists themselves. It is about a certain contact with matter that is being transformed through work.[36] It is the recognition that part of the aesthetic sensations we experience are coming not merely from contemplation but from participation, a notion that is now validated by

[34]Eco U., *The Open work*, Harvard University Press, Cambridge Massachusetts,1989
[35]Eco U., *Op. Cit.*
[36] Simondon G., *On techno-Aesthetics*, Papiers, Issue 12, Paris, 1989

the contemporary studies in neurosciences and their *embodied simulation* theory. (See also Chapter 1.2.6.)

According to Simondon here would lay the secret of the incredible success of Mona Lisa's smile: Leonardo painted and revealed only two extreme terms of the smile. The smile's complete unfolding is read into the painting by those who contemplate it in their own individual or personal interiority.[37]

Aesthetic experiences de facto are not just *effects* caused by certain exposure or event, which imply a sort of unilateral directionality (cause-effect), but are mostly *affects*, a bidirectional movement in which the boundary between subject and object of the experience is blurred, overlapped. Affects represent both the value of the 'active' verb *affect* and the one of the 'passive' verb *to be affected*. Affects or percepts are emotions, are the vibrations of our most inner cords, the reverberation of inputs from the outside world given back as resonating outputs and as such they are the 'content' and the main 'formation' of the aesthetic experience. They thrive in the mutual action of feedback between the external and internal world: the bigger and more active/participated the exchange, the stronger the emotions.

As Simondon pointed out: '[…] contemplation is not techno-aesthetics' primary category. It is in usage, in action, that it becomes something orgasmic, a tactile means and motor of stimulation. […]It is a type of intuition that's perceptive-motoric and sensorial[38]'.

Artefacts or *techno-constructions* like urban environments need to be considered using these same techno-aesthetics criteria, criteria which are, by the way, subjected to a specific culture with its conventional and collective system of signs (see previously Chapter 1.4 of this volume): 'the aesthèsis, the fundamental perceptive intuition, is part of a culture.'[39]

We could refer to what Guattari calls the 'aesthetic decentring of points of view', a deconstruction of structures and codes in use typical of every polyphonic reduction of the components of expression, whose recomposition implies 're-creation, an enrichment of the world and a proliferation not just of forms but of modalities of being'[40].

According to Guattari's ecosophic paradigm these collective assemblages, or *abstract machines*, working transversally (read: transdisciplinary) on the different levels of existence, would organize a reinvention of social practices which would give back to humanity a

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[37] Simondon G., *Op.cit.*, Issue 12, Paris, 1989
[38] Simondon G., *Op.cit.*, Issue 12, Paris, 1989
[39] Simondon G., *Op.cit.*, Issue 12, Paris, 1989
[40] Guattari F.. *Chaosmosis, An ethico-aesthetic paradigm*, Power Publication, Sydney, 2006

sense of responsibility not only towards the material component of life itself (the planet and its living beings) but also towards that immaterial component (incorporeal species) which constitutes consciousness and knowledge, echoing Ulysses' words in Dante's verse: '*Considerate la vostra semenza:/ Fatti non foste a viver come bruti / ma per seguir virtute e canoscenza...*' [41] (*trs:* 'Consider well the seed that gave you birth:/ you were not made to live as brutes / but to follow virtue and knowledge').

This change of perspective in terms of critical agency would inevitably bring along a change in what Jacque Rancière calls the *distribution of the sensible,* whereby for SENSIBLE it is meant the acceptation of 'perceptible or appreciable by the senses or by the mind', not as the synonym of realistic, reasonable nor prudent or sober.

Hence the distribution of the sensible consists in new forms of inclusion and exclusion of the collectivity in the process of politic/aesthetic appropriation of reality, since the access to it (to the different distribution of the sensible) is the political instrument par excellence against monopoly.[42]

To the above, we could add that being the *inter-face* a literary locution, as well as a political statement, following Rancière's thought, it would be able to 'define models of speech or action but also regimes of sensible intensity, […] modifying the speeds, the trajectories, and the ways in which groups of people adhere to a condition, react to situations, recognize their images. They [literary locutions and political statements] reconfigure the map of the sensible by interfering with the functionality of gestures and rhythms adapted to the natural cycles of production, reproduction and submission.' [43]

So that the desired distribution of the sensible developed in a new model of critical agency, the *interface [i/f]* will have to catalyze an ontological symbolic reinterpretation of the map of the sensitive which sees the concept of ecology coincide with the idea of a good nature, primitive, pure and undisturbed, destroyed by human *hybris,* according to an outdated vision of ecology, better defined as the *new opiate for the masses.*[44]

Often criticized as the theory of 'out of control', definition that becomes even more pregnant in terms of critical agency, the complexity theory applied to the urban could instead, in our opinion, be the enabler of a

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[41] Alighieri D., *La Divina Commedia*, *Inferno*, Canto XVI, vv.116-120, Mondadori, 2005

[42] Rancière J., *The Politics of Aesthetics,* Continuum, MPG Books, Cornwall, UK, 2004

[43] Rancière J., *Op.cit*, Continuum, MPG Books, Cornwall, UK, 2004

[44] Žižek S., *On Ecology*, @ https://www.youtube.com/watch?v=iGCfiv1xtoU

new paradigm where the notion of single authorship with intellectual ownership and his aesthetic language is substituted by the concept of a collective and a new *Aesthetics of Choice* or 'aesthetics of decision'[45]. Aesthetics then might recover, according to the evolutionary theory, their real and fundamental meaning, traded, throughout history, for more cultural, intellectual, philosophical and abstract definitions, losing its very core nature: their essence of *an adaptive system* and *an ecological category*[46].

We would then recuperate that '*flux of participation'* evoked by David Abram: 'Our senses are not for detached cognition but for participation, for sharing the metamorphic capacity of things that lure us[47].'

[45]Shaviro S., Against self-organization; The Pinocchio theory, on line http://www.shaviro.com/Blog/?p=756

[46] Di Carlo I., The aesthetics in the definition of sustainability, *Cities in Nature. Eco-urbanism Landscape Architecture,* ed. Scaglione Pino, List Lab, Trento, pp 87-94, 2012

[47] Abram D., as quoted in *Reclaiming Animism*, Stengers I., on line http://www.e-flux.com/journal/reclaiming-animism/

3.2 Evaluation metrics: a need? Maybe a possibility...

"Aesthetics create the need.
Metrics provides the measurements of change required.
Design provides the mean."
(Thackara J., Metrics or Aesthtetics? 2010)

"Only if the processing of symbolic representations is related to the tacit context within which they become meaningful, does a semantic engine becomes possible."
(C.P. Goodman, The Tacit dimension, 2003)

"In order to harvest the power of organic machines, we have to instill in them guidelines and self-governance, and relinquish some of our total control"
(K. Kelly Out of Control: the new biology of Machines, Social systems, and the economic world, 1994)

3.2.1. Evaluation metrics: important questions

Having defined the architect as the new cartographer of subjectivity and the *interface [i/f]* as an abstract machine for collaborative rationality, we have been also suggesting that their meta-product, those 'incorporeal ecosystems' that are also aesthetic assemblages, are at the same time a combination of extremely precise parameters controlled by the potentials of technology and a mixture of personal and collective values, a less 'measurable' set of information and knowledge.
The above considerations lead us inevitably to ponder over different important questions:

-How could the above mix ever work in an effective and accountable way?
-Could the *interface [i/f]* reconcile both a top down and a bottom up approach into one urban model?
-If so, what would be the difference with other previous models of 'participatory design'?
-Is there a need for an evaluation metric to measure the aesthetic success of such incorporeal ecosystems, to pursue a measurable scale of aesthetic values?
-And if this would be the case, would there be a possibility to do so?

Those questions really lies in trying to combine a metric system, defined by parameters, an *explicit* form of knowledge codified and vastly accepted ('the metric system is for all people for all time[1]'), with values, a more tacit form of knowledge, or *tacit dimension* as per the definition of Polanyi[2].

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[1] Condorcet de N., quoted by Alder, K. in *The Measure of all Things - The Seven - Year Odyssey that Transformed the World*., London: Abacus., 2002
[2]Polanyi M., *the Tacit Dimension*, University Of Chicago Press, Reissue edition,

As said previously in Chapter 1.2.4. another characteristic of the tacit knowledge is that it can only be revealed through practice in a particular context and transmitted through social networks[3].
The fact that the *interface [i/f]* is according to the definition previously given an open-ended, participatory, interactive and self-organizing device puts it automatically within the same realm of the social networks and therefore among the modalities for transmission of values.
The importance of the social network is related to the significance of enabling the incorporation of an external component, 'the others', into the validation of any semantic process of investiture of meaning.
This principle is also the one at the base of both the Open Source (OS) phenomenon and the attitude of any scientific communities: the essence is not just a voluntary unpaid work with the eventual wish to get something for free, but it is rather a need to transmit to others the results of a work for them to judge, analyze, change, criticize and even develop further.
As a matter of fact, as Guattari said, it is actually 'this praxic *openness* that constitutes the essence of the art of the '*eco*'[4] where 'eco' is used in its original Greek sense of *oikos* (*οἶκος*), habitat, environment, natural milieu.
On this regard it is worth mentioning a consideration done by Valerie Châtelet on OS phenomenon but definitely applicable to the *interface [i/f]* concept: "It is important not to reduce the OS phenomenon to the decentralisation or radical distribution of decision-making. In actual fact, the role of integrator, the person who coordinates new versions by deciding whether or not to include developments, or who runs a mailing list, remains very much to the fore[5]". If we were to exchange the words OS phenomenon with *interface [i/f]* and the integrator with the cartographer of subjectivity, the meaning of the sentence would remain nearly the same.

In this light it seems correct to suppose that also an accurate and sensible management of different degrees of involvement of the users/public/collectivity into the design process becomes critical to gain proper and successful results in the search of meaningful models.

2009
[3]Schmidt, F. L.& Hunter, J. E, *Tacit Knowledge, Practical Intelligence, General Mental Ability, and Job Knowledge Current Directions* in Psychological Science, February 1993, 2, pp. 8-9,
[4]Guattari F., *The three Ecologies*, Continuum International Publishing Group – Athlone, July 2000
[5]Châtelet V., *Op.Cit*

3.2.2. An explicit form of knowledge that integrates the tacit dimension: the development of Relational Urban Models (RUM)

An example of how an *interface [i/f]* device could develop in terms of technology and use can be seen in the groundbreaking work done by the group Relational Urbanism® (Eduardo Rico Carranza and Enriqueta Llabres Valls) with their RUMs (Relational Urban Models).
Questioning the relationship between urban environments, current technologies, availability of data, roles of the main actors to the planning processes and citizen participation, they have started to set up a parametric system capable to allow for a real time interaction/participation between different groups of contributors during the design process, creating fully functional, self-organised complete models for Urban Planning/Design.
Conjugating Harvey's understanding of constructing space time and value through *relational domains*, group of people sharing common features relative to a specific issue, with Polanyi's concept of *the tacit dimension* and the master use of *parametric algorithms*, they have created an *interface [i/f],* which they call *'informal domain'* or *RUM.*
'These are customized toolkits of urban parametric models, databases, infographics and interactive platforms allowing real time interplay with urban form in such a way that users can understand interdependencies between different spatial and non-spatial parameters. The purpose is not so much showcasing existing data or decisions made a priori, but fabricating new knowledge and building urban institutions understood as "a set of rules based on ethical values of a specific community that influence the individual's decision making [6].'
The RUMs are not only incorporeal, or informal, ecosystems but are most of all aesthetic assemblages: the designer, employing the tacit knowledge, is capable 'to engage with this level of knowledge and arrive to the wider audience through inner feelings and developing ideas in the form of intuition that can only be contained within the individual[7].'
Some meaningful examples of how the RUMS work can be found in the regeneration of BaiShiZhou urban village in ShenZen, the transformation of the Brazilian town of Santos and the landscape analysis and proposals for the Yangtze River during the Wuhan Future City Workshop.

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[6]Rico Carranza E. & Llabres Valls E., *Relational Urban Models: parameters, values and tacit forms of algorithms,* in AD: Parametricism 2.0: Rethinking Architecture's Agenda for the 21st century, March/April,, John Wiley&Sons Ltd, London, 2016
[7]Rico Carranza E. & Llabres Valls E., *Op. Cit.*

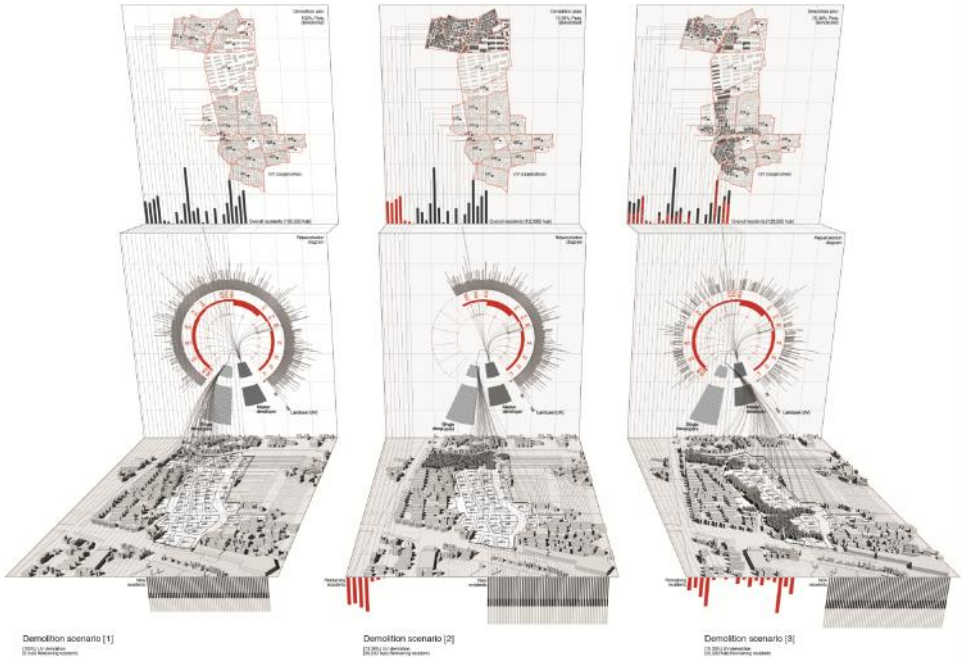


Fig 3.5: Relational model outcome for three demolition options in BaiSHiZhou urban Village.

In the BaiShiZhou[8] regeneration plan, the RUM has been modelled to help a reduced group of stakeholders to face the challenge of a problematic regeneration: the will to keep key workers in Chinese villages as per the government agenda would conflict with the interests of the landowners and developers who would count on a total upgrade of the area with higher densities and profits. The goal was therefore to imagine scenarios capable to induce incremental regeneration though partially maintaining the existing social mix.

The RUM was then designed, through the use of a generative algorithm, to respond to retained blocks proximity, highlighting the value of the urban villages' public spaces. The diversity in size and types of the public spaces was granted by the use of a plinth structure while densities and sunlight exposure constraints were regulated by a series of above towers. 'An optimization mechanism was used to interrupt and reverse the flow of information which typically would go from design parameters towards calculation results. The outputs can be turned into inputs, seamlessly moving between spatial, infrastructure and economic decisions, opening up discussions about marginal costs of design concepts, potential economic transfers linked to density distribution or other types of negotiations[9].'

[8]Baishizhoun RUM. Team: RU Direction Enriqueta Llabres. Team Giorgio Ponzo, Jung Hyun Woo, Juan Carpio, Javier Serrano, Giulia Grassi, Giulio Dini and Tessa Steenkamp. Coding Direction Immanuel Koh. ARUP Ian Carradice and Eduardo Rico. PEER REVIEW Charles Waldheim. Local support by ShenZhen University

[9]Rico Carranza E. & Llabres Valls E., *Op. Cit.*

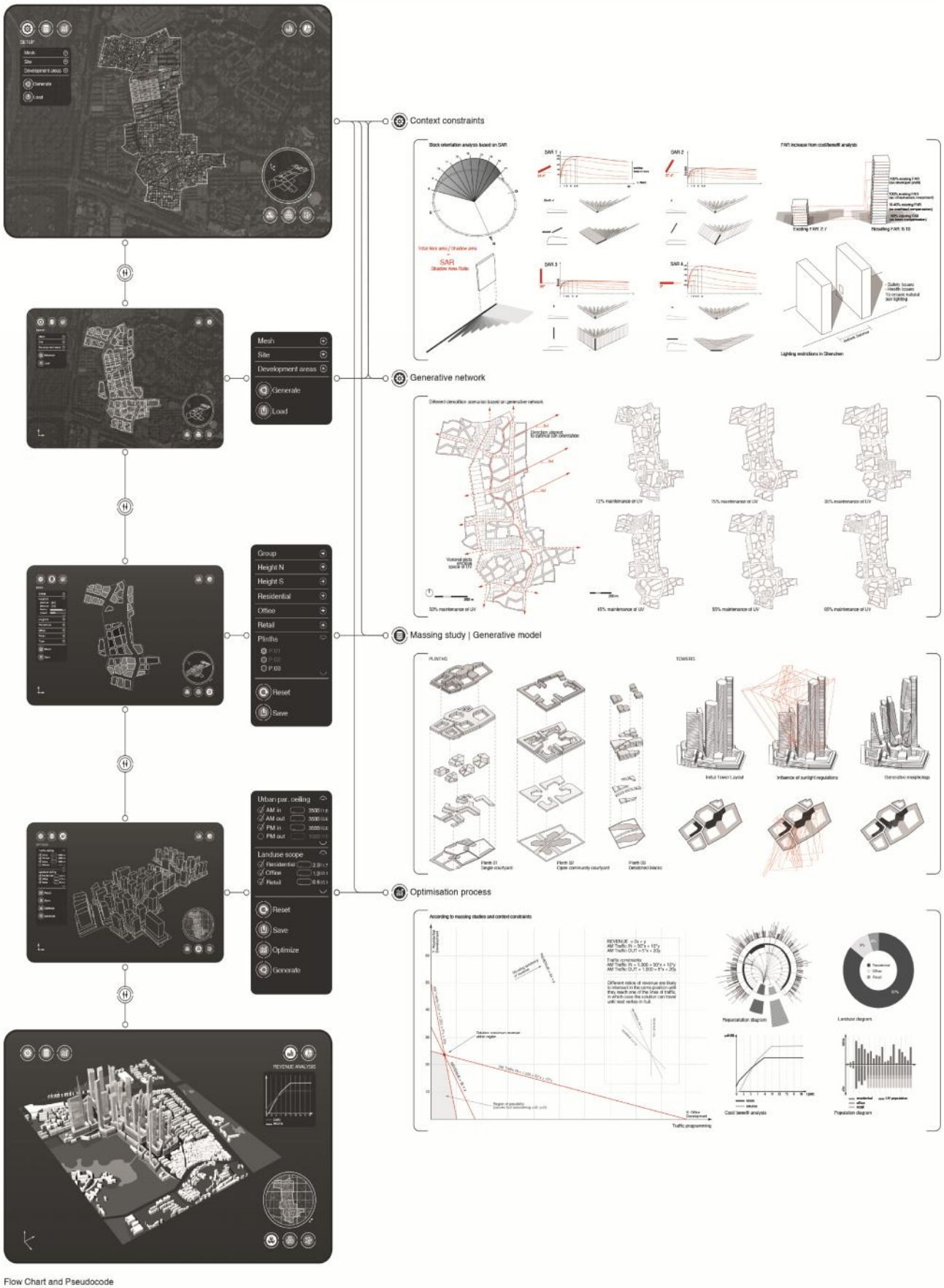


Fig 3.6: Development of the interface for BaiShiZhou regeneration project.

Fig 3.7: Sample of plan for BaiShiZhou regeneration project.

In this case the role of the *interface [i/f]* has been modelled by the designers to offer the users a systematic rather than intuitive control over different spatial results targeted to balance social mix and profit though maintaining a similar development quantum.

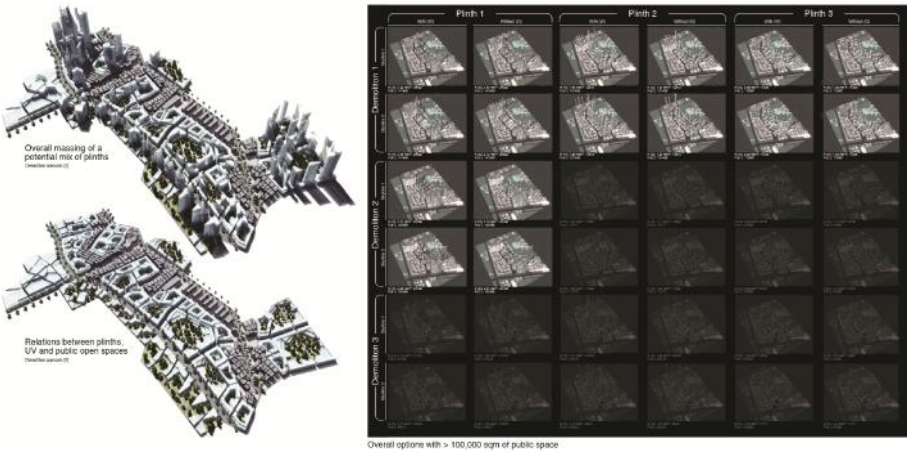


Figure 3.8: Model outcome and options for BaiShiZhou regeneration project.

In the second example, in Santos[10], the RUM was designed as well for a restricted group of stakeholders but in this case they were 'non-experts', a characteristic that implied a higher attention and inclusion of values, the tacit dimension, within the assemblage of the model.

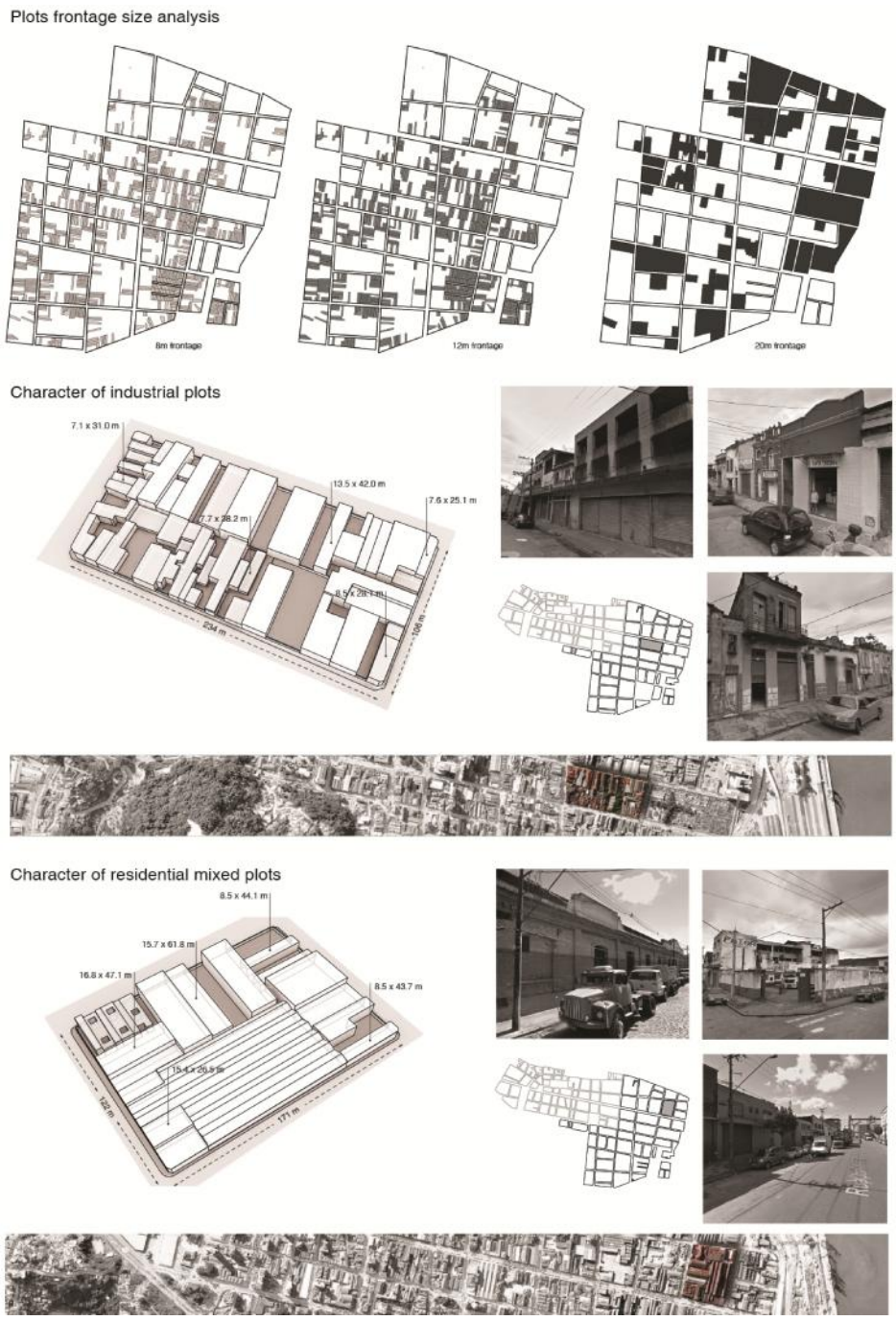


Fig. 3.8: Context of Santos Vilanova and Paqueta area

[10]Santos RUM. Team: RU Direction Enriqueta Llabres. Team Giorgio Ponzo, Jung Hyun Woo, Juan Carpio, Javier Serrano, Giulia Grassi, Giulio Dini and Tessa Steenkamp. Coding Direction Immanuel Koh. ARUP Ian Carradice and Eduardo Rico. PEER REVIEW Charles Waldheim.

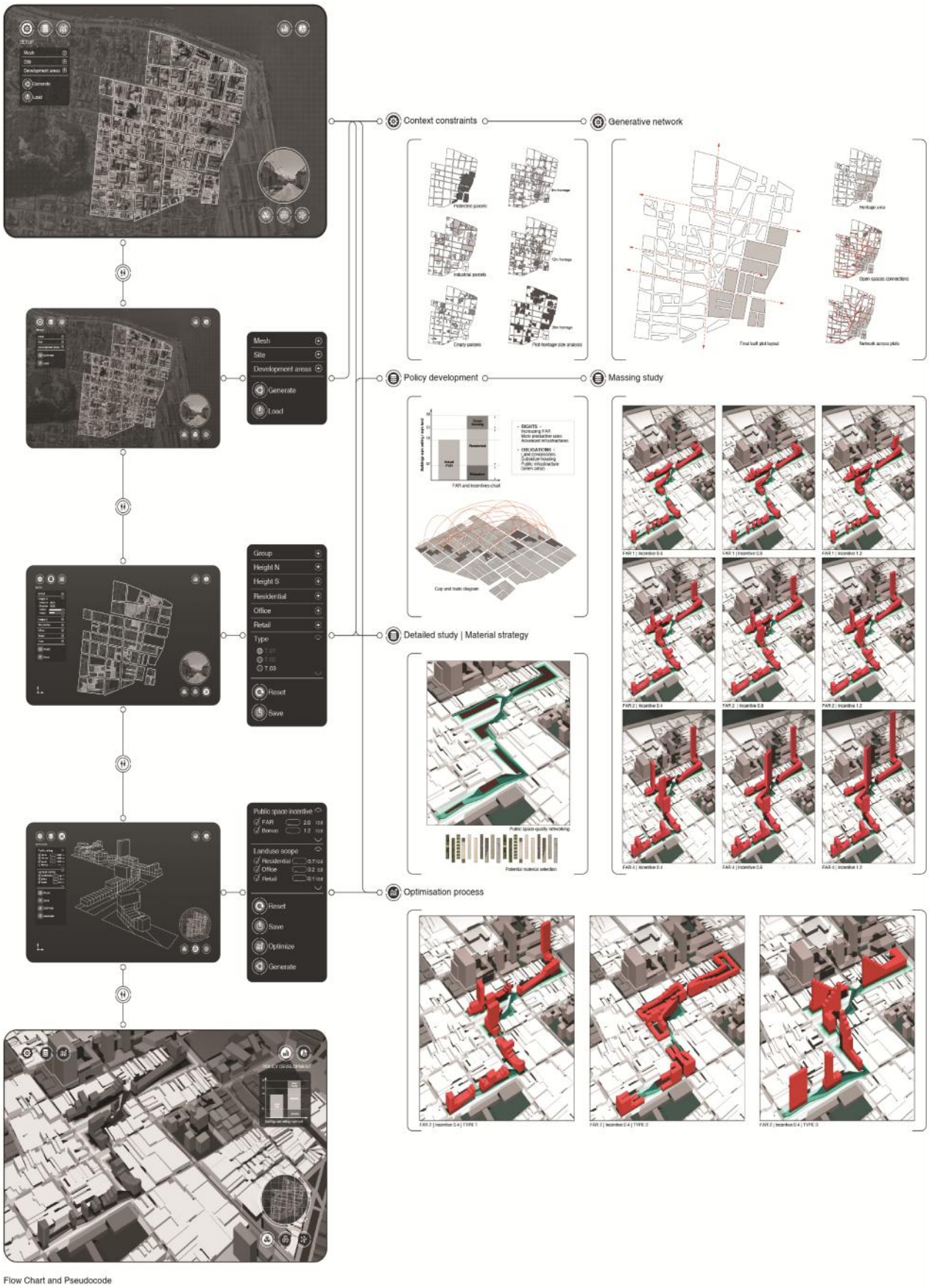


Fig. 3.9: Development of the interface for Santos regeneration project

A low density mixed use area was to be transformed by public investment in civic buildings and two new tram lines. Within this context of small grain and fragmented land ownership, the challenge raised was to provide a successful story by 'orchestrating' diverse proposals without relying on a single final top down master plan.

'In this context, the RUM was used as a form of testing the effects of an incentive for the fabrication of a public space design based on an interconnecting landscape which derives from the user's selection of urban plots to be regenerated. Densities as well as bonuses for landscape provision can be tested in the model giving a quick feedback about the influence of incentives as a form of policy together with a vision of the quality of public space[11].'

The interesting thing about this specific RUM is that not only the designers had to capture the values of the community turning them into incentives set by the municipalities, but that the model itself had to comply and please individual decisions of 'clustering and reaching one to one agreements. It was designed to extract knowledge about preferences in pooling resources by members of the public in ways which are more difficult to systematize.[12]'

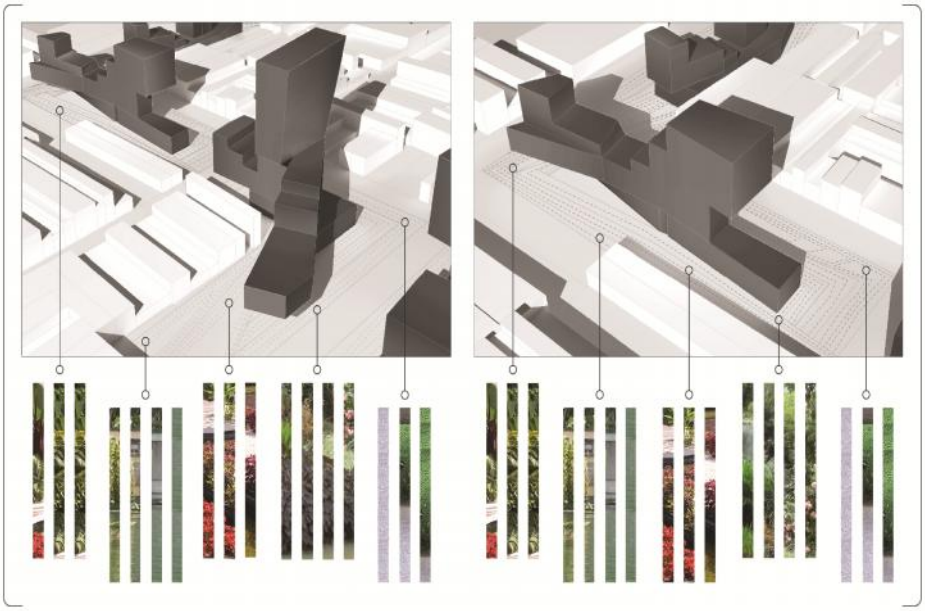


Fig. 3.10: Generative urban landscape linked to open space network for Santos regeneration

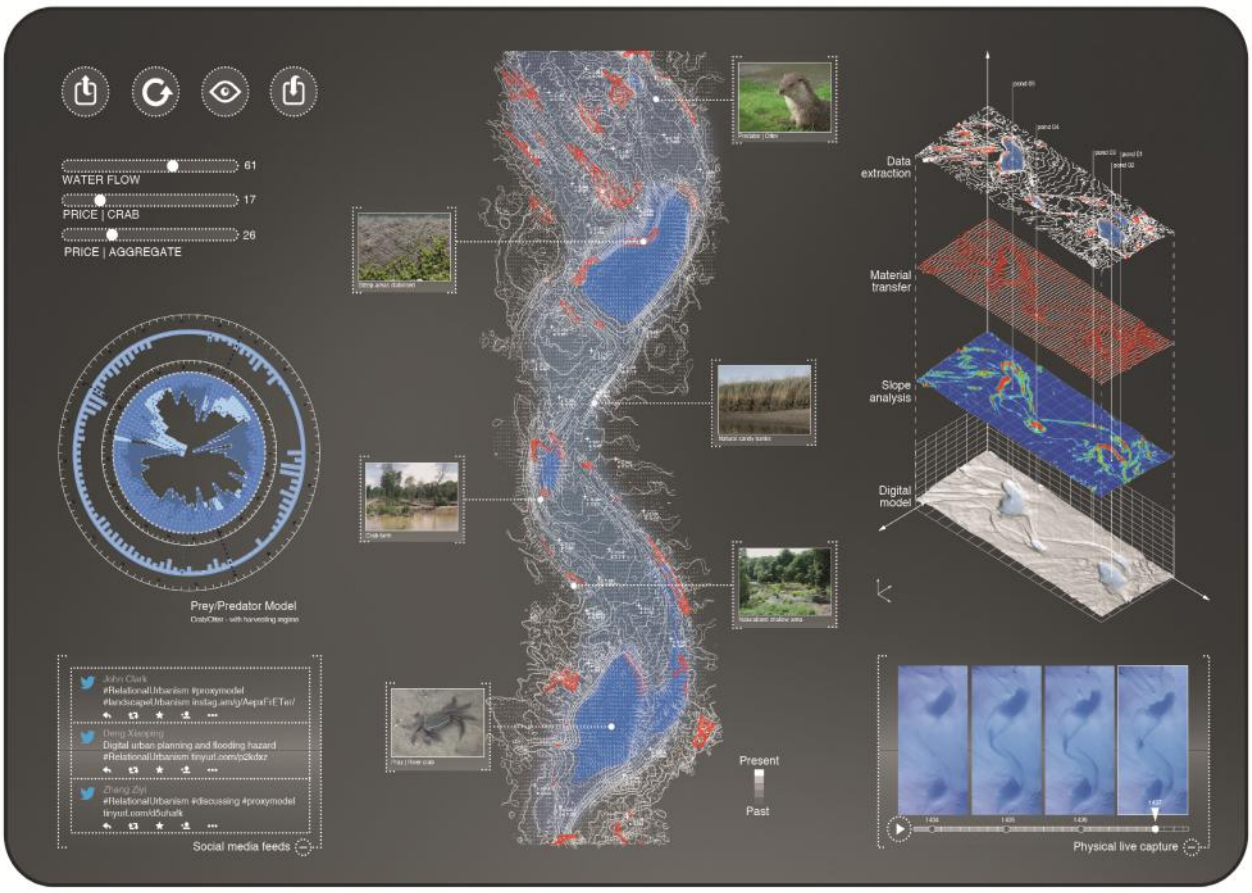
[11]Rico Carranza E. & Llabres Valls E., *Op. Cit.*
[12]Rico Carranza E. & Llabres Valls E., *Op.Cit.*

The last case, the Yangtze River model[13], is possibly the most engaged with the harvest and the use of the tacit dimension, in its vastest meaning of values, ideals, beliefs, feelings, mental and aesthetic models, etc..
The project was basically an installation, a scaled down version of a braided river running in a laboratory tank, meant to deal with the problem of sediment and ecosystem management in river landscapes where the use of riparian terraces as sources of aggregate and the channelization of the river could have either a negative impact on ecologies or, if properly planned, be a potential benefit in landscape regeneration. This part of the installation constitutes the tacit knowledge, as the results of this model are mainly of a qualitative nature.

Fig. 3.11: Generative urban landscape linked to open space network for Santos regeneration

The explicit knowledge instead is represented by the incorporation in the installation of a digital system capable of scanning the river morphology in terms of water depth and sand topography to generate its computer version with the accuracy of a millimetre. Alongside the tank, the digital model is analysed in real time through its different components: geometric (pond area, average and local slopes), ecologic

Yangtze River[13]Team RU: RU Direction Eduardo Rico. Team Enriqueta Llabres, Giulio Dini



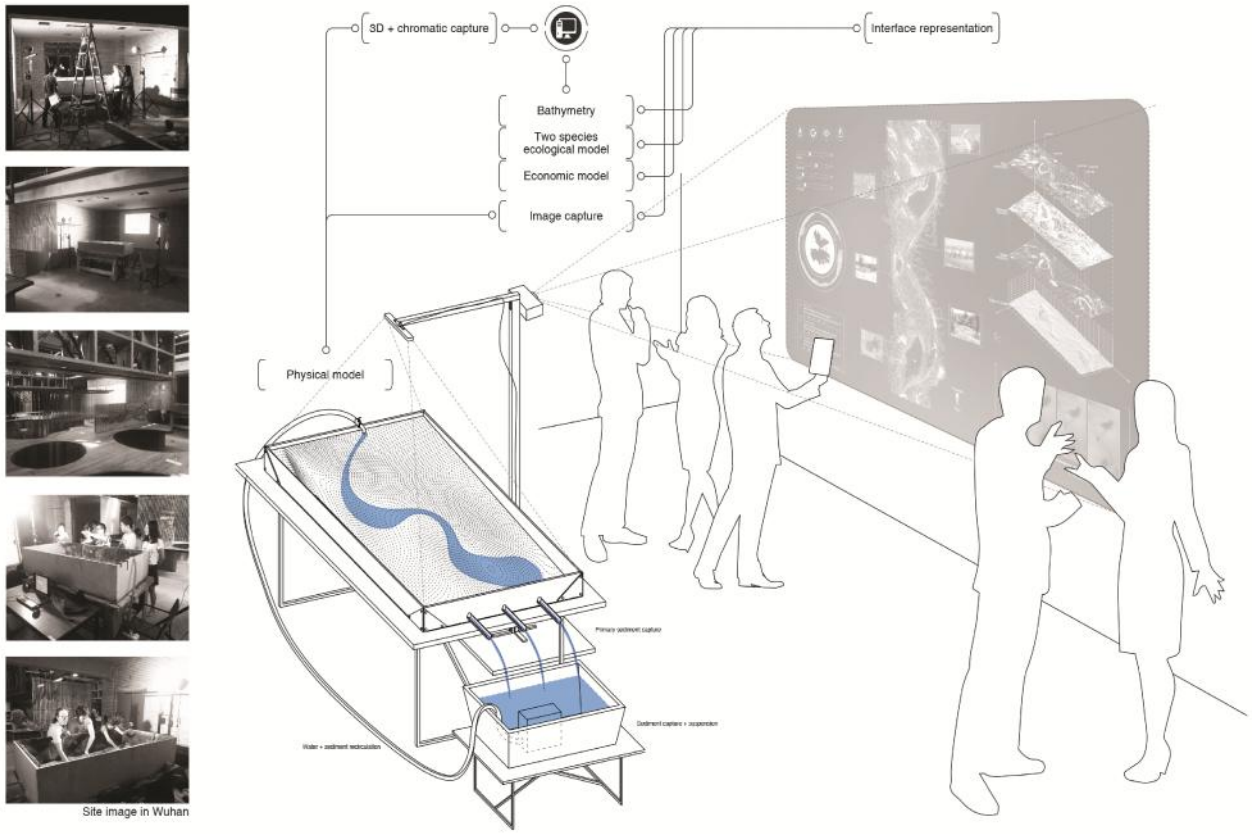


Fig. 3.12: Interaction between public and watercourse in a physical Relational Model

(prey-predator model simulation) and economic (fisheries and aggregate extraction).

'The idea behind the work is that users can "play" as a form of tacit algorithm with a landscape miniature which immediately reacts to alterations and observe a "fast track" evolution of the landscape morphologies and ecological succession which would take several years to occur at the large scale. Cause and effect of human actions are amplified and accelerated so the spectator becomes aware of the interdependencies, subtleties and the relational nature of the environment which he or she is manufacturing. The RUM has a strong tacit component, seeking a sense of immersion into the river dynamics provided by the texture and noise of the model as well as data projection[14].'

The work of Relational Urbanism® shows us how their models, in the form of an *interface [i/f],* are capable to deal with three of the biggest issues in the praxis of the self-organised city:

- to use an explicit form of knowledge that integrates a tacit dimension,
- to reconcile both a top down and a bottom up approach into one urban model and
- to handle different degrees of participation, interaction and self organization according to the level of involvement required by its users

The public is never just a 'spectator', being included in the creation process since the beginning, and has therefore the possibility to feel active in a process of *collective choice.*
The Architect, on the other hand, remains that *cartographer of subjectivity* skilled enough to 'provide the mean' of a coral, polyphonic and collective form of intervention.
A balance between top down and bottom up processes is maintained and this is a guarantee to surmount any rigidity of a pure linguistic methodology, based on the cult of the object typical of the archistars world, or a merely ideological one, based on strategic and organizational paradigms characteristic of urban planners.

What becomes interesting to analyze is how the RUMS differentiate from other past and present models of participatory design and place making. Why they represent a radical improvement compared to such models (ie: Giancarlo De Carlo, Alejandro Echeverri e Sergio Fajardo -

[14]Rico Carranza E. & Llabres Valls E., *Op.Cit.*

Municipio de Medellín-, Architecture for Humanity, Elemental, Ecosistema Urbano, Atelier d'architecture autogérée, etc...) and an unprecedented opportunity for *co-design* by citizens, communities, and professionals alike?

The answer lies on the exploitations of the technological era and its apparata or mediums: the world is becoming more and more digital and virtual offering countless technological, online, open sourced, real-time set of tools that have gradually deconstructed many physical, political and cultural frames. The convoluted system of networks crossing the planet is shaking and reformulating the operative framework and its tools both in physical and notional terms. The strategic, creative and synthetic combination of those tools represents the news.

Looking into details, the majority of the so called participatory place-making in urban planning is too often in reality a form of consultation rather than participation: information about the change rather than active contribution into the design process. Even when the participation does happen, usually it happens through a dialogue, oral or written, with the designer which most probably will take the form of a sort of 'wish list' that the designer will assess, producing later on one or two options.

In some lucky cases like, for instance, the works of *Ecosistema Urbano*, the users are provided with a web platform, LOCAL_IN, 'to facilitate consultation, exploration and visualization tasks of a great variety of data[15]' helping to define the project and to integrate it into a socio-urban context, identifying opportunities or problems.

However, even in this case the exchange of information happens just in the form of texts or dialogue boxes, but it never materialises in real time into the creation of a design output. It is not really an interface of interplay because the architects cannot assess the request of each participating individual.

The RUMS have the capacity to organize and manage in real-time huge numbers though concurrently allowing interplay: enormous quantity of data, massive participation of individuals, vast amount of design variations for the same requirements, large number of disciplinary fields examined at the same time, etc....

They do it simultaneously providing a design output with all sort of graphic materials, from infographics to tables, from plans and sections to 3D models and diagrams to allow an easier, more real, profound and synthetic understanding of the design process.

They differ from precedent analogous models as:

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[15]From http://ecosistemaurbano.com/portfolio/localin/.

1. They insure the possibility to welcome, integrate, manage and organize the input of a tremendous amount of people at the same time which in the past would not have been possible for the simple lack of adequate physical space and economic resources ;
2. They do it independently from the participants' actual geographical location and time zone since the participatory act happens through access from any computer or portable device connected to internet;
3. They process extensive amount of data and
4. Their design output is given back in real-time, being the process governed by self-organizing genetic algorithms;
5. They organize at once feedbacks seamlessly moving between economic, technical, spatial, morphological, environmental and statistical decisions;
6. They are able to produce an incredible number of design variations characterised by the same chosen requirements;
7. Last but not least, they have the capacity to develop and synthesise the *tacit knowledge.* They are based on the belief that 'we know more than we can tell' and therefore that people, provided with the relevant tools, can design and through design communicate things that they cannot tell or even think about. This is why the RUMS are customised design toolkit, customised to the project, audience and main issues at stake.

The RUMS models are therefore quite far from the previous models of participatory design used in urban planning and are instead much closer to the concept of *co-design* proposed by CK Prahalad and V. Ramaswamy in their work on marketing '*The Future of Competition: Co-creating unique Value with Customers'* published in 2004 by the Harvard Business School Press.

In this publication the authors explain how in order to transform a brand or a product into something new, and not simply better, the company needs to tap into the consumers' creativity both in global online communities and in workshops around the world.

The need for change begins by recognizing the new role of the consumer (in our case : of the citizen) which has changed from isolated to connected, from localised to globalised, from unaware to informed, from passive to active. It is the access to unprecedented amount of information, the erosion of geographical limits, the power of networking, and the desire of the 'consumers to exercise their influence in every part of the business system.[16]' In other words, it is the authority

[16]Prahalad C.K. & Ramaswamy V., *Co-creating unique value with customers*, 2004, available on line @ https://www.cs.cmu.edu/~jhm/Readings/Co-

of the digital era which establishes that the use of interaction is the basis for co-creation in our emerging reality. It institutes 'a new frame of reference for value creation[17]' where the co-creation experience of the consumer/citizen becomes the very basis of value.
Prahalad and Ramaswamy strongly underlines that the fundamental condition that determines the co-creation of value lies in personalised interactions that are meaningful and sensitive to a specific consumer.
This is exactly what the RUMS do and the reason of their unique potential.
(For more specific information on the RUMS please see the Appendix)

3.2.3. Evaluation metrics: a need for an aesthetic assessment?

Within a framework like the one described in the previous paragraph and following Simondon's thought on techno-aesthetics (see Chapter 3.1.4.), one could argue that the question about the need for an evaluation metric to measure and assess the aesthetic success of such an *interface[i/f]/*incorporeal ecosystem/aesthetic assemblage could sound redundant.
Following different studies on the constraints and opportunities of OS phenomena, it would seem that the fact of coordination without coercion guarantees project quality and durability.
"Unnecessary developments that are not linked to any specific requirement disappear naturally, while those that spark the most interest will spontaneously develop more quickly. The surprising thing is that the development of OS software turns out to be more reliable, more durable and more rapid; to such an extent that Alain Levebvre maintains that the development of OS is the only method capable of defining standards. [18]"

However, despite the philosophical backup, it would be worth dwelling a bit longer on the possibility to pursue a measurable scale of aesthetic values for the final output of the creation process of our urban environments.
Architecture and the city, where city is considered as the Latin concept of *Urbs* and not *Civitas*, are to all effects artifacts and "are generally considered to be static, a-biotic components of the constructed or natural ecosystems in which they are situated[19]" They are the physical

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creating%20unique%20value%20with%20customers.pdf
[17]Prahalad C.K. & Ramaswamy V., *Op. Cit.*
[18]Châtelet V., *Op.Cit*
[19] Mangone G. & Teuffel P., Constructing Sensuous Ecologies: Beyond the energy efficiency and zero carbon argument, *Aesthetics of Sustainable Architecture*, ed.

medium where living subjects exchange relations. Borrowing again the dictionary of biology we could argue that they are the *biotopes*, ecosystems' components characterized by a-biotic factors with their physical and chemical features but not disjointed from their biotic biological components, the *biocenosis*: both are the indivisible components of an ecosystem.

However, within the framework of systemic thinking a more adept perspective would be to redefine buildings and cities as *constructed habitats*.

This design approach inherently encourages exploration of the performance potential of incorporating ecological behaviors – multivalent, adaptive, aesthetic, spatial, parametric and systemic – into the design process, constructing '*sensuous ecologies*'[20].

In order to pursue this path we need to answer the question: "Is it possible for constructed ecosystems to be developed in symbiotic ways?" According to Mangone and Teuffel, this is possible when natural ecosystems and processes are understood as valuable design elements. This perspective reconnects natural and human processes and environments, considering them to be interdependent and in the end indistinguishable. Developing habitats that interweave the natural ecosystem with the constructed ecosystem is one approach that has the potential for creating environments with much more intensity and nuance than current static ones permit[21]: in other words a new Aesthetics.

The challenge though here is how to establish the metric system for evaluating constructed habitats to objectively distinguish parameters and processes that advance, from those that diminish the aesthetic quality of such habitats.

A possible investigation in order to measure a certain degree of success or failure in terms of aesthetics could lead us to borrow the method and the performance metrics from how ecologists measure natural ecosystems as cultural services and non use values where cultural-cum-service is defined as the 'aesthetic, artistic, educational and /or scientific value of ecosystems[22]' and non-use values as the ones which 'encompass all values separated from use[23]'.

Sang Lee, 010 Publishers, Rotterdam, the Netherlands, pp. 243-258, 2011

[20] Abram D., *The Spell of the Sensuous: perception and Language in a More than human World*, New York: Pantheon Books, 1996

[21] Mangone G. & Teuffel P., *Op. cit.*

[22] Costanza R. and others, The value of the world's ecosystem services and natural capital, *Nature* (387**)**, 253-0,1997

[23] Goulder&Kennedy, Valuing ecosystem services: philosophical base and empirical methods, *Nature's services: social dependence on natural ecosystems*. ed.G.C. Daily, Island Press, Washington, DC, pp.23-47, 1997

This could be the path to recover and regain ‘the way the senses themselves have, of throwing themselves beyond what is immediately given, in order to make tentative contact with the other sides of things that we do not sense directly, with the hidden or invisible aspects of the sensible[24].’

To say it as Joseph Beuys did, where perception is comprehended, there is reality.

[24] Abram D., *The Spell of the Sensuous: perception and Language in a More than human World*, New York: Pantheon Books, 1996

APPENDIX

A critical reading of an application of the Relational Urban Models

Testing of Digital Interfaces as negotiation devices for densification plans in BaiShiZhou, a Shenzhen district.

1. Introduction

In 2013 Arup DTF funding was granted for the study of the applicability of *Relational Urban Models* as new working methodologies in emerging economies. The funding is granted for the collaborative research between Arup, Relational Urbanism Ltd and ShenZhen University and the peer review of the project was led by Charles Waldheim, Chair of the Landscape Architecture Department at Harvard University.

The aim of the research was to aid and develop a new approach to Master planning in emergent economies based on the use of *Relational Urban Models* (RUMS).The research proved that these models help the discussion and allocation of development area (Gross Floor Area or GFA) in a master-planning proposal according simultaneously to architectural concepts, infrastructure constraints and economic criteria, taking into account also a participatory mode among all the stakeholders during the design process.

A RUM is a digital design interface that generates 3D massing of urban environments derived from parameters (both mathematical and intuitive – that is why related to the *tacit knowledge*[1]) as well as the representation of key infrastructure and environmental variables (traffic, CO2 emissions, built area).

Its main advantages are:

-It is a dynamic tool that updates in real time a 3D model and the output data (traffic, cost, others) with the manipulation of the input variables.

-It is tailored to be understood by non-expert audience and to be used during negotiation workshops allowing real time participation and interaction.

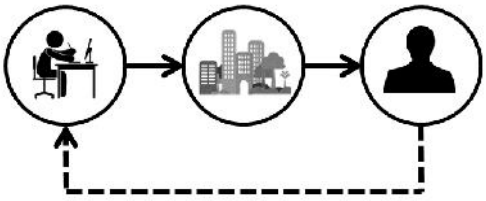
-The simultaneous visualization of design parameters and 3D massing allows for the discussion on how urban form is related to infrastructure requirements.

[1]For more on the *Tacit Knowledge* please see Chapter 1.2.4. and Chapter 3.2.2.

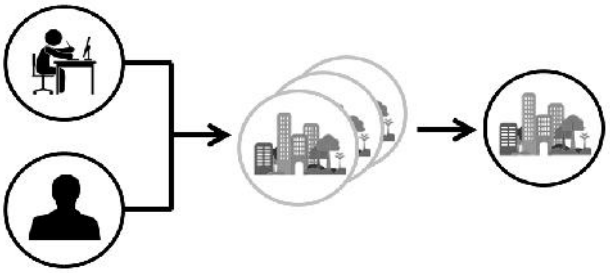
- It is a dynamic model that should enable the solution of complex negotiations running in simultaneously with the interface. This can help city governments and public institutions to develop strategies to incentivize private investments with city wide policy frameworks.

The Interface of the RUMs

In Chapter 2 of this Appendix the design and function of the *interface* will be explained focusing on the participatory aspect of the apparatus, giving more detailed information than the ones provided in Chapter 3.2.2. of the main document. In Chapter 3 of this same Appendix instead the case study of BaiShiZhou will be illustrated, showing the specificity of the aspect of participation during different modalities/objectives of negotiation with the various stakeholders involved in the project.



From a traditional form of design consultancy.....(3-4 options – 6-9 months of work)



.....Towards a collaborative approach (great number of options – 3-6 months of work)

2. Development of the Design Interface

The RUM's are based on the use of a digital interface in order to discuss urban massing in relationship with economic, infrastructure and environmental variables. The design of this interface and the way in which it links data streams coming from different members of the design team is the critical part of this work.
This section outlines (1) interface objectives, (2) competitive advantage, (3) data flow and (4) layout and functionality.

2.1. Objectives of the interface

The main objective of the design interface is to help understand the links between design concepts and infrastructure, environmental and economic constrains. In order to achieve this, the model has to present three main characteristics:

-It should be dynamic: the user shall be able to change variables in the 3D model and understand their implications on other variables. These changes should be communicated into the 3D in a relatively quick form easy to assess and judge.

-Adaptable to design concepts: the user should be able to bring a unique design to be tested in the interface. The tool should be flexible to adapt itself to different design methodologies.

-Adaptable to design technologies: the interface should be able to communicate with different design software (AutoCAD, REVIT, Sketchup). Despite the existing interface is designed to communicate with Rhinos, in fact that core is written in JAVA facilitates the communication with other design software.

-Adaptable to different strategies of infrastructure and economic optimisation: for models where optimisation is required, the model should be able to shift design criteria (ie. change optimisation targets) without the need to substantially redesign the interface logic.

-Able to accommodate other models in Arup: the interface should be able to accommodate other models in Arup such as IRM (integrated resource management model)

-User friendly: the models should allow to be used by other members of the design team

-Be presented as a distinctive service: the model can be packaged and sold as an interface or web-based interface.

2.2. Programming characteristics

The points below outline the main strategies followed in the design of the interface:

-JAVA: the computer programming language chosen is JAVA. The main advantages of choosing this language are the following:
1. It is concurrent so several computations are executed during overlapping periods of time. Meaning that if it can be executed in a network if necessary and a computation can progress without waiting for all other computations to complete.
2. The code that runs on one platform does not need to be compiled to run on another. JAVA is particularly popular for client-server web applications.
3. It is flexible, open source and can communicate with any design software

-Simple design linking 3D and Excel: the interface consists of a tool coded in JAVA that can link to a parametric model of the urban environment and to an infrastructure - economic model, both of which can be designed by others. The interface focuses in the representation of spatial data (colour coding of densities, etc..), data flow, execution of different software and 3D previews and results of infrastructure and economic models. Most of the analytical work and 3D generation is carried out in Rhino-Excel, which work in parallel to the interface.

-Link to parametric model: the interface manages design in block by block basis calling upon a parametric model that can be generated by others. In this case the parametric model is built in grasshopper and python; however, the interface would allow the linkage with other programs.

-Two stage modelling: the interface allows for the generation of the overall modelling in a two way formulation:
-Dynamic urban plot generation: in an initial phase, the design can select parts of the context or define variables for the parametric definition of urban plots.
-Massing: in this second phase tests can be done within each plot considering options for the overall massing by application of pre-defined architectural typologies.

-Introduce a solver tool that can be adapted to different criteria of optimisation: the model should be able to work to different mechanisms linking input to models (traditional parametric or optimised) namely:
-traditional parametric model: in this case the designer controls the urban form with architecturally driven parameters. The database calculates economic, environmental and infrastructure data as a result which is further represented in the interface.
-optimisation model: in this case the designer gives indications of distribution as well as economic and infrastructural constraints. The model works by adjusting the formal results of a parametric model to comply with the given constraints.

-Two mode massing: the interface can show the massing in several modes of detail depending on the phase of design.
-outline mode: the representation is a light version of the overall massing , which allows fast evaluation and a more dynamic approach to management of variables.
-rhino import: the full 3D can be imported and previewed as part of the interface. Depending on the level of details this can be burdensome and may be only required as a final output.

-It should be linked to a database: the interface designed so far is linked to economic and traffic models.

-Capacity to generate phasing or obtain data from parts of the site: the interface shall be able to group data according to areas, land users or particular development objectives. This function shall enhance potential detailed discussions on traffic, phasing, etc...

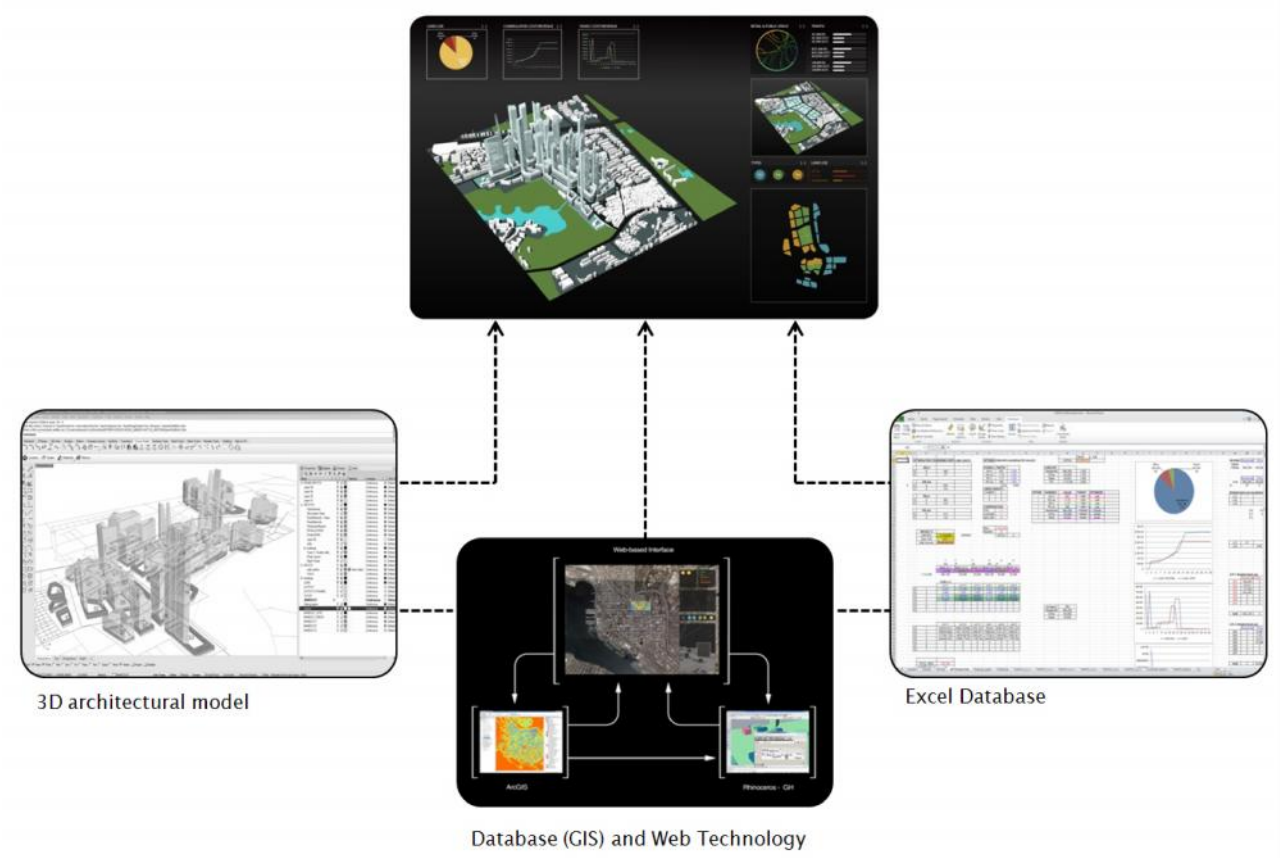
2.3. Data Flow

The interface is built up from a combination of software some of which are of common distribution and circulation between designers in the built environment. These are the following:

-Rhino: This is a commonly used 3D package with a parametric engine (Grasshopper) which is ultimately in charge of generating the geometries which form the master plan. The software is easy to use and allows each architect /designer to come up with their own definition of architectural concepts.

-Excel: this is used to implement both the economic and infrastructure models, but also as a repository of some geometrical data (areas, intended distributions) and the solver for optimisation.

-Eclipse: This is the software where the interface gets shown (Java Applet) and all the data (both statistical and 3D) gets represented. It is intended that the user only has to operate with this interface while other software operate in the background.
As mentioned in the previous section, the design of the interface has been developed to showcase a reasonable amount of information about the design process, yet it handles a minimum amount of calculations or numeric evaluations, which are mostly carried out in Rhino and Excel. This helps the tool to become as light as possible and enables other team members to perform analysis or estimates that are brought into the design in a simple way.



The Interface Structure

In the case of BaiShiZhou in specific
-Geometrical information on the site was introduced as basic polylines in Rhino (series of parcels, roads, etc..)
-In an initial phase the interface allowed for a first selection of features within the site such as deciding the areas to be regenerated.

This choice was driven by a participatory process of negotiation among the different stakeholders using the interface to relate to each others

-This selection of area was sent back into Rhino, which used it as a basis to generate the final geometry of urban plots, which got sent back to the interface

-The interface used the geometry of the plots as the base of the further operations of design

-The user could easily give values (numeric, group type, etc..) to each parcel, which later get turned into buildings. These values were given in an interactive way by hovering with the mouse over the parcel and clicking to add (this part of the process was also conducted with a participatory mode during workshops or single group sessions)

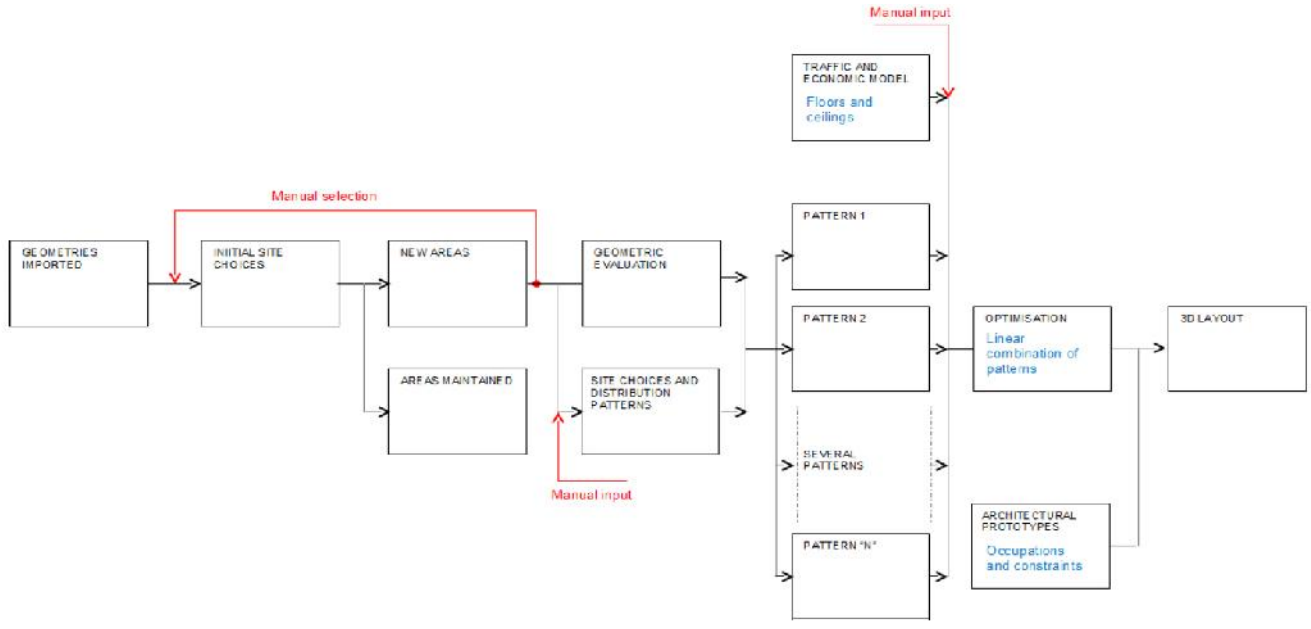
-These values, altogether with geometrical values got sent to excel, which performs the optimization process.

-The optimisation process brought back definitive m2/plot, as well as height of typologies. These values were sent to Rhino for detailed modelling and to processing for basic modelling.

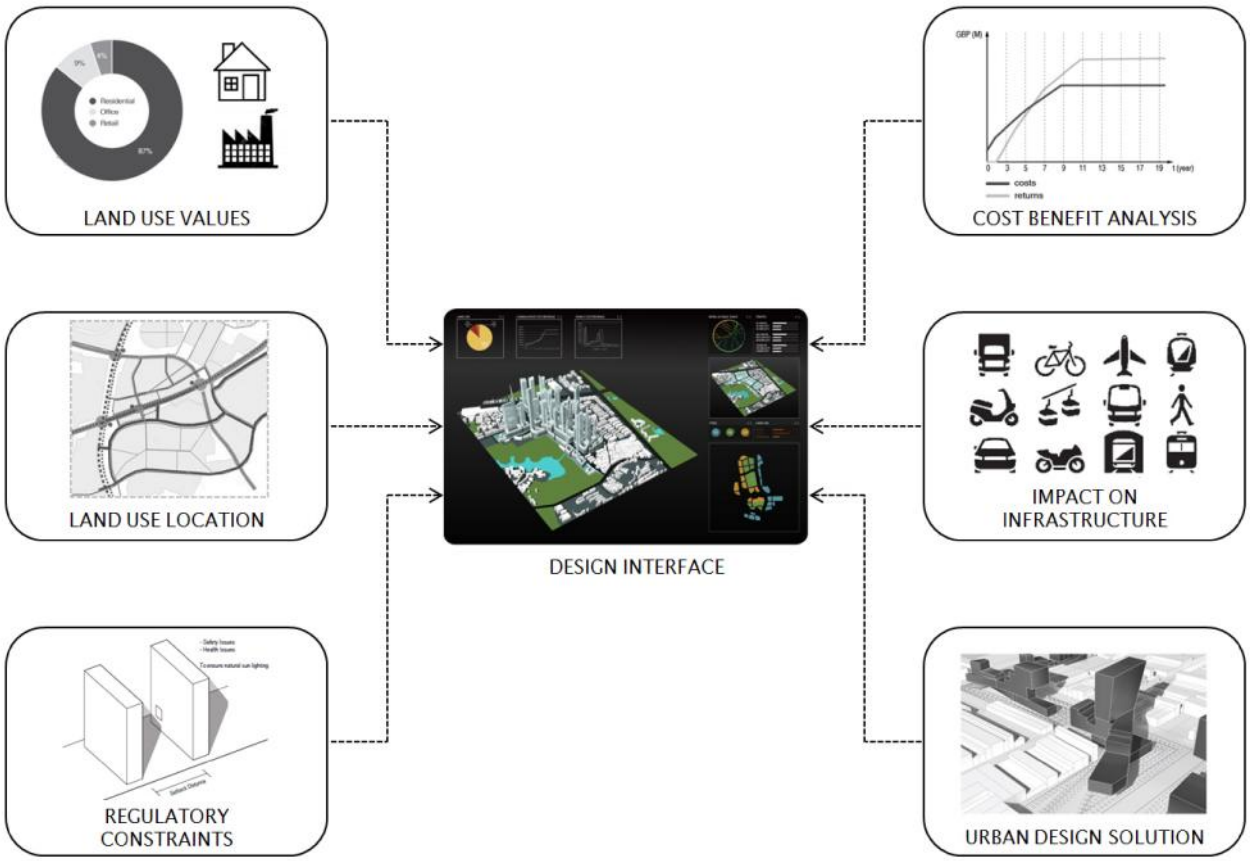
-Types and architectural design came imported as pre designed series of models in grasshopper which further got populated into the plots.

-The interface could either represent the basic modelling or import the more sophisticated version of 3D from Rhino.

-The interface equally showed the outcome from land use and economic evaluations. Such outputs were examined by the stakeholders and initiated a series of evaluations of the results originating a succession of adjusted solutions negotiating each user requests to finally get to the optimum co-designed proposal



Pseudo-code operations in the interface



General Data Flow

2.4. Layout and Functionality

The layout is designed in order to give the maximum protagonism to the urban design proposal.
The background is a linear gradient from black (in the upper and lower edges) to blue (in the centre). The purpose is to emphasize the 3dimensional character of the interface.
Five buttons are located in the upper right of the interface allowing displaying resulting information:

-LAND USE DISTRIBUTION: a graph showing the overall land-use distribution;
-REVENUE ANALYSIS: a timeline chart displaying the cost and return curves;
-ROADS: to display the road axis;
-PREVIEW: to display a basic 3D datascape;
-VIEW: to show the 3D model;

Three TABS are located on the upper left of the screen, containing the functions that the user manipulates in order to generate different urban options. The TABS are linear meaning that the protocol starts with

SETUP, it is followed by DATA and ends up with OPTIMISE. Once the user has run the three tabs, he can go back and forth in order to generate options.

TAB SET UP

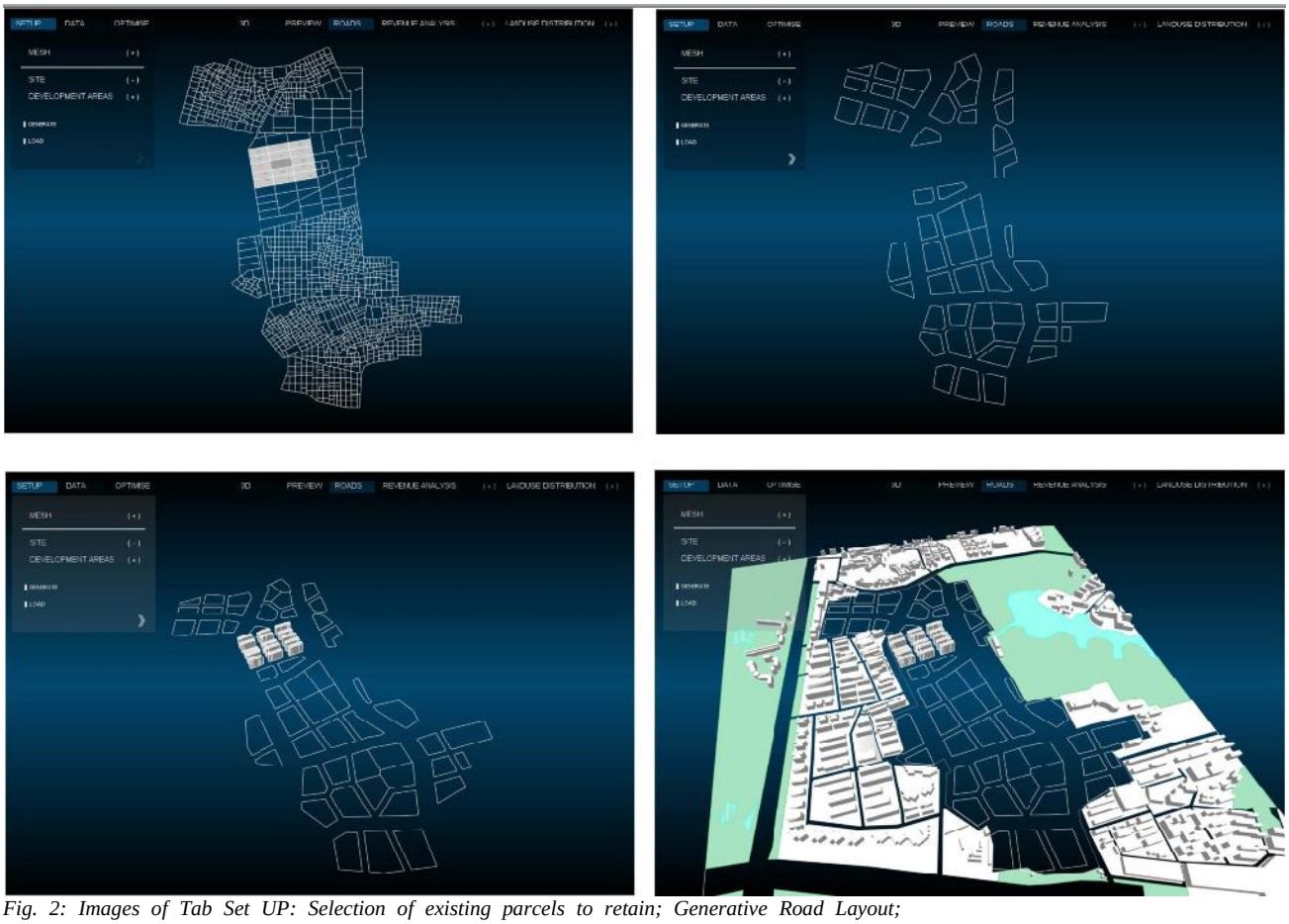


Fig. 2: Images of Tab Set UP: Selection of existing parcels to retain; Generative Road Layout; Visualization of remaining blocks; Visualization of existing context

The tab SET UP is the first tab the user manipulates. It allows for the introduction of different road network designs. These road network designs can be decided in relation to an existing context. The buttons included in the tab SETUP are the following:

- SITE: importing the site and areas to define outputs for road generation
- MESH: inputs a block datascape (heights, land use likelihoods, phasing, etc..)
- -DEVELOPMENT AREAS: inputs for the optimization model (GFA, traffic, economic, sustainability targets)
- MESH AND DEVELOPMENT AREAS: used when the user wants to open an ongoing project
- GENERATE: it activates the engine for the generation of urban blocks

- LOAD: it loads the new urban blocks.

The interface allows for interventions in existing urban context.
See *Fig.2:* first the user selects the buildings to maintain. After clicking the buttons ‘generate’ and ‘load’ the interface displays the resulting urban blocks for new development. The interface also allows to visualize the retaining urban blocks by typing the keystroke ‘K’ and the existing context by typing the keystroke ‘S’.

TAB DATA

Fig. 3: Datascapes

The tab DATA (see *Fig. 3*) is the second tab the user manipulates. It allows for the introduction of datascapes plans. These datascapes can be customised in relation to the objectives of the project. They can be manipulated with the interface in an intuitive manner by redistributing the areas with paint brush or with precision by introducing solvers in the mathematical model.
For each datascape the user have the following options: ‘0’to assign the value 0 to all parcels, ‘1’ to assign the highest value to all the parcels, ‘Direction +’ to add value to the parcel the user clicks on,

‘Direction –‘ to deduct value. The ‘radius’ and ‘impact’ sliders allow for controlling the impact on neighbouring parcels.
For the BaiShiZhou model the following buttons were introduced:

-GROUP: Introduce different urban groups
-HEIGHT N: Overall Skyline datascape (1)
-HEIGHT S: Overall Skyline datascape (2)
-RESIDENTIAL: Residential land use
-OFFICE: office land use
-RETAIL: retail land use
-TYPE: Introduce different architecture and landscape architecture proposals.

TAB OPTIMISE

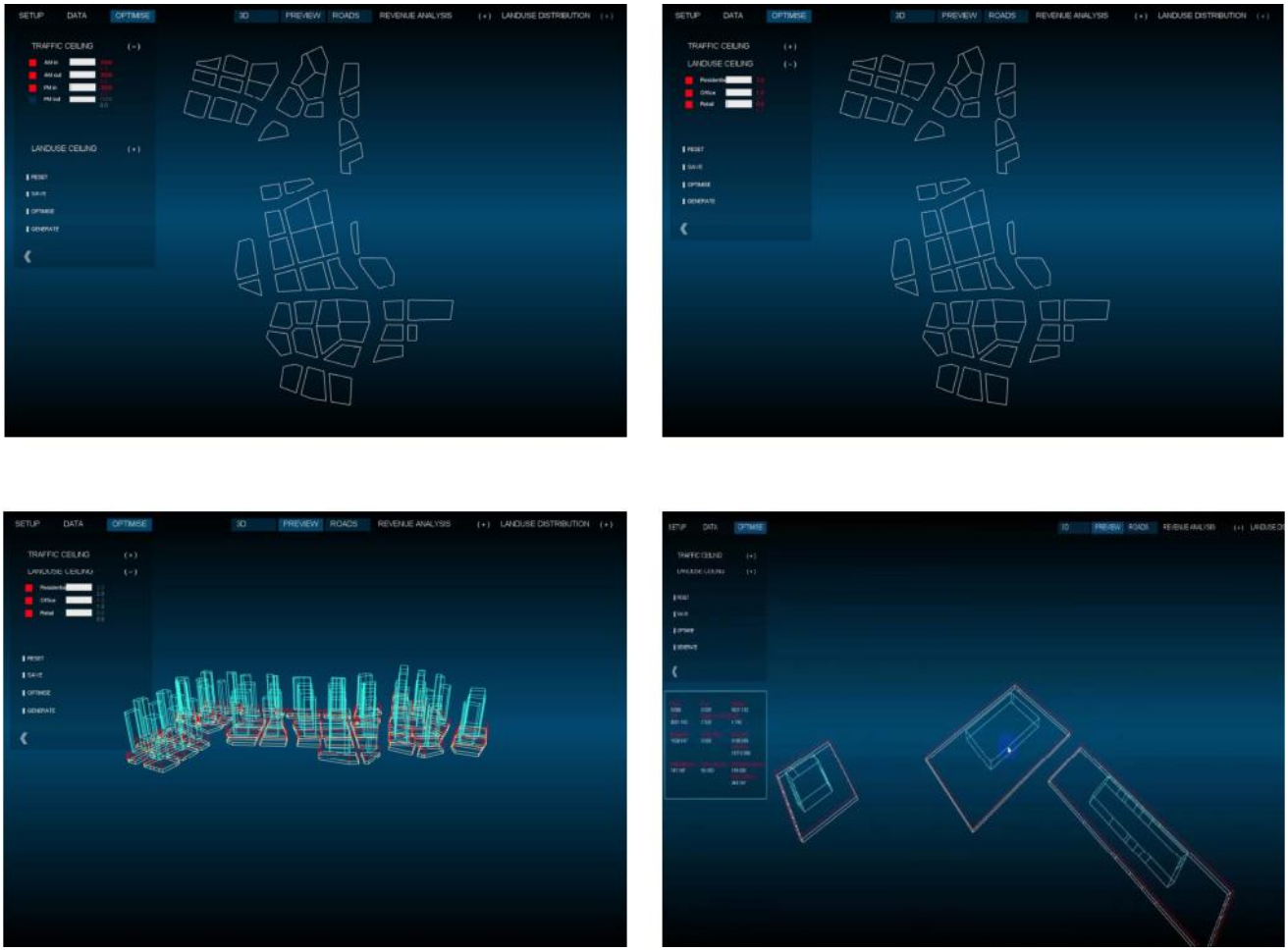


Fig. 4: Data Optimisation: introduction of urban ceilings; Introduction of urban scope; Visualisation of urban datascape, block by block info, revenue and landuse analysis; Option to retrieve info from an individual cell

The tab OPTIMISE is the last tab the user manipulates. It allows for the introduction of ceilings and scopes limiting development. The user can request the model to interface to optimise development distribution to reach those ceilings or development limits/cap. The urban ceilings can be customised according to the requirements of the different projects. In

this project the selected ceilings are about traffic. In order to activate the ceiling the user needs to click on the ceiling button, this will turn red showing that the ceiling is activated.
By activating and deactivating the different ceilings the designer can understand the effects (economic and land use) of different ceilings in the urban development. In BaiShiZhou there was also the introduction of urban scopes. Once the user activates the button 'optimise' the mathematical model will optimise the urban scopes without surpassing the urban ceilings.
Once the user obtains the optimised data this can be visualised in the 3D model in the form of a datascape.(see *Fig. 4*)

3D VISUALIZATION AND EXPORT OPTION

Fig. 5: 3D visualization from interface

The user can also visualize the resulting 3D model and export the data during a design session for an option that needs to be recorded. The interface will generate a package that includes: a one page short report describing the option chosen, which allows for the introduction of a small description, a 3D model and an Excel file with the urban data.

2.5. Solver model: Floating model for optimization

For the purpose of the generation of the relational model, an optimisation technique has been introduced that would help achieve targets linked to the infrastructure or economic models according to the following points:

-the model shall allow to maximise or minimise the value of a certain function while considering a series of given constraints. In urban design terms, this can be translated into maximisation of GFA (function) trying to obtain traffic figures within certain ranges (constraints)

-The proposed model allows turning some of the outputs of the simulation into inputs of the model such that other variables adjust to comply with them. While in a normal parametric model, simulated values (traffic, environmental variables or others) generally come as a result of the introduction of design parameters (density, height, etc..) in this case some of these variables or outputs can be turned into a target point.

2.5.1. Floating model mechanism: Linear programming

For the purposes of this interface generation, a linear programming method is used as a mechanism to reach any number of targets or constraints.
The use of this mechanism has been adopted for the following reasons:

-It is an existing solver within most conventional database programs (Excel or other)

-Linear programming is a methodology which tries to maximise a function of several variables within the boundaries of constraints set by various relations between the variables which generate the constraints. More advanced methods of linear programming incorporate the possibility of non linear equations.

-It allows an easy introduction of constraints and variables. This is an important aspect of the method, since the change of variables from outputs of the simulation into inputs of the optimisation is likely to be required during the use of the interface

-For the purpose of the development such as the one studied, the models which generate relevant output (traffic, GFA quantities, cost-benefit) are programmed to be linear functions of the inputs. This allows for the use of linear programming optimization methods, which provide a simple basis on the understanding of the relational problem.

-For the case of urban pattern, it was assumed that the overall massing was a linear combination of several land use patterns (6 in total for BaiShiZhou). The variables introduced in the linear solver are weights given to each of the patterns.

-The values of traffic in different points as well as revenue are supposed to add between patterns linearly. For instance, double amount of GFA means double amount of traffic generation associated with the GFA.

2.5.2. Graphic example for traffic planning

Linear programming can be explained in graphic terms for cases of maximisation of function of two variables with any number of constraints between those two variables. This section includes a simplified case of a development formed by office and residential uses, which can be represented graphically in xy plane. The following points outline the main characteristics of the model:

-the final outcome of the urban pattern is a combination of two patterns, each of which only have either residential or office use

-total revenue stream is to be maximised in a development composed of office and residential. The following applies:

- revenue from office is twice as revenue from residential
- generation of traffic per 1000m2 of residential is 10 vehicles in and 20 vehicles out during peak hour
- generation of traffic per 1000m2 of office is 50 vehicles in and 5 vehicles out during peak hour
- there is a constraints in AM in and out traffic of 1000 vehicles/hour each

-Both values have to be no negative

-solution is unlikely to be sensitive to small changes in the profitability ratio of office vs residential until its benefit/vehicle are larger than those of the residential. This can be seen by rotating the red line (revenue) which is likely to reach the same threshold

(intersection point between blue constraints) until it reaches the same slope as one of these constraints

-Solutions can sometimes ‘travel’ suddenly within the variable space along the edges of the constraints region when the slope of the revenue (red) equals one of the slopes of the constraints (blue). (See *Fig. 6)*

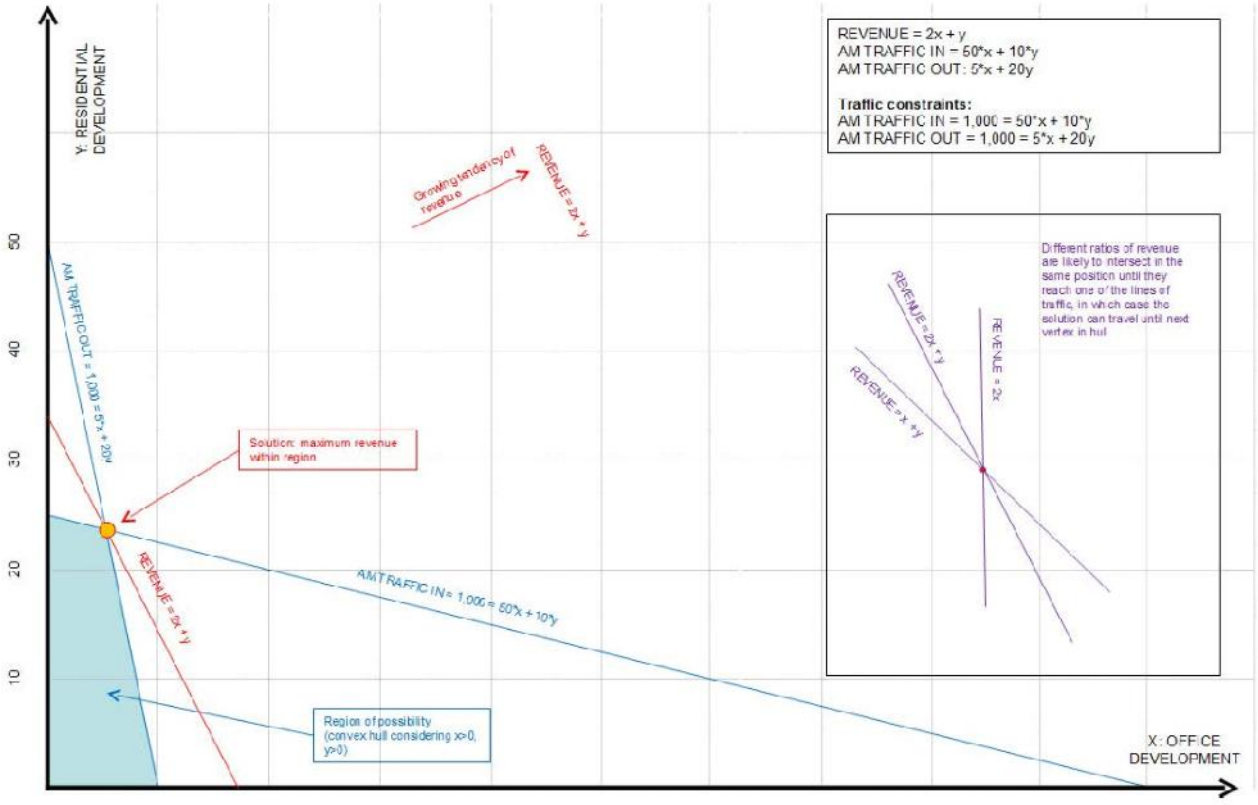


Fig. 6: Linear Programming Example for traffic

2.5.3. Improvement of outcomes when adding multiple parameters

The use of optimization techniques allows for a more efficient use of existing capacity in networks. The basic premise is that, by using an increasingly diverse set of base patterns to combine, it is possible to increasingly use up existing capacity in the system that each of the patterns would leave unutilised. As an example *Fig. 7* show how these types of model use capacity in traffic network over time.

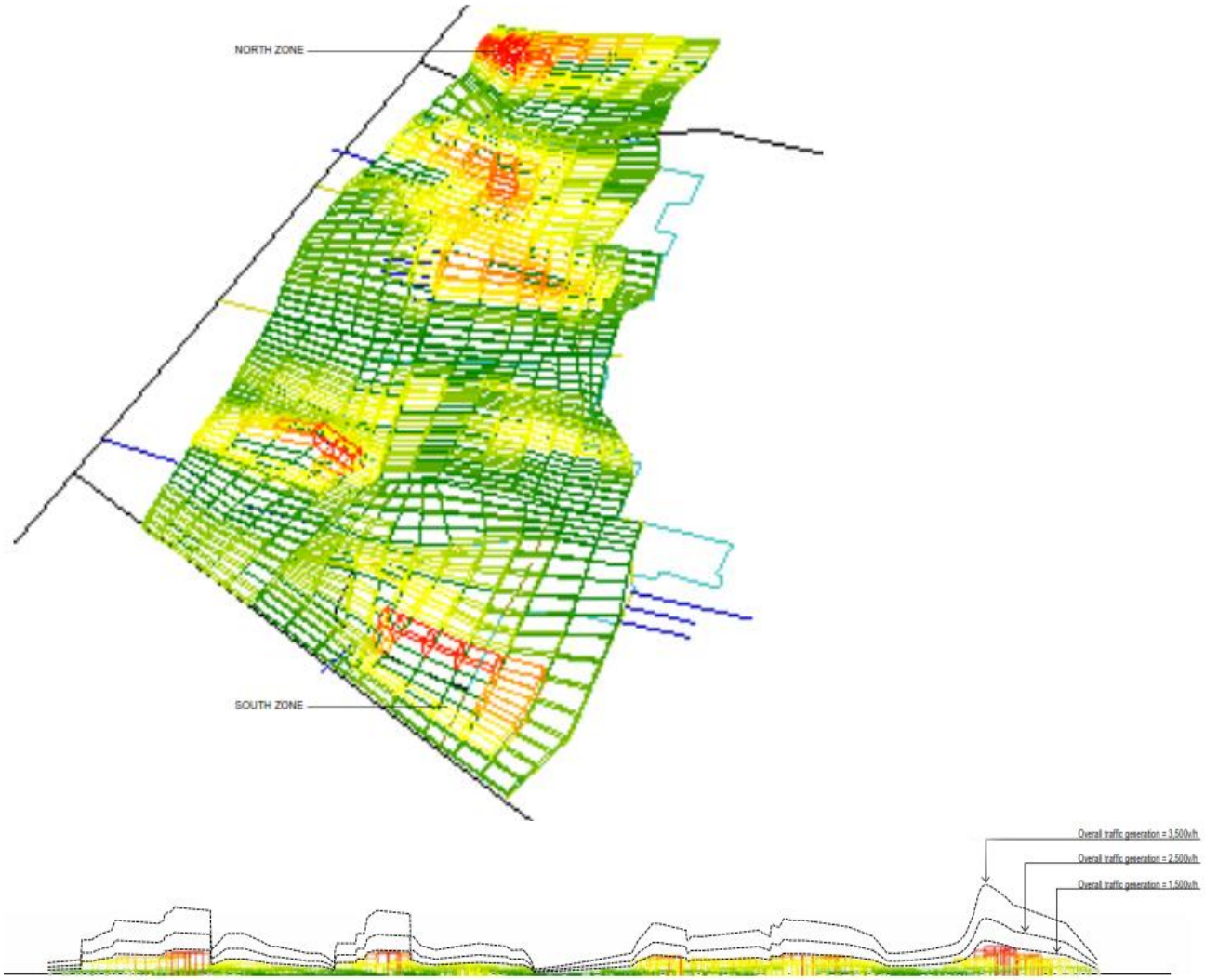


Fig.7: Interface Appearance

The following points outline how the model works:

-In the case of a single variable network, the model would work by extruding the massing in all cells in a proportional manner (*Fig. 7*). Assuming that the resulting traffic from a single configuration is known, the final outcome in traffic would be derived by linearly 'floating' this initial value until it reaches the limit. The 3D model would be 'grown up'. For the case shown in *Fig.7*, this growth consists on liner extrusion, although this technique varies with each project.

-If the previously mentioned pattern is made only of one single use, it is likely that, while reaching the capacity in certain times of the day, there may be spare capacity left in other times (ie: residential is linked to outbound traffic AM and inbound traffic PM, leaving the opposing flows untouched)

-A combination of two land use patterns (residential and office) is likely to be more effective than the previous single use solution, since the capacity left by one pattern is likely to be occupied by the other (*Fig. 8*)

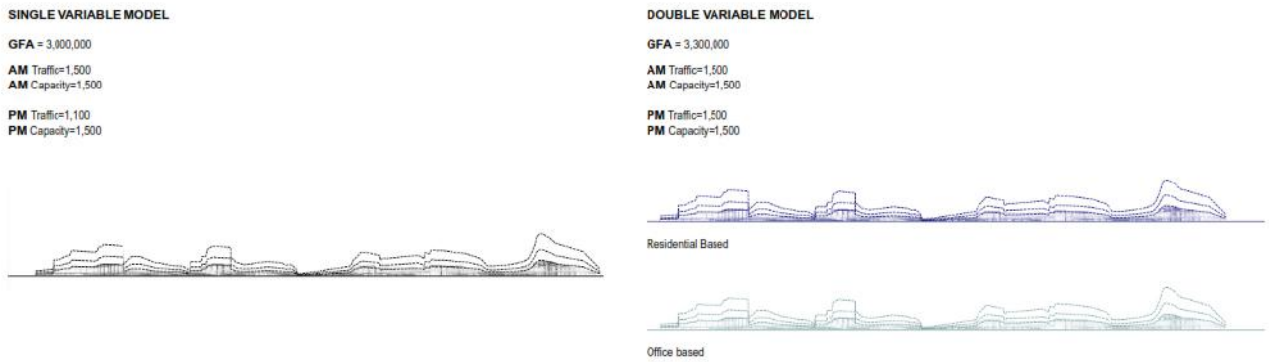


Fig.8: principles of floating models (two variables)

-In case that there are different capacities in different nodes north and south for instance) and that there is the possibility to decide to use nodes depending on location, extra patterns can be introduced in order to occupy AM and PM capacities in-out in north south (8 targets in total). (*Fig. 9*)

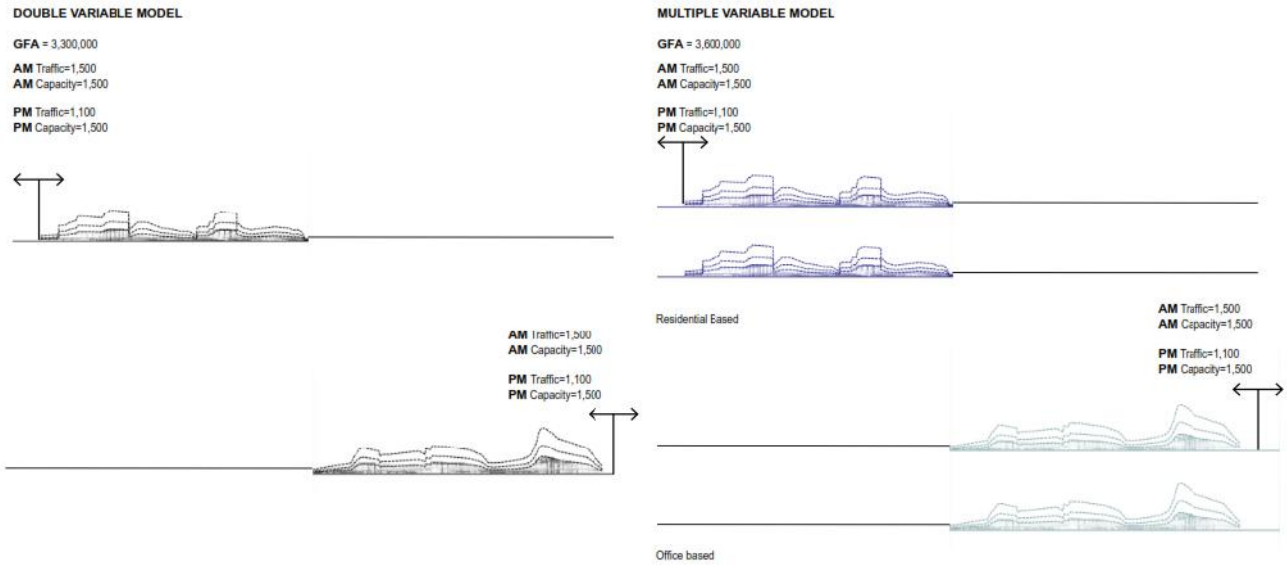


Fig.9: principles of floating models (four variables)

-For the case of the BaiShiZhou project, a total of 6 patterns (*Fig. 10*) were used as combinatorial base for the linear modelling, resulting in a model that manages 8 targets.

-using a preliminary estimate of capacity (1500 vehicles in-out both N-S and AM and PM) the capacity grew from 3million m2 when

using only a residential pattern to 3.3 million m2 using residential+office+retail.

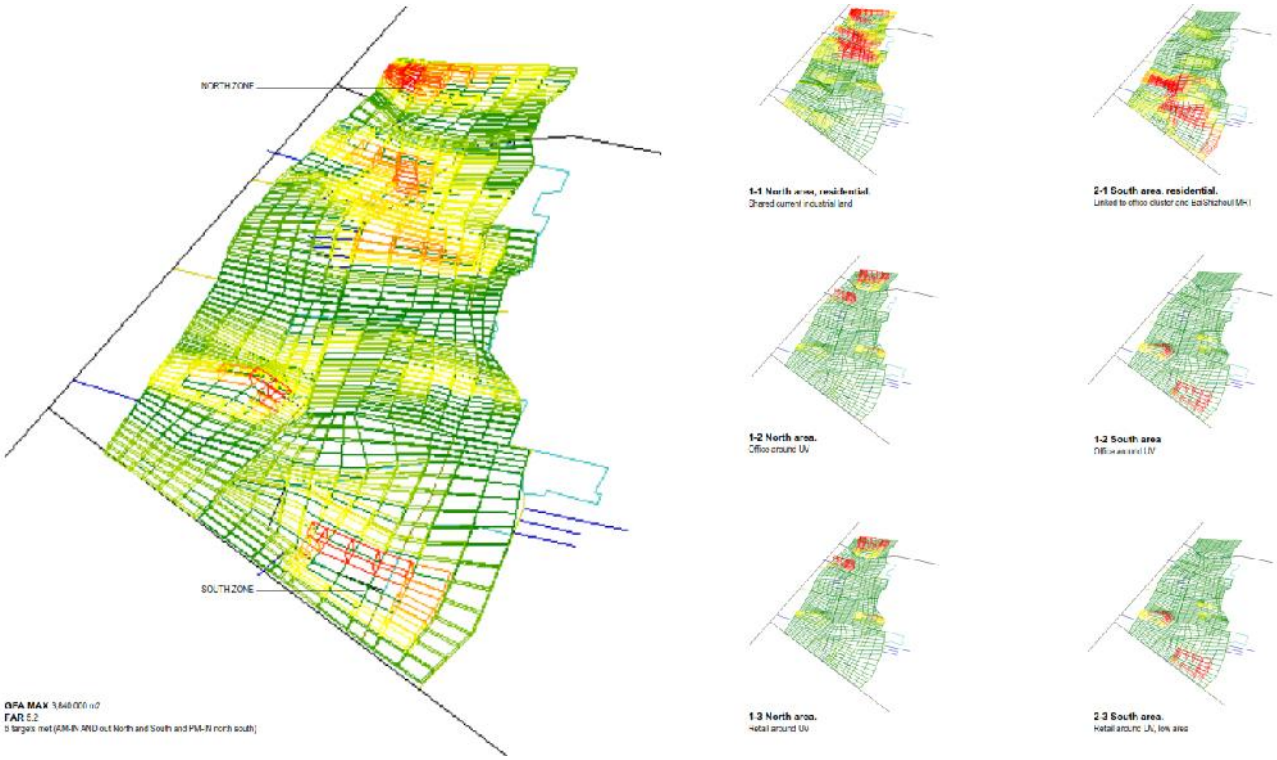


Fig.10: combination of 6 land use patterns

In order to properly assess the possibilities of applying linear models to the development of master plans:

-Patterns are used that can be easily understood as being separate or independent from each other. This means that each of the patterns should be trying to clearly target one of the objectives.

-A number of patterns lower than the number of constraints is recommended, since it is likely that the linear program will tend to reduce excessive patterns to ‘0’.

2.5.4. Application for planning

The optimization model built within excel allows for the definition of the variables to be affected as well as the targets for the optimisation. With the help of this tool, the following typical problems in a development can be introduced into the solver:

-Minimum thresholds for development: : set a minimum GFA to be achieved for break even situations or in order to obtain a minimum return on investment

-Limits for road traffic in a given junction: maximum traffic in a particular road/access which should not be reached.

-Limits for public transport demand

-Define ratios between land uses: the solver can be used in order to 'lock' the ratio between several land uses (or minimum thresholds of ratios), typically to ensure supply of support uses (local retails to residential, etc..)

-Limits for CO2 emissions or other environmental parameters.

3. The specific case study of BAISHIZOU

This section outlines the design development for the architectural proposal and use of the interface for the redevelopment of BaiShiZhou urban village in ShenZhen, China.

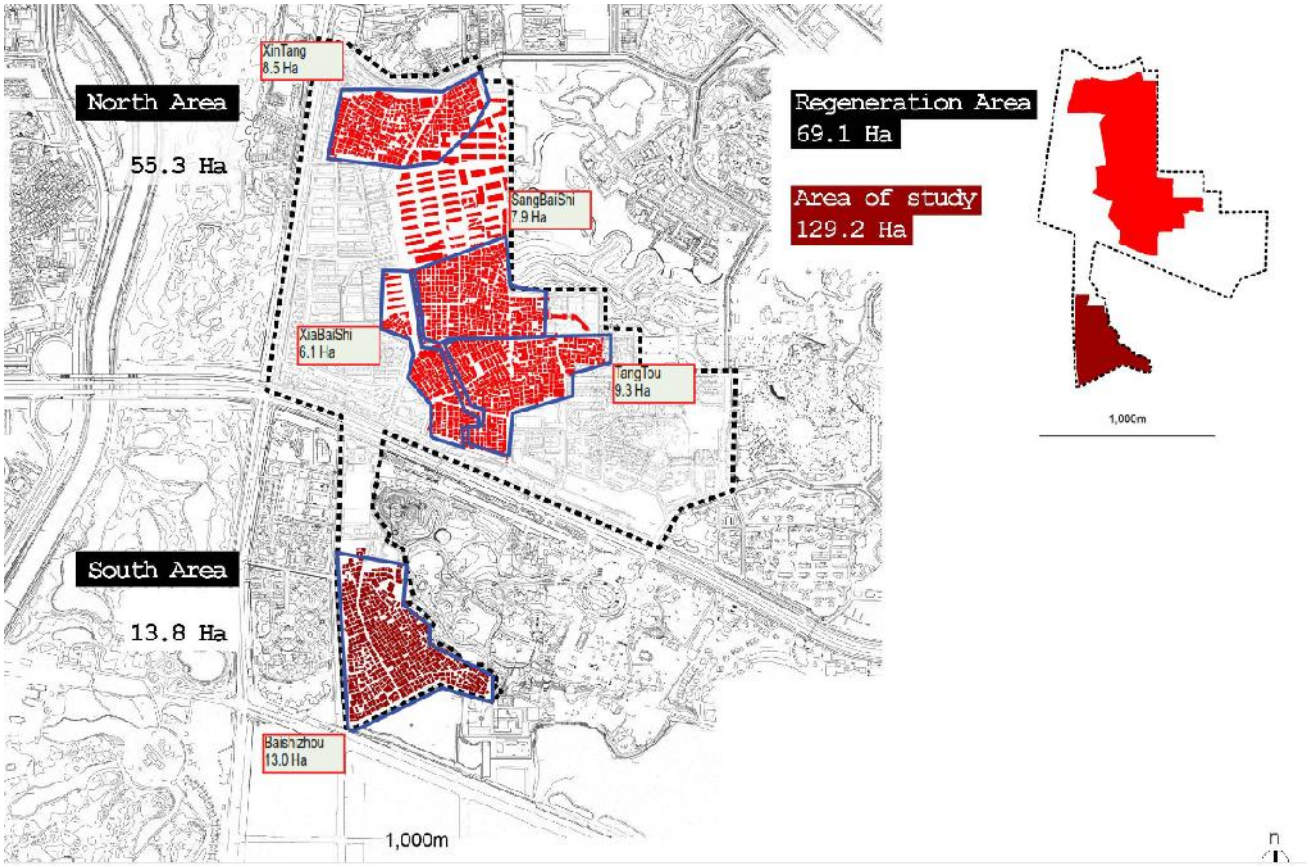


Fig.11: site boundary and area study

3.1. Background of the study

-BaiShiZhou is an urban village (UV) located in the centre of ShenZhen (SZ).
-While strategically located with good transport links and surrounded by one of the most expensive pieces of real estate in SZ, the quality of buildings is poor, as most cases of UV's.
-This can have associated health problems and also economic ones, since low quality of fabric linked to ownership problems de-incentives investment.
-Most inhabitants are renting. These are typically university students, low skilled workers employed in house service or low paid jobs in the area.
-There is a huge pressure from landowners and developers to redevelop the area, turning it into a profitable piece of regeneration.

However there is a growing tendency within government to partially maintain these areas due to the following reasons:

- UVs provide diversity in the fabric and can become vibrant parts of the city. This prevents segregation and can have knock on effects on the general economy of the city.
- UVs provide cheap housing for low skilled workers, helping to lower pressure on wages. This can be at risk if UV inhabitants have to leave the city or work around excessively long commutes.

Considering the potential conflict of interests (developers and owners wanting to remove and government wanting to retain UVs) an initial idea of the RUM was to serve as the basis of a discussion about the management and co-design of these areas, where considerations about remaining population, profit and infrastructure are linked to the development, are incorporated as part of the design.

OBJECTIVES SET FOR THE DEVELOPMENT OF THE RUM
-balance new fabric and old fabric achieving:
-maintenance of social networks
-maintenance of urban character and existing activity nodes
-provision of social housing
-maximising revenue for developer
-observe sustainability objectives
-minimise impact on transport network both public and private

3.2. Scope for the RUM

With the previous objectives in mind, a proposal for architecture design and relational model was built according to the following strategies:

-define remaining areas of UVs and new development areas: the model will be able to define areas to be retained and also define areas for the development of new fabric
-allow control development variables: the model shall allow for the inclusion and testing of variables linked to the infrastructure and economic context of the site such as

- Population remaining in the site
- New GFA(residential, retail, offices)

- Traffic generated by the land use proposed
- Economic analysis of the proposed scenario
- Potential definition of phasing options

3.3. Working methodology

-Analysis of the typical negotiation process: an initial assessment is made of the stakeholders generally involved in this type of projects, as well as the main constraints for the development consequences of this negotiation

-Analysis of the existing urban fabric: this section analyses the existing fabric of the UVs outlining the main potential and problems for maintenance and the generic tower residential typologies that are predominant in Chinese residential market

-Analysis of the relevant guidelines and regulations: outlines main consideration on access, distances and orientations derived from building regulations in China and SZ

-Urban Design proposal. Based on the previous analysis, this section describes both proposals for the generation of urban blocks, public space strategy and building typologies.

-Traffic study and site capacity: outlines site analysis and assessment of the site capacity which is to be used as constraints in the model. It also outlines connectivity strategy for the area

-Development of an economic model: outlines economic considerations incorporated into the RUM

-Development of the interface: this section describes the variables introduced into the model, the different iterations and main outcomes.

3.4. Analysis of the typical negotiation process

STAKEHOLDERS

-Landowners: Landownership in BaiShiZhou is fragmented. Buildings belong to families who owned the dwellings of rural cluster before this was heavily urbanised. These landowners were tacitly allowed to increase density in their plot and rent out the property. Due to recent

change in legislation they now own the building but not the right to use the land, which is ultimately vested in the central government.
In case of redevelopment, once the building is removed landowners will lose development rights. These rights are typically rented by the government to developers. The landowners will wait until a deal with a developer can be struck typically in the form of rights to future GFA building. For the case of SZ neighbour cooperatives are generally likely to expect a trade in terms of 10% to 40% of GFA. This means that for every m2 demolished the developer is expected to hand over 1.1 m2 to 1.4m2 built to the existing land owner.

-Neighbourhood cooperative: landowners tend to group in cooperatives which act as a single economic entity in the process of negotiation, giving them more bargaining power.

-Dwellers: These tend to be renting accommodation in the UV and their presence tends to be temporal. There is a limited commitment from their side to the maintenance of good quality urban space. However this depends on the context since for the case of villages in areas with historical value and better environmental conditions there is a tendency to have stronger links between community and urban fabric.

-Master developer: these are developers who tend to buy large portions of land to develop a master plan which then gets resold as developable areas to smaller developers. Theirs is the task to reach an agreement with landowners and neighbour cooperatives in order to develop a master plan which is submitted for approval to the Urban Regeneration Authority (URA).

-Local developers: Once the master plan is approved by the URA, different plots are sold to individual developers who carry out detailed proposals for these plots following the guidelines previously agreed between the master developer and the URA

-Urban Regeneration Authority (URA): this is the body who assess the proposals brought by the master developer and have the ultimate capacity to approve or reject them.

-ShenZhen Design centre: this is an organization charged with the improvement of design standards in SZ. Although it does not have an executive role, it has an influence in the way planning is undertaken in the city.

-NGO's: with the purpose of improving living conditions in UVs.

APPROVAL PROCESS

While having many points in common with other approval processes in different parts of the world, the Chinese planning approval process has its own characteristics which make it unique.

-The city provides a general background of land use structure for the entire metropolitan area. This plan outlines an idea of road layout and hierarchy and indication of prevalent land uses in the different plots. This plan does not highlight areas or densities, nor width and capacity of roads.

-For large portions of the city, the municipality calls out competitions for city visions. These visions form the basis of a negotiation between master developers and municipality in order to finalise ideas about built area and spatial character. It is up to the developer who is doing the proposal to specify limits.

-If these negotiations end up in an agreement, the master plan is approved and the master developer can sell plots of land with a given GFA and a set of architectural criteria to the different developers.

NEGOTIATION CRITERIA

There are a number of criteria weighted in the process of approval of the master plan. From conversations between the different planning authorities and experts, it seems that there are no single categorical lines or constraints for the setting of capacity parameters, however there is a broad consensus as to which are some of the most relevant variables that get discussed in this process.
In order of importance:

-Vision Character: the master plan shall fit within a general vision of the city in terms of landscape, typology and urban character. This is generally discussed and assessed with a visual assessment of rendered views or models which help discuss how the model fits within the overall framework of the image of the city.

-Revenue generated for the developer: considerations on what is the minimal density to gain substantial profit are incorporated within the discussion/proposal. For the case of UV regeneration this generally implies substantial increases in FAR since the development has to pay for payment to landowners, infrastructure and profit.

-Environmental assessment of lighting regulations: while there are many considerations, these tend to be more critical in the case of providing sunlight for residential developments. Even though a detailed environmental assessment may not be carried out during the master plan, visual inspection of rendered views or models generally allows for a quick understanding of problems that may not be bottomed out in more detailed phases of development .

-Retention of fabric with UV: while this had traditionally not being an important consideration with master planning, it seems that recently it is within the agenda of the planning officers to maintain certain portions of the UV, even for a certain amount of time. From discussion with different stakeholders, it seems that ratios of 1/ 2.5 or retained/demolished areas are being considered in projects in SZ

-Traffic figures: understanding likely demands of the development on the infrastructure can play a role in the decision for the density and type of land use, however this is not necessarily the critical aspect being considered in SZ at present.

3.5. Analysis of the existing urban fabric

3.5.1. Site urban fabric Analysis

Overall the site presents 4 different conditions (*see Fig. 12*) : (1)Farm dormitories, (2) Handshakes urban blocks – irregular dense urban mass of 2/3 stories organised along a thin corridor - in the North area, (3)the industrial site and (4) Handshakes urban block in the south area.

-Farm dormitories / Tangtou
Tangtou constitutes five rows of one story buildings distributed in a grid of five by two. Each building accommodated 8 to 6 households. The public spaces between the blocks, used for storage or drying clothes, are between 2 and 4 meters wide. Some of the buildings are derelict while others have been augmented with new extensions. Adjacent to the blocks is a rectangular public space that depending on the time of day serves as a basketball court, a night market and an expansion of the various restaurants that surround it. This space concentrates a rich mix of recreational and retail activities.

- Handshakes urban in the North area
The condition of the UV corridors located north of the site is relatively good. The main axis is roughly 10m wide, it contains

differentiated sidewalks and local shops. The interior corridors are roughly 4-5m wide, have a residential character and are often connected to semi –public residential courtyards.
As an overall result the lighting conditions are relatively good. The finishes in the majority of the corridors are made of shared surface with patches of elevated sidewalks to access the residential units.

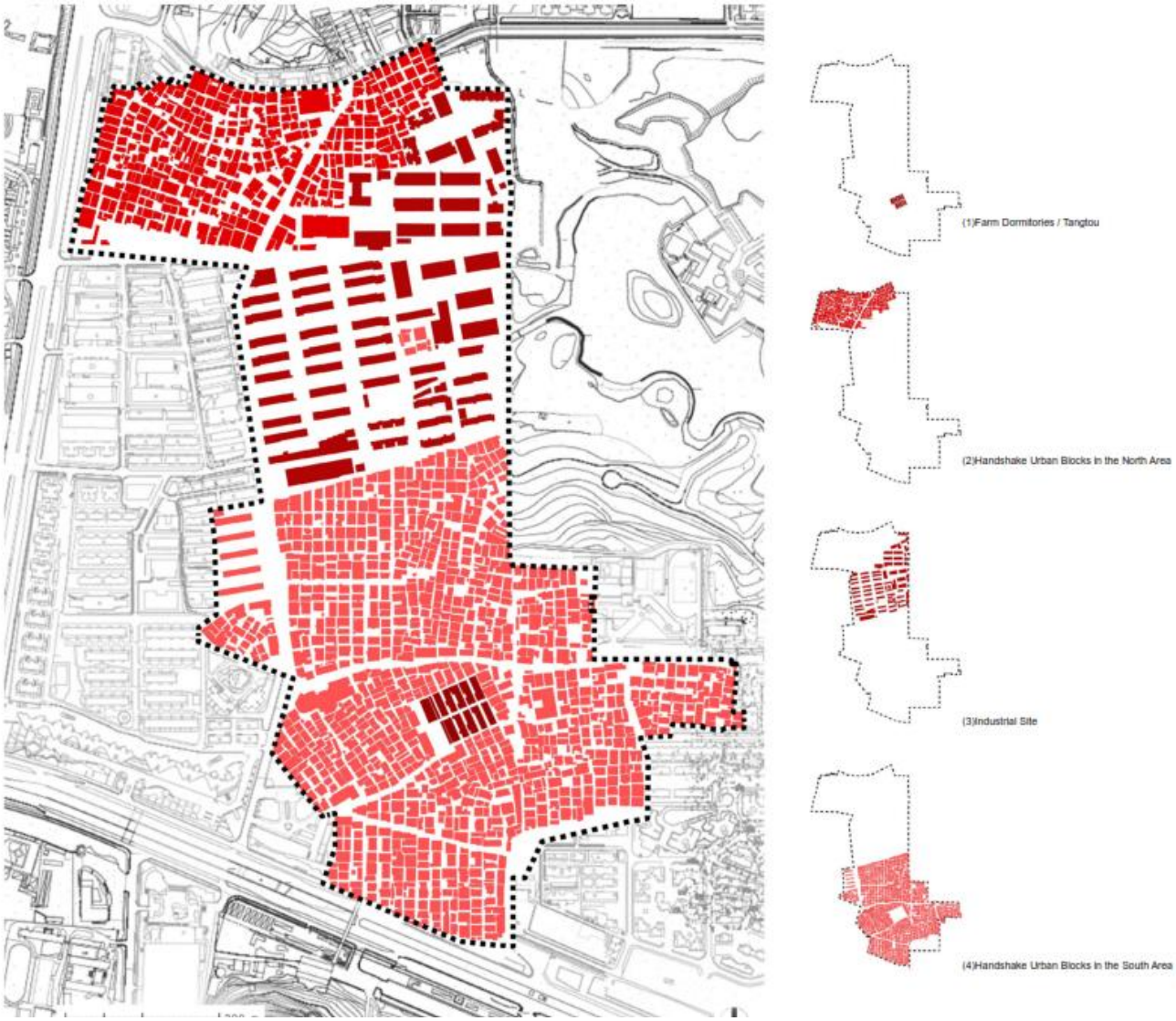


Fig.12: site conditions

-Industrial area

The industrial site is formed by three differentiated areas. The first area is constituted by 5-6 storey buildings distributed in a N-S grid of 3 by 11 buildings. Two commercial buildings 22m wide by 90m long are located west of the two southern roads, the rest of the buildings are 11X50m. The second area limits the first area to the east. It presents a more diverse range of building typologies. The third area north of the site presents a series of scattered and diverse buildings.

-Handshakes urban block in the south area: The UV corridors located in the south are in average 30cm to 1m wide. Some of them are not wide enough to walk across and often just become dumping sites for rubbish and waste while others are wide enough to walk across just at the ground level. Those wide enough to walk create a secondary network of pedestrian flow. The south area corridors contain services for the buildings: drain pipes, electric wires, air conditioning units,etc...

3.5.2. The quality of UV: the edge and the network

There are two outstanding spatial qualities within the UVs: one is the edge of the UV *(Fig. 13)* and the other one is the urban network. These two make UVs differentiated pieces within the urban fabric being perceived as one standing alone block surrounded by generic modern architecture. Moreover, the small scale labyrinth like network of UVs intensifies the urban experience; here the boundaries between work, retail and leisure are blurred. At the street level, the UVs can be considered as one intensive layer of low income activities. This condition presents some similarities with the spaces described by urban development authors such as Jane Jacobs and Saskia Sassen as the ideal urban conditions to promote innovation and creativity in the city. The only element missing is proximity between different business sizes (start-ups small medium enterprises and multinational corporations) proximity with university facilities and cultural/recreational amenities.

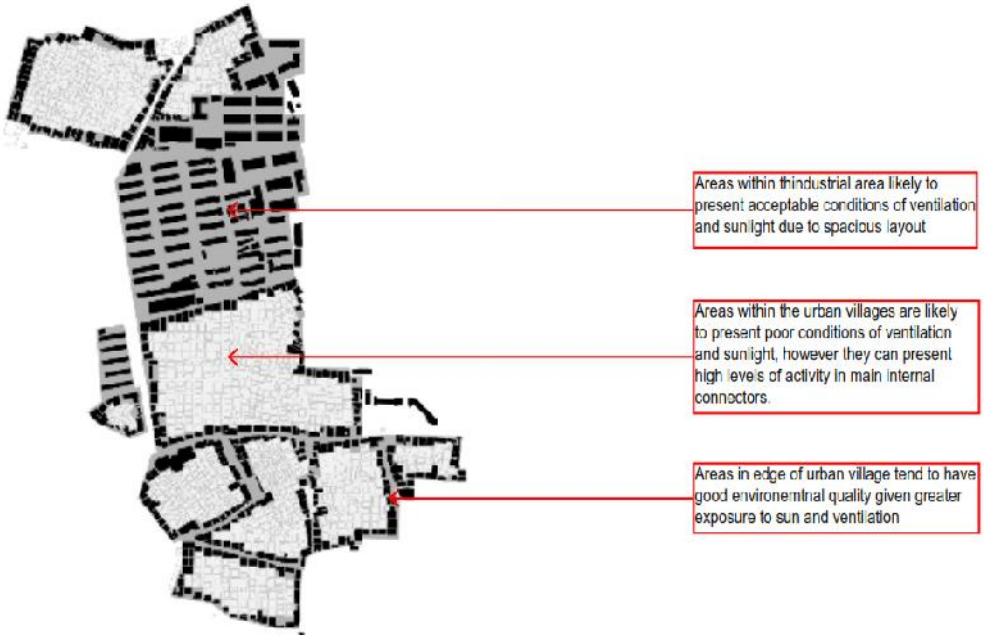


Fig.13: areas with best environmental qualities

3.6. Guidelines and Regulations

3.6.1. Break down of the main urban parameters

Fig.14 describes the main Urban Parameters in the context of Shenzhen: Residential Unit Floor Area, Number of Buildings, Plot Area, Building Typologies, Housing Typologies and Housing Types Ratio. *Fig.15* showcases typical result of the negotiation process in terms of FAR increase.

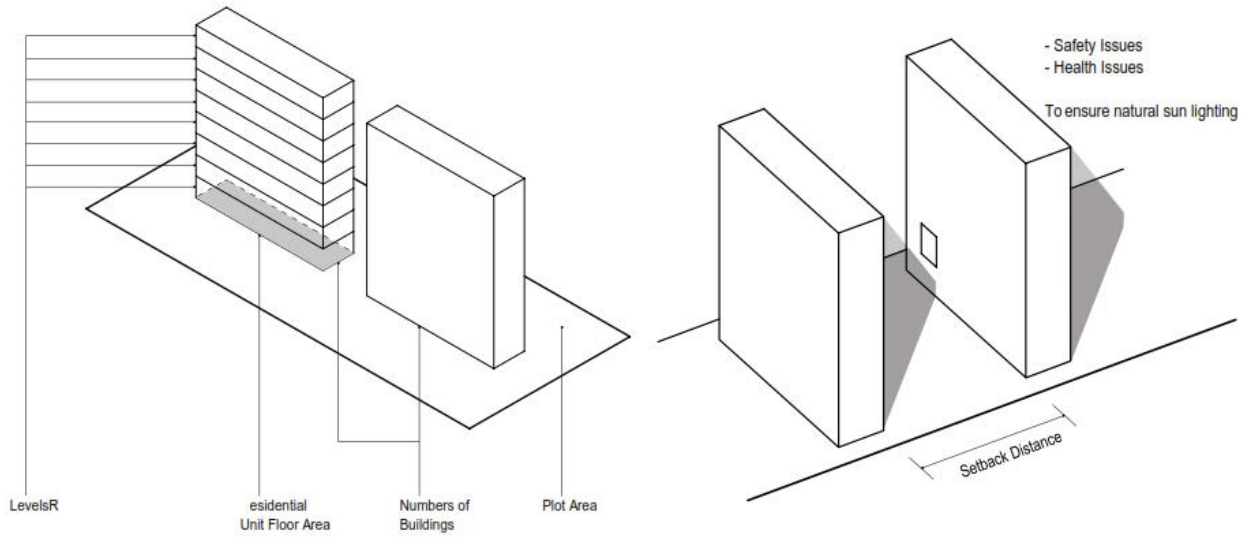


Fig.14: FAR definitions and sun light constraints in December

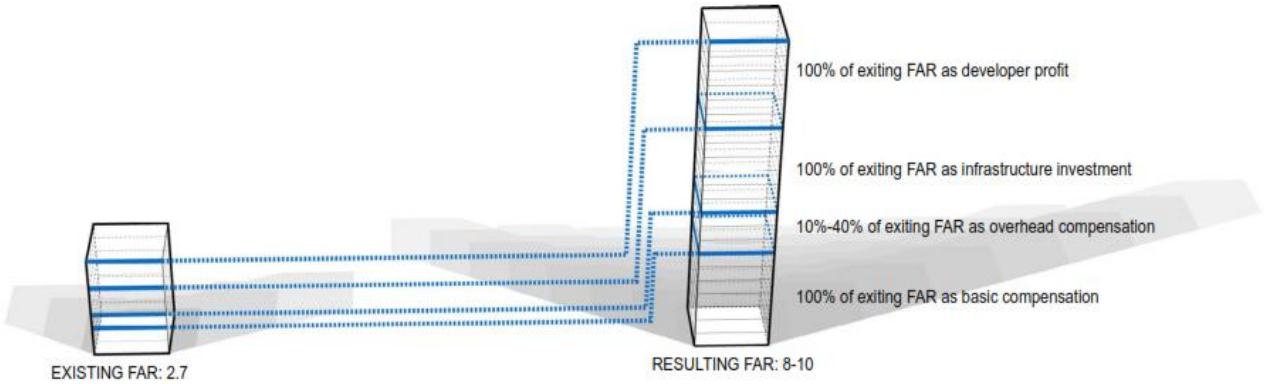


Fig.15: basic FAR trade

3.6.2. Building orientation – Shadow area ratio

A first parametric study tries to understand which building orientation works better with environmental regulations in SZ. It does so by introducing the urban parameter Shadow Area Ratio (SAR)which results from dividing the built floor area by the projected shadow area

in YX plane between 8am and 17pm on the 20th of January. The higher the SAR the less shadow the building projects relatively to the building built area (see *Fig.16).*

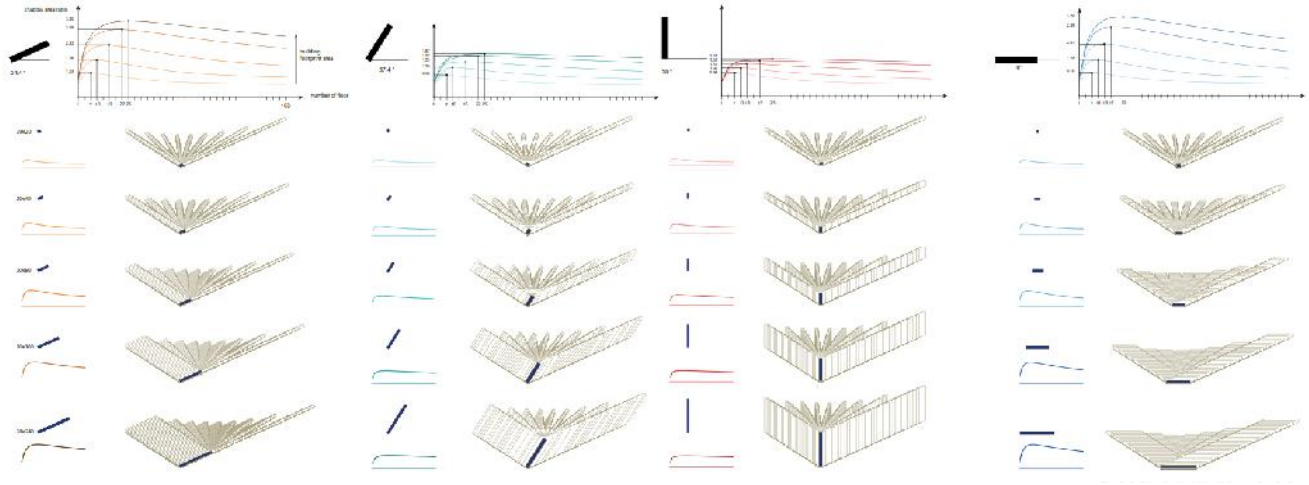


Fig.16: optimal building orientation

The matrix shows 4 different building orientations distributed along the X axis: N-S, E-W, 24.4 degrees from N-S axis and 57.4 degrees from N-S. Within each orientation group 5 different building footprints are displayed along the Y axis, from 20 by 20m to 20 by 240 m. Each test includes the increasing projected shadow as the building increases height from 1 floor level to103 floors level. The first graph adjacent to each test shows the shadow area ratio value along the Y axis and the number of floors distributed along the X axis.

It can be observed from the study that in all cases linear blocks are more efficient that tower buildings. There is a maximum SAR in relation to the number of floor levels that decreases as the building footprint is less linear. In the case of 24.4 degrees orientation the maximum ranges from 25 floors level for a building footprint of 20 by 240 meters to 7 floors for a building footprint of 20 by 20 meters. The N-S and the 24.4 degrees cases are more efficient that the other two. However the curve is different, the N-S case peaks and gradually decreases while the 24.4 degrees peaks and remains constant. Overall the study concludes that 24.4 degrees orientation locks are more efficient than tower like blocks.

3.7. Urban Design Proposal

3.7.1. Concept

The proposal aims to provide a distinguished and iconic part of the city by exacerbating the positive qualities of the remaining UVs and providing a unique urban experience derived from its proximity to it. The proposal wraps up the remaining pieces of UVs with a transitioning typology organized in areas of minimum edge (*Fig 17*).

The aggregation and subdivision of these areas constitute a dense podium that allocates a mix of office, retail and leisure space distributed horizontally). The roof will constitute a semi-public open space that could serve for cultural activities or residential use (*Fig. 18*) The dense podium will gradually open up as it moves away from the UV edge, increasing the size of the landscape and concentrating the urban activities in high-rise standing alone buildings.

The urban landscape articulates the different typologies. The ground activities take place at several levels along the podium wrapping up small plazas in the typology adjacent to the UV. As the development moves away from the remaining UVs the plazas become larger residential gardens with some standing alone towers inserted in it.

This will facilitate the transition from an FAR 2 in existing UVs to an FAR 7-8 in new developments (*Fig. 19*). The landscape will increasingly widen up until having the condition of standing alone buildings on the landscape.

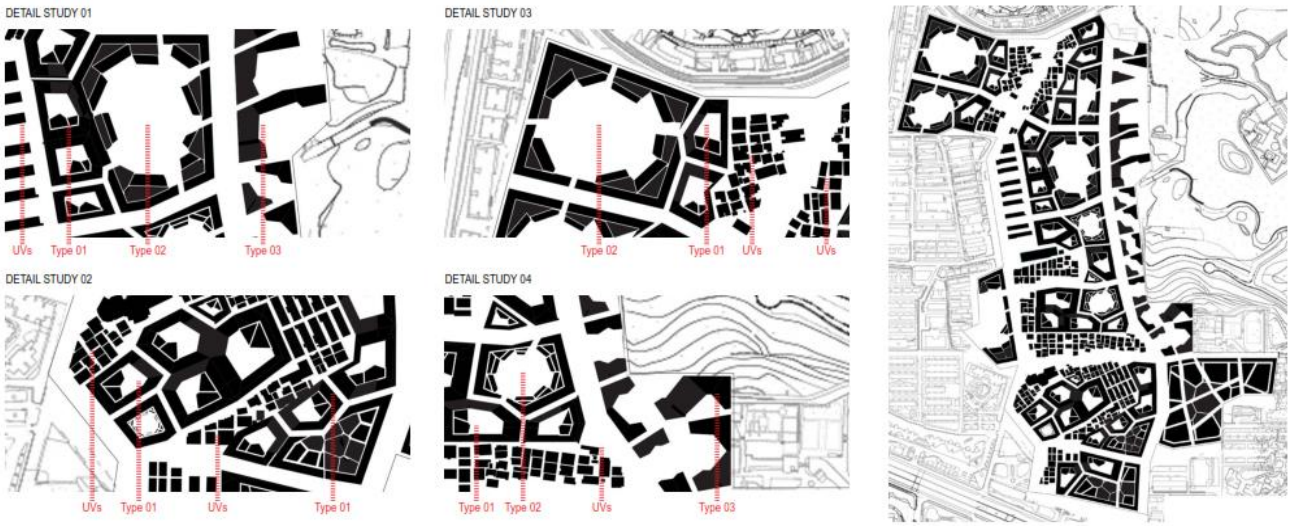


Fig.17: figure ground studies of the relationship between the plinth and the UVs and overall Nolli map

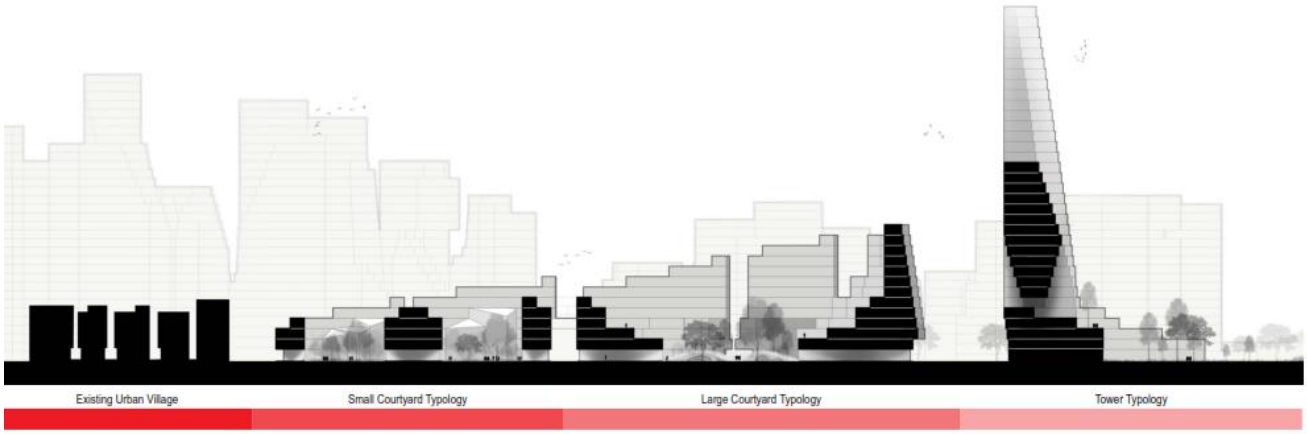


Fig.18: conceptual section

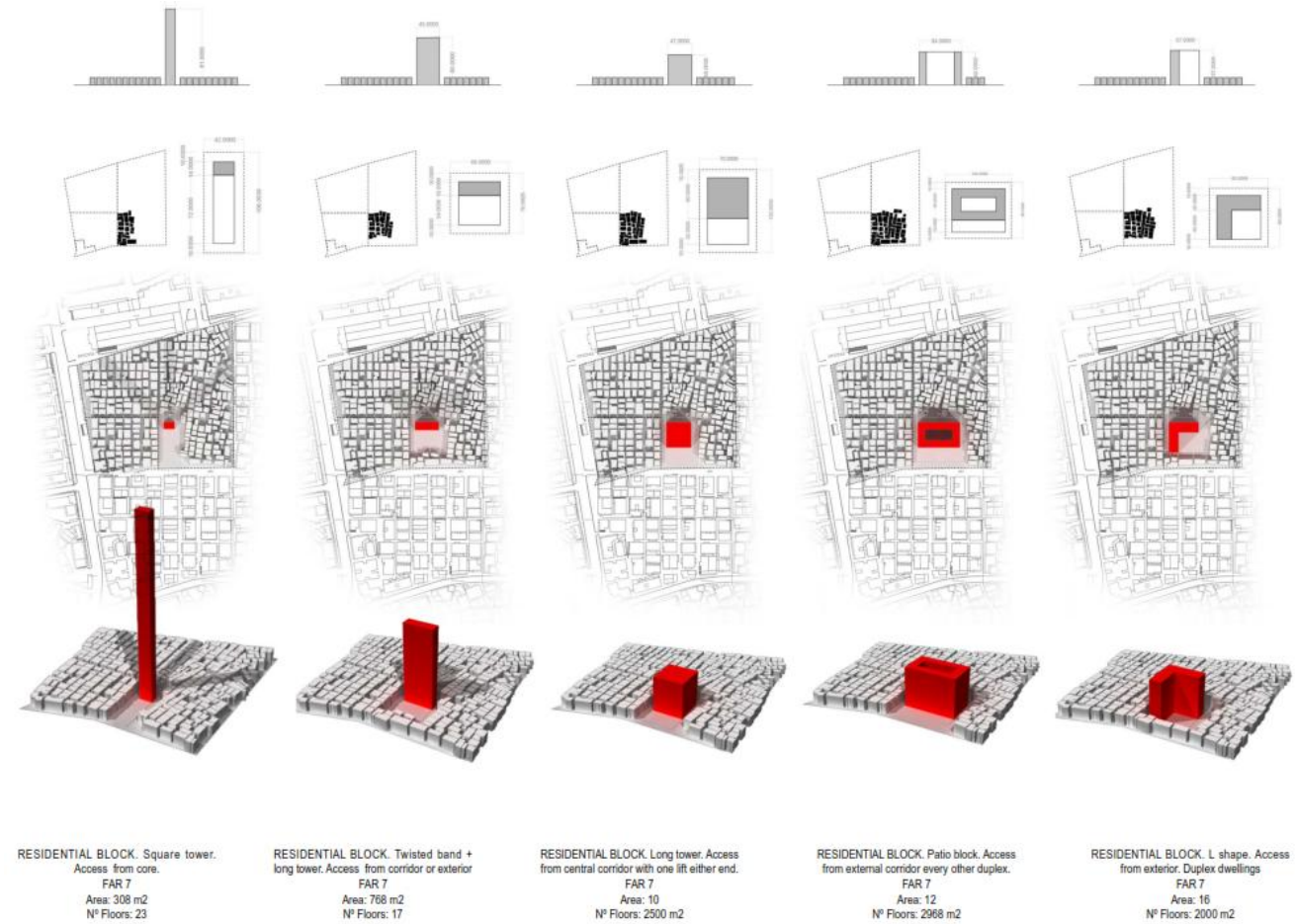


Fig.18: minimum parcel type comparison for FAR 7

INTRODUCING A FAR OF 7 IN EXISTING UVs CONTEXT

A preliminary series of massing studies tries to understand the minimum parcel intervention and the quality of the public spaces that emerge once a new development is inserted in the site. *Fig. 18* shows a first attempt to insert five generic types in the UV fabric: a tower, a

linear block, a fully occupied block, a closed block and a semi-open block. A first insight from this test is that any of these interventions breaks with the density and diversity that provides the urban villages corridors.

3.7.2. Plinth Landscape Typologies

In the areas close to the UVs the plinth encloses small plazas of 50m of diameter (*Fig. 19*) that can be occupied by retail buildings that connect vertically the different podium levels, generating smaller plazas of 20 m. of diameter. The podium has a recess in the upper levels and the built areas are concentrated in the centre of the larger blocks generating a stepping roof landscape that will serve as the base for the towers. Departing from this condition the podium can accommodate higher density by occupying totally the interior courtyards and lower density by concentrating the built area in the block edges enclosing private gardens for the residential developments The last option is having the towers standing alone on the landscape which in this case is the element that organizes the accessibility to the residential gardens. The relational urban model allows different combinations across the site of the four conditions described above.

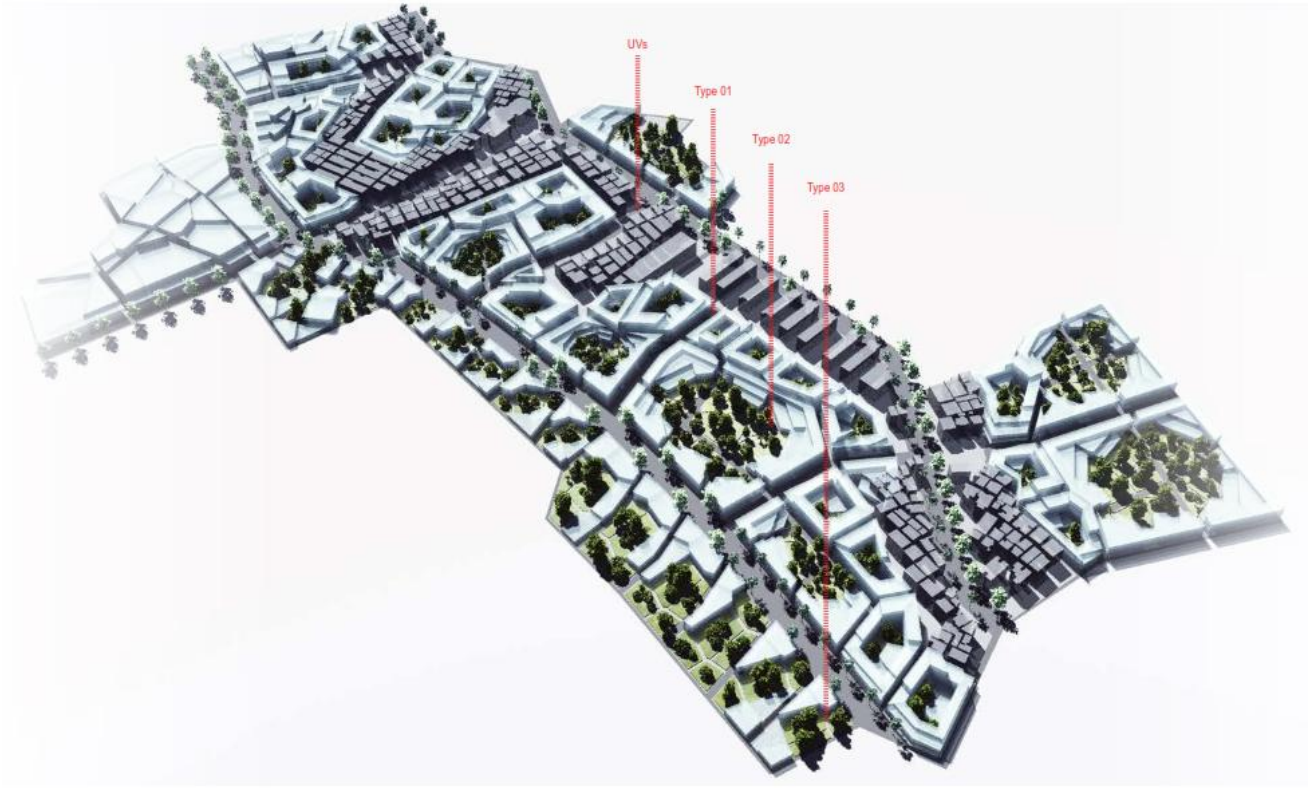


Fig.19: aerial image of the landscape podium

3.7.3. Landuse allocation of the plinth layers

The plinth proposal for the three different typologies is constituted by a series of layers. These layers have a specific landuse assigned in the Relational Urban Model.
Once the Relational Urban Model receives a landuse scope for each plot it starts to build up layers until it reaches the target. There is an option of limiting the number of floors or each layer. In the case that the Relational Urban Model cannot allocate the land-use target it will display it in the leftover cell data.(see *Fig.20*)

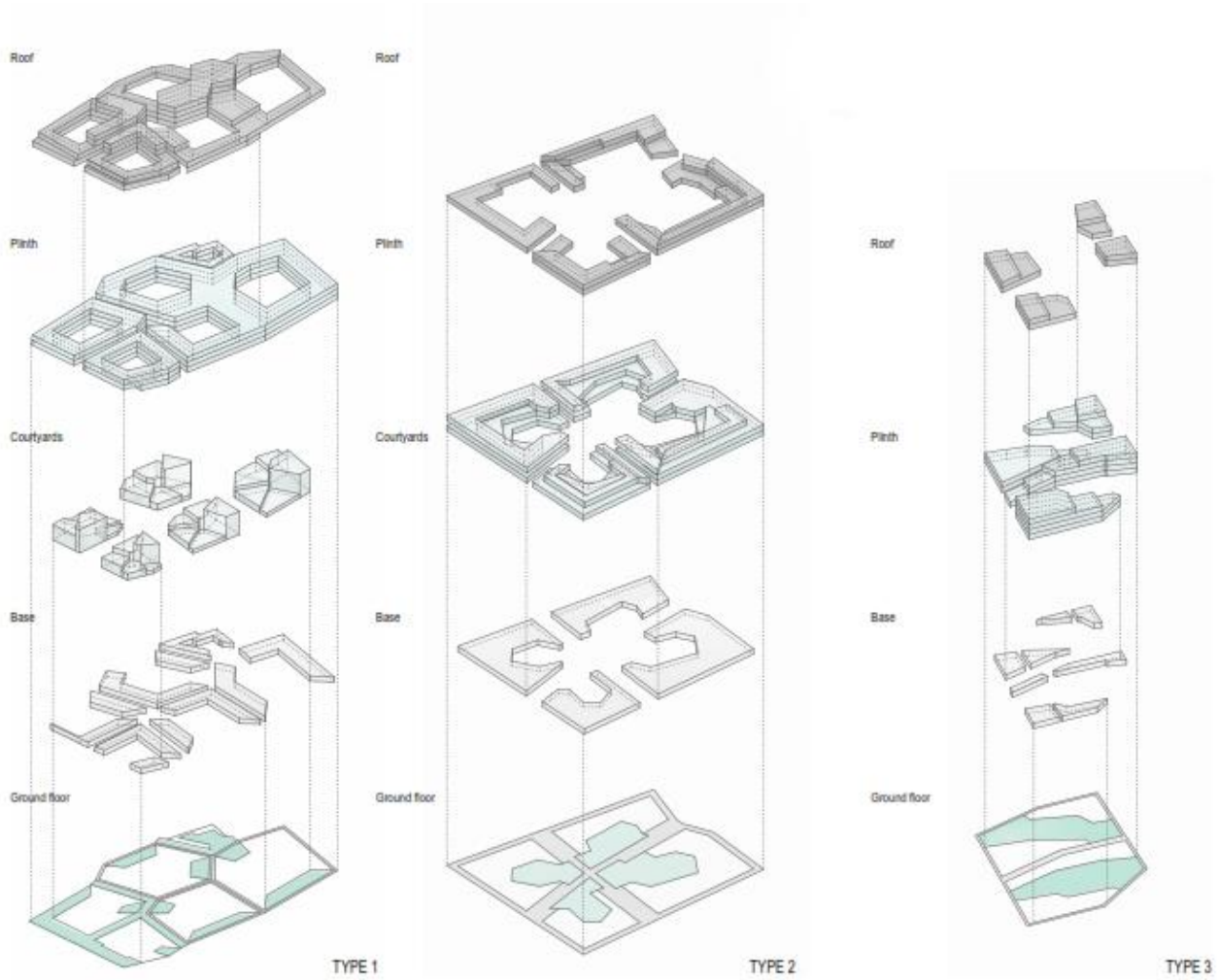


Fig.20: layers in different typologies in the development

3.7.4. Tower morphology

Due to the environmental regulations in Shenzhen the majority of the towers are either symmetrically staggered or aligned to large mega-plots edges with a resulting homogeneous skyline. The proposal aims to present a diverse skyline with peaks concentrated in specific areas of the development where the towers are across rich podiums and then sculpted to allow the sun incidence in the façade (See *Fig.21*).
A diversity of land-uses results from the different façade conditions, having the possibility of introducing: offices, residential, vertical gardens and vertical public facilities. *Fig. 24* shows the proposed skyline of 3.6 m. square meters of development with clustered buildings and diverse skyline.

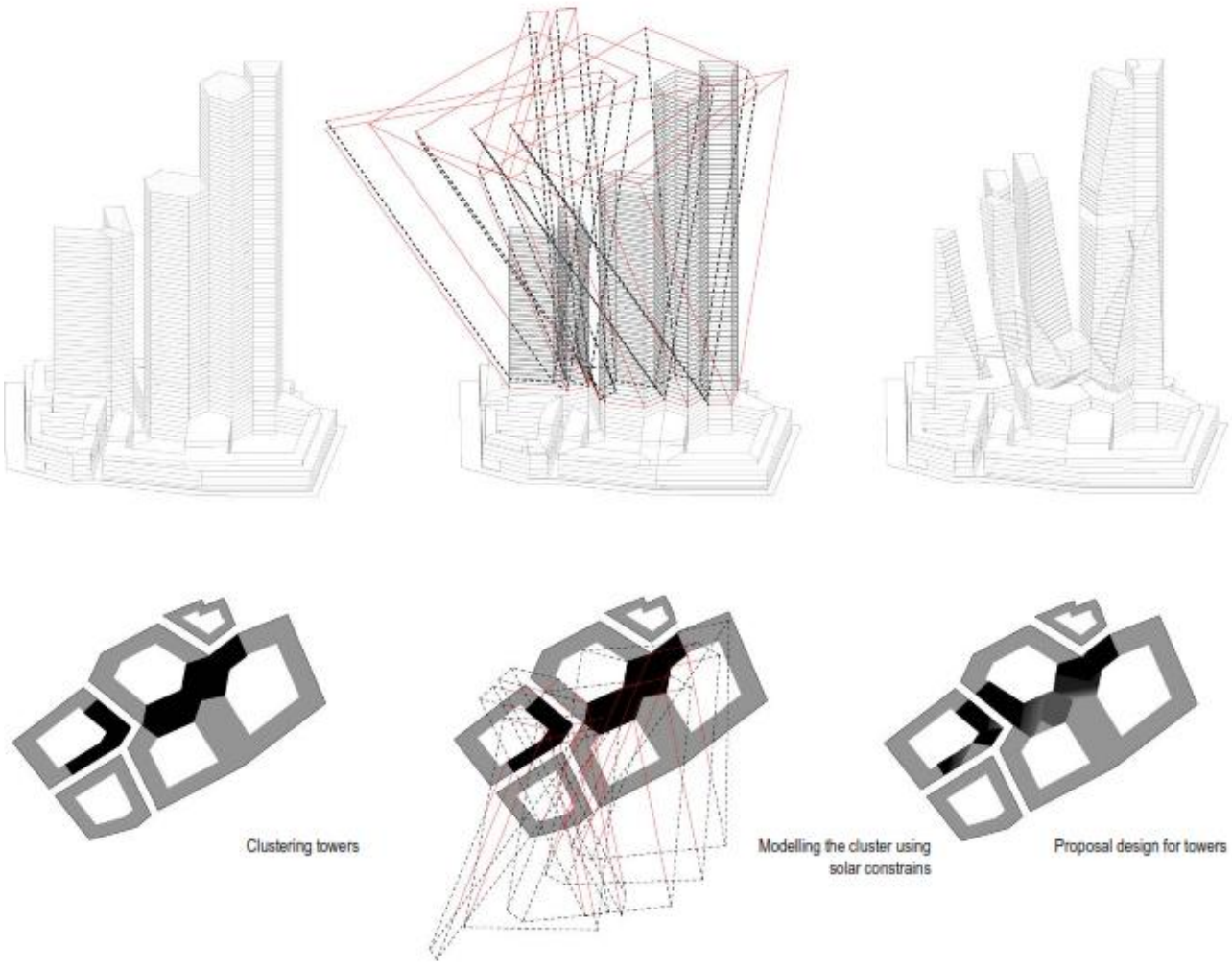


Fig.21: tower morphology according to sunlight requirement

3.7.5. Generative network Design

Two N-S axes (20 m. wide) provide accessibility to the site connecting Shennan Ave in the South with Beihuan Ave in the North. A series of E-W roads connect the two N-S axes creating a primary network and generating primary blocks which size are in average 300-400 m. long. A secondary road network subdivides the primary bocks.
In the areas closer to the remaining pieces of UVs the secondary road network is organized concentrically around them; the resulting parcels have the morphology of a bubble. As the site moves away from the remaining pieces of UVs the parcels are more regular adopting the optimum direction along the lines of the Sun Area Ratio study (*Fig.22*).
Following these design principles, the relational urban model allows for testing different scenarios by the different users: on the one hand different portions of UVs can be selected to remain and the mesh with actualize automatically setting the base for the building typologies (*Fig.23*)

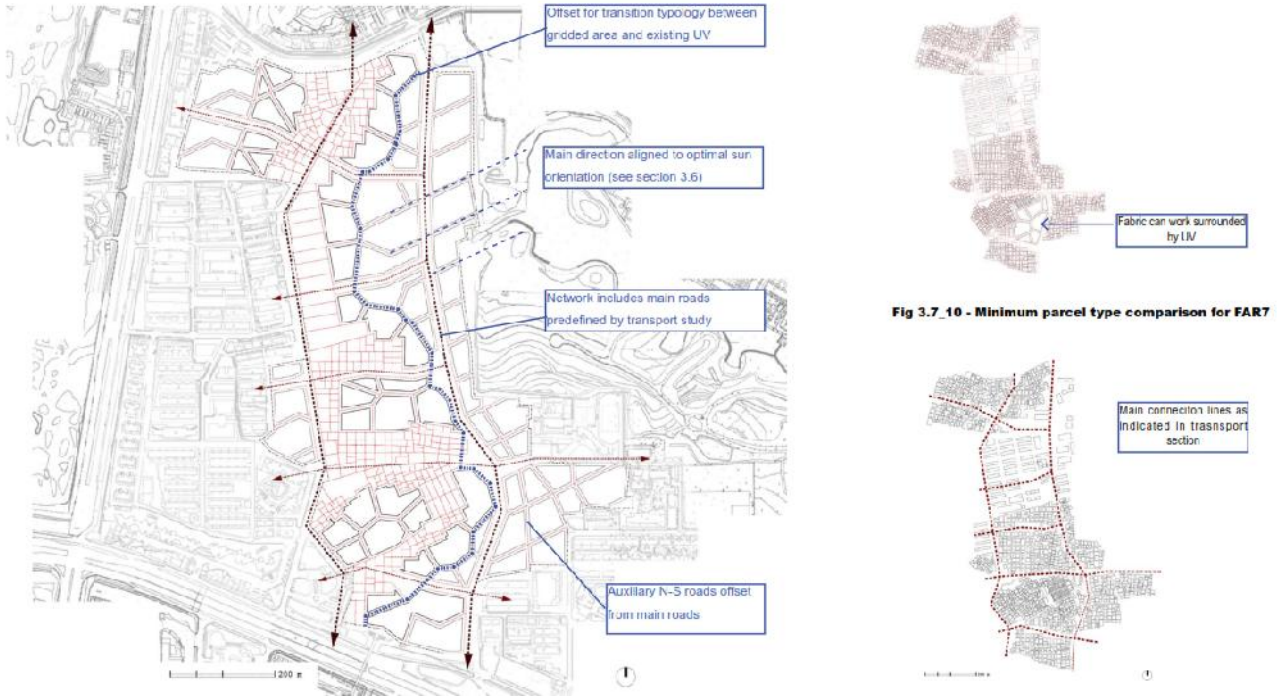


Fig.23: minimum parcel type comparison for FAR 7

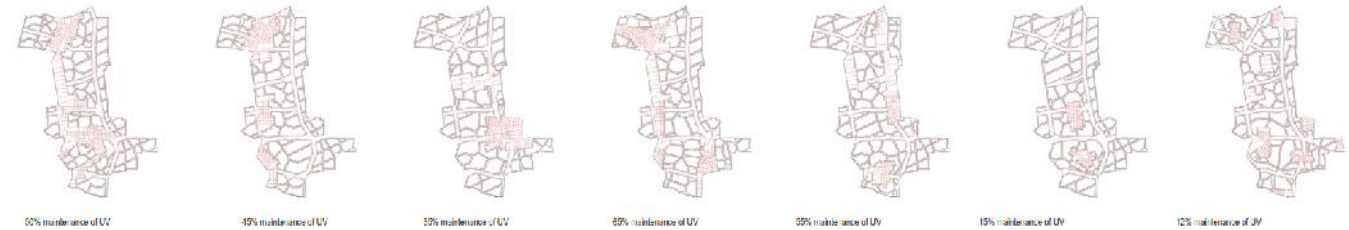


Fig.22: minimum parcel type comparison for FAR 7

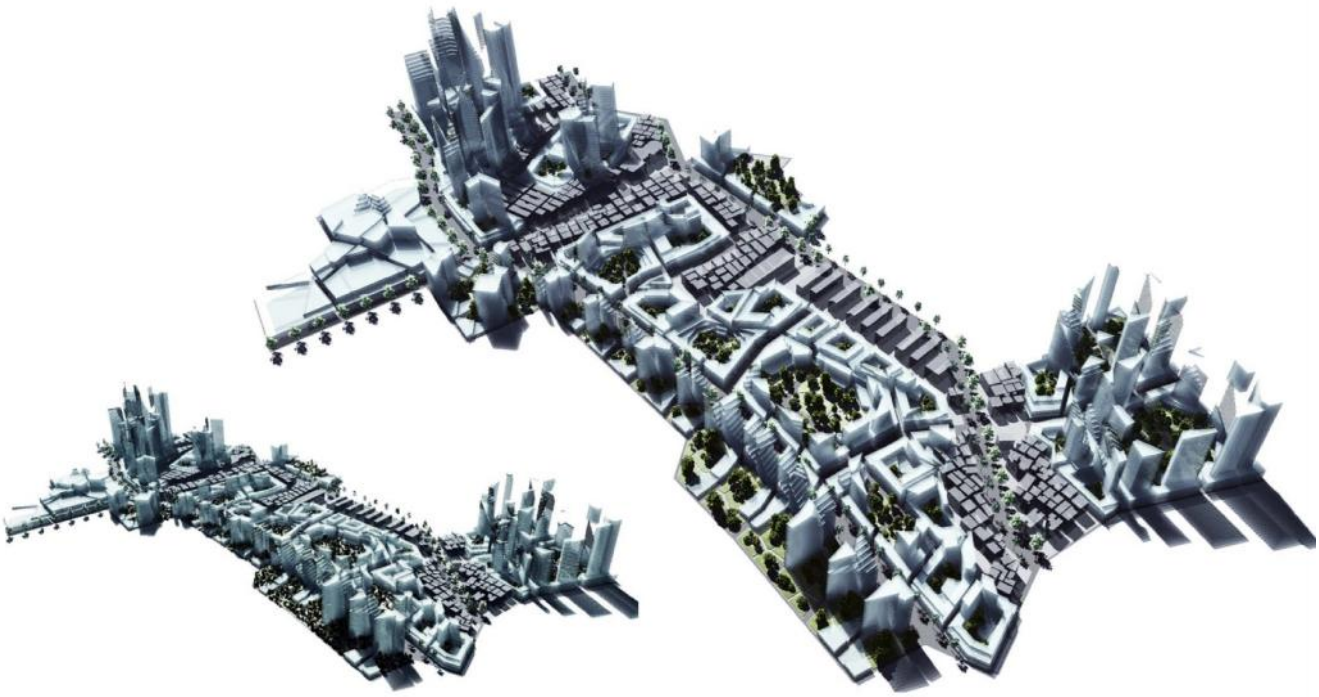


Fig.24: rendered view of the potential mix of typologies

3.8. Transport study and site capacity

Since for the purpose of this research the analysis of the transport studies are not considered of particular relevance as they were meant to inform the stakeholders on the impact that the development would have caused in the new overall road network of SZ, this part of the project investigation has been omitted.

3.8.1. Capacity study

A capacity study has been undertaken in order to assess the impact of different development scenarios in the transport network and be able to find a limiting condition for the overall planned density. This limit is used as a constraint to obtain the land use schedule proposed within the overall interface.

Likely movements from and to the development are evaluated with a traffic model that has the general characteristics

- Average density of residential is in the region of 1 person / 20m2
- Average density of office is in the region of 1 person /12m2
- It is assumed that live work is 10%
- Car usage for office workers is10%

The model estimates the traffic that comes from and to the development and locates it into the adjacent network. It also estimates flows of roads within development assuming there is no through traffic from the external areas across Baishizhou. The main characteristics of such a model are the following:

- The model is sensitive to the increase in GFA of office since this drives considerable amounts of early commuting. This is due to a higher concentration of workers per m2 of development
- The model is also sensitive to slight increases in modal shift towards private vehicles, since these tend to occupy spare road capacity.
- This routing is used to assess the different impacts of land use scenarios on Baihuan avenue or Shennan Dadao.

3.9. Development of an economic model

An initial economic model has been introduced into the RUM as a form of evaluation of proposals, tested, shared and modified by the different users in order to reach agreement. It estimates both cost and benefit of the investment over a period of time, producing a cash flow analysis.
The model includes (See *Fig.25*):
-Estimated cost of infrastructures
-Estimated cost of purchasing the land
-Estimated revenue stream from commercial development. The model allows distinguishing between maintaining stock for rental or immediate selling.
-Estimated purchase value of existing development rights. As previously mentioned, this is likely to be compensation in GFA of around 110% to 140% of existing built area. The model assumes a phasing of project divided in 7stages (average 2 years per phase):
this gives a cash flow analysis (See *Fig. 26*) for the duration of the several phases, which considers the following:
-Cost of borrowing in China is high (data obtained from Arup SZ indicates values of up to 20% - 30%)
-Assumes a two years delay between purchase of land and selling of development. The following can be said about the principles of the economic model:
-Given the high premium to be paid by the developer to the landowner in terms of land purchase (110%-140%) of existing GFA (already FAR 2.7) this means that densities below FAR 4-5 do not break even.

-Given the high cost of borrowing (30% or more) the incentive is to sell quickly in order to prevent paying interests. This also means that minimising the delay between purchase and sale is critical.

Typical Construction Cost (RMB) per Square Metre Construction Floor Area

Types	Demolition (RMB per m2)		Construction (RMB)		Selling Rate (RMB per m2)	Rental Rate (RMB per sq m)
	(Lower Cost)	(Upper Cost)	(Lower Cost)	(Upper Cost)		
Residential						
High Rise; High Quality	6,000	6,500	3,950	5,500	32,255	78
High Rise; Better Quality	6,000	6,500	3,050	3,050	32,255	78
High Rise; Ordinary Quality	6,000	6,500	2,100	2,900	26,618	58
Low to Med Rise; High Quality	6,000	6,500	4,200	5,900	40,404	100
Low to Med Rise; Ordinary Quality	6,000	6,500	2,800	3,650	25,345	48
Shopping						
Retail (high quality)	4,500	62,000	7,400	11,200	-	-
Retail (ordinary quality)	4,500	62,000	5,900	7,200	-	343
Office						
High Quality Office	6,000	6,900	6,700	10,100	-	-
Medium Quality Office	6,000	6,900	4,900	6,900	-	78
Ordinary Quality Office	6,000	6,900	3,650	4,050	-	78
Landscaping						
External Area	-	-	1,000	6,000	-	-
Roads and Parking						
Arterial (cost per km)	-	-	309,523,810	309,523,810	-	-
Collector (cost per km)	-	-	92,307,692	92,307,692	-	-
Pedestrian paths- asphalt (cost per m)	-	-	1,000	1,000	-	-
Pedestrian paths- natural stone (cost per m)			2,000	3,000		
Underground Parking			3,550	6,200		
Aboveground Parking	-	-	2,200	2,200	-	-
Hotel						
5-Star	-	-	11,900	15,400	-	-
3-Star	-	-	8,900	11,200	-	-
			3,095			

Developer Bank Rates

	Most Banks	Agriculture Commerce Bank
Residential	10%+	30%+
Commercial	20%+	50%+

Assumptions:

1. Construction cost based on Rider Levett Bucknall Quarterly Construction Cost Update (Hong Kong) June 2013
2. Aboveground parking cost based on Davis Langdon & Seah Quarterly (DL&S) Construction Cost Review Second Quarter 2011
3. Landscaping cost based on consultation with Arup landscape architects in Shenzhen and Hong Kong
4. Commercial demolition cost based on DL&S, price of industrial to office (Grade B) buildings in HK
5. Demolition cost based on Foshan's policy of resettlement pricing [minimum fees per sq m paid to owner/resident] instead of physical construction work
6. Developer bank rates from consultation with Chinese medium-sized developer with projects in Shenzhen and throughout China
7. Pedestrian footpaths (non-vehicular) are estimated per square meter; leave a margin of error for costs estimates
8. High quality and better quality high rise residentials are grouped together

Fig.25: data for economic model

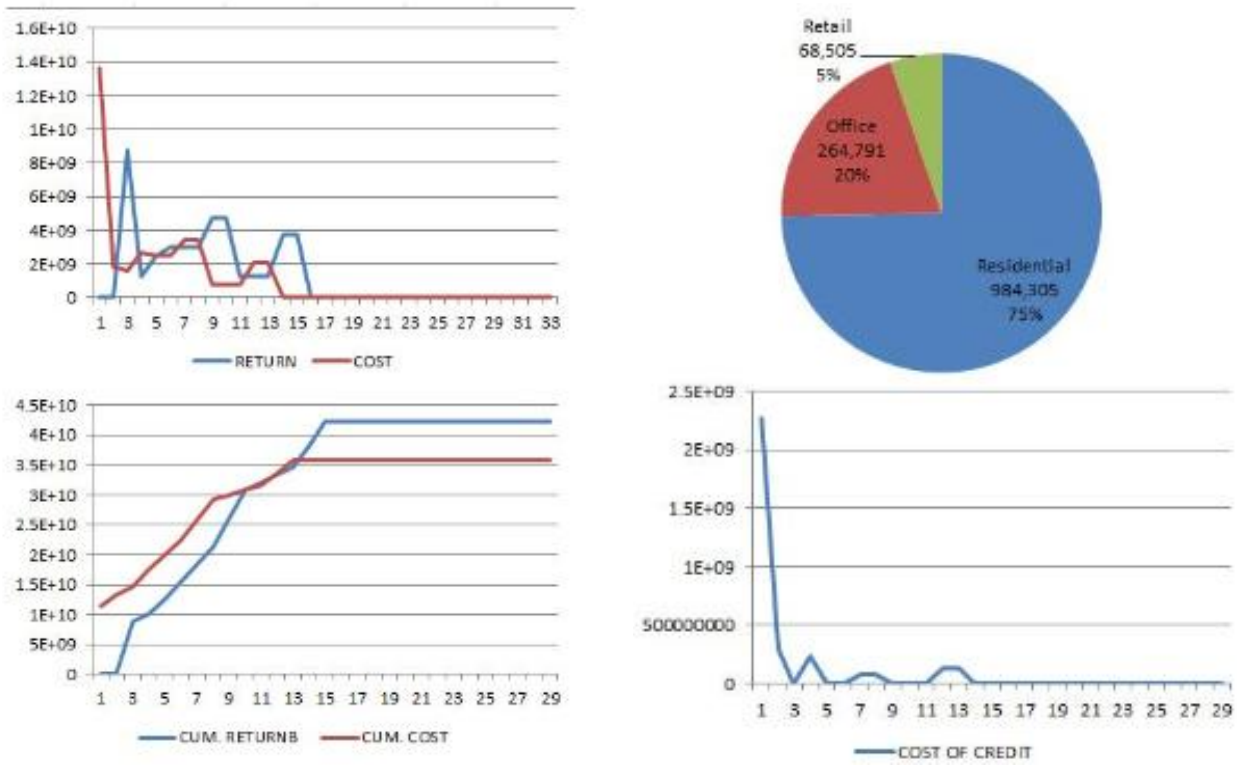


Fig.26: typical outcomes for economic model

3.10. Development of the interface and massing studies

The interface has been used as well in order to assess the applicability of the design methodology in the case of Baishizhou. Two exercises were undertaken:

- Traffic optimisation with N-S access in relation to Landuse distribution: Generation of basic 3D model with traffic optimisation including 6 different land use patterns (residential, commercial and office both south and north).
  This process enabled the generation of design options that would manage to use up a larger proportion of infrastructure capacity (outlined in points below).
  The graphic outcomes of the interface are shown in *Fig. 27*
- Massing studies in relation to existing UVs: Study of three UV demolition strategies and test how the allocation of different, typologies allows for more or less GFA capacity and urban qualities.

3.10.1 Traffic optimisation with N-S access

The fundamental advantage of working with methods of optimisation, whether it is linear programming or other is the fact that GFA can be allocate in term of space and land use in such a way that several aspects of capacity are reached simultaneously. This means that, before the most critical limit is reached, GFA is allocated in order to use up other capacity which may be less critical, reaching a maximum value when at capacity is exhausted across the site.

- For the purposes of the development of the interface, the tool has been used in order to optimise the distribution of GFA reaching a series of traffic targets. The following points outline the variables and targets used:
- Three independent patterns are used (residential, office, retail) for the north and the south, giving a total of 6 variables for the land use combination. These are shown indicatively in section on linear programming.
- Traffic constraints are given for north and south for AM and PM peaks in and out, giving a total of 8 constraints.
- It has to be considered that, for this case, the use of different areas (north and south) within the optimization model will give meaningful results since there is likely to be a difference in the result of locating traffic sources in different areas of the site. This is likely to happen since there is the partial

possibility of choice to use either north or south exit for some of the destinations (East and West). In case that this choice would not exist, location of weighted towards the exits would stop being relevant to external loading (it would have an internal impact, which is no considered in this exercise)

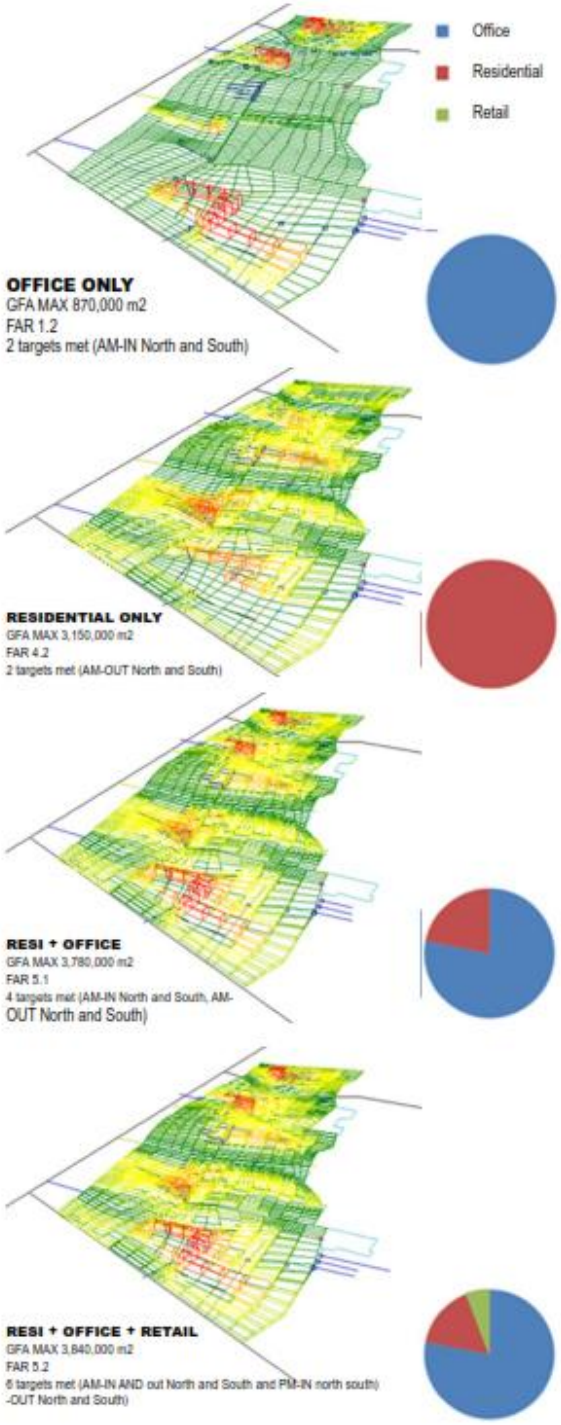


Fig.27: influence of land usage in maximum capacity

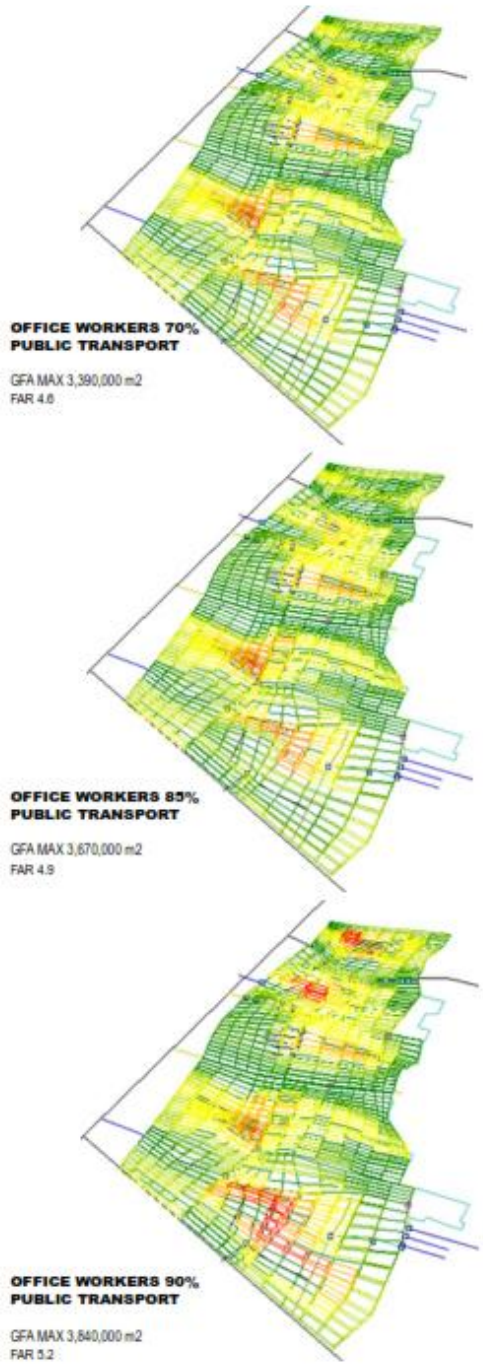


Fig.28: influence of public transportusage in maximum capacity

3.10.2 Initial results

From an initial use of the linear programming method, the following conclusions can be obtained:

- Traffic generation levels of 3,500 vehicles/hour in + out, North + South give a total GFA of 3,550,000m2. This value can be considered optimistic, given the large impact that this traffic values imply
- It is understood that the developers and officials are targeting density levels above 6-7. This would result in areas of about 5-6 million m2, which would imply a heavy burden in the overall network.
- Land use mixes that occupy most capacity at different hours tend to be in the region of resi/office/retail of 70/20/10.This is due to the following:
- Each land use is complementary in terms of patterns-Land uses such as office and retail are more transport intensive (ie attract or generate more traffic per m2) and therefore fill their capacity earlier.
- Improvements in public transport use have implications in the maximum GFA permitted of up to 20% (see *Fig.28*). This restriction can be applied to office and commercial, since it is within the realm of the master plan to limit usage of car using parking strategy, while it is not practicable for residential, which has a car usage dependent on the provision of parking elsewhere.
- If internal capacity of roads is not a constraint, the solver will try to push GFA away from the northern node, which tends to attract more traffic. This can lead to results that initially appear to be counterintuitive especially since, although more capacity may be assigned to this node, this gets “eaten up” more quickly than the one in the south. However, although the solver is doing the “correct” operation (ie dis-incentivise the movement towards key node by moving people to a node where alternative choice is viable) it is also encouraging longer internal trips.

ITERATION 01					
LAND USE	MILL. SQM.	AM IN (VPH)	AM OUT (VPH)	PM IN (VPH)	PM OUT (VPH)
Residential	2	6368	2787	4429	5872
Office	1				
Retail	0.6				
ITERATION 02					
LAND USE	MILL. SQM.	AM IN (VPH)	AM OUT (VPH)	PM IN (VPH)	PM OUT
Residential	2.8	3500	3500	3500	NO LIMIT
Office	0.6				
Retail	0.15				

3.10.3 Massing studies in relation to existing UVs

The purpose of this section is to assess what is the impact of adding development in different demolition scenarios and how the choice of different typologies may affect the final result. The following steps have been followed in order to address these issues:

- Three demolition strategies are produced ranging from total demolition to minimal demolition.
- Two massing distribution strategies are proposed: homogeneous and variable skyline
- The interface attempts to distribute 3.6 million m2 in the vacant area (2m residential, 1m office and 0.6m Retail.)
- The interface applies two series of architectural constraints:

  -ARCHITECTURAL CONCEPT: Max height of towers / blocks according to architectural concept and design idea. This brings initially figures down from initial 3.5 million/m2 as shown in column marked O in *Fig.29*

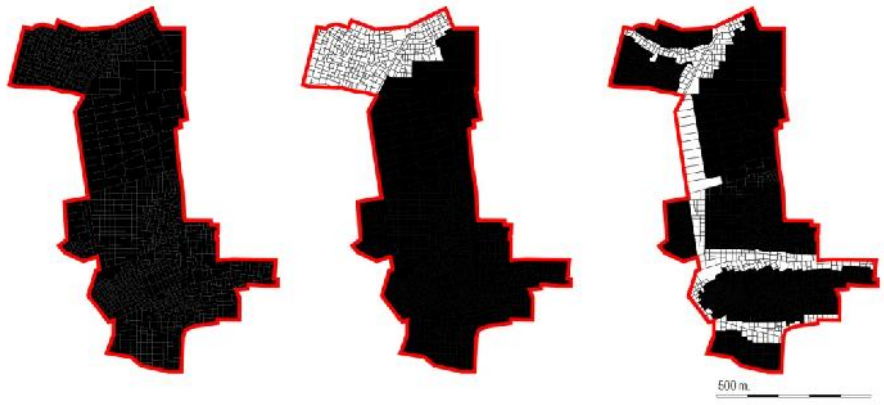
  -SUNLIGHT REGULATION: The interface applies sunlight regulations and "cuts" the massing to prevent excessive shading. This brings massing further down from previous figure as shown in column marked W in *Fig.29.*

- Each of the results is further analysed in terms of urban parameters (facades, provision of public space) and scored in *Figures 30-33*

DEMOLITION STRATEGIES

- Strategy 1: 100% Demolition and adding a new development account for 3.6 million of Square meters
- Strategy 2: 82.4% Demolition, retaining the residential area that has the best environmental conditions and adding a new development accounting for 3.6 million of Square meters.
- Strategy 3: 72.2% Demolition, retaining the urban fabric along the most active streets and adding a new development accounting for 3.6 million of Square meters.

The interface will test twice the three typologies separately for each of the three demolition scenarios. First it will test it implementing a continuous skyline and secondly it will test it with a variable skyline.



		TYPOLOGY 01			TYPOLOGY 02			TYPOLOGY 03		
		W	O	%	W	O	%	W	O	%
DEMOLITION STRATEGY 01	CONTINUOUS SKYLINE	Resi(A): 2.35 mill. sm2 Ret(F): 29202 m Pub(A):141540 m2	Resi(A): 2.44 mill. m2 Ret(F): 29202 m Pub(A): 141540m2	96.14%	Resi(A): 1.33 mill. m2 Ret(F): 14573 m Pub(A): 101408 m2	Resi(A): 1.95 mill. sqm Ret(F): 14573 m Pub(A): 101408 m2	67.95%	Resi(A): 1.80 mill m2 Ret(F): 11357 m Pub(A): 119301 m2	Resi(A): 2.0 mill m2 Ret(F): 11357 m Pub(A): 119301 m2	88.73%
	VARIABLE SKYLINE	Resi(A): 2.12 mil sqm. Ret(F): 29202 m Pub(A): 141540 m2	Resi(A): 2.36 mill sqm. Ret(F): 29202 m Pub(A): 141540 m2	90.07%	Resi(A): 1.23 mill. m2 Ret(F): 14573 m Pub(A): 101408 m2	Resi(A): 1.86 mill. m2 Ret(F): 14573 m Pub(A): 101408 m2	65.98%	Resi(A): 1.63 mill m2 Ret(F): 11357 m Pub(A): 119301 m2	Resi(A): 2.03 mill m2 Ret(F): 11357 m Pub(A): 119301 m2	80.66%
DEMOLITION STRATEGY 02	CONTINUOUS SKYLINE	Resi(A): 2.15 mill. m2 Ret(F): 23108 m Pub(A): 105365 m2	Resi(A): 2.31 mill. m2 Ret(F): 23108 m Pub(A): 105365 m2	93.25%	Resi(A): 1.67 mill. m2 Ret(F): 11082 m Pub(A): 75176 m2	Resi(A): 1.11 mill. m2 Ret(F): 11082 m Pub(A): 75176 m2	59.04%	Resi(A): 1.12 mill m2 Ret(F): 8738 m Pub(A): 91900 m2	Resi(A): 2.02 Ret(F): 8738 m Pub(A): 91900 m2	55.4%
	VARIABLE SKYLINE	Resi(A): 2.26 mill. m2 Ret(F): 23108 m Pub(A): 105365 m2	Resi(A): 2.04 mill. m2. Ret(F): 23108 m Pub(A): 105365 m2	90.6%	Resi(A): 1.90 mill. m2 Ret(F): 11082 m Pub(A): 75176 m2	Resi(A): 1.05 mill. m2 Ret(F): 11082 m Pub(A): 75176 m2	55.19%	Resi(A): 1.44 mill m2 Ret(F): 8738 m Pub(A): 91900 m2	Resi(A): 2.00 mill m2 Ret(F): 8738 m Pub(A): 91900 m2	71.71%
DEMOLITION STRATEGY 03	CONTINUOUS SKYLINE	Resi(A):1.92 mill m2 Ret(F): 22977 m Pub(A): 99970 m2	Resi(A): 2.12 mill m2 Ret(F): 22977 m Pub(A): 99970 m2	90.63%	Resi(A): 1.04 mill m2 Ret(F): 9239 m Pub(A): 83578 m2	Resi(A): 1.77 mill m2 Ret(F): 9239 m Pub(A): 83578 m2	58.84%	Resi(A): 1.57 mill m2 Ret(F): 8364 m Pub(A): 91062 m2	Resi(A): 1.94 mill m2 Ret(F): 8364 m Pub(A): 91062 m2	81.16%
	VARIABLE SKYLINE	Resi(A): 1.93 mill m2 Ret(F): 22977 m Pub(A): 99970 m2	Resi(A): 2.07 mill m2 Ret(F): 22977 m Pub(A): 99970 m2	93.03%	Resi(A): 1.03 Ret(F): 9239 m Pub(A): 83578 m2	Resi(A): 1.72 Ret(F): 9239 m Pub(A): 83578 m2	60.19%	Resi(A): 1.44 mill m2 Ret(F): 8364 m Pub(A): 91062 m2	Resi(A): 1.87 mill m2 Ret(F): 8364 m Pub(A): 91062 m2	76.92%

Fig.29: demolition strategy table

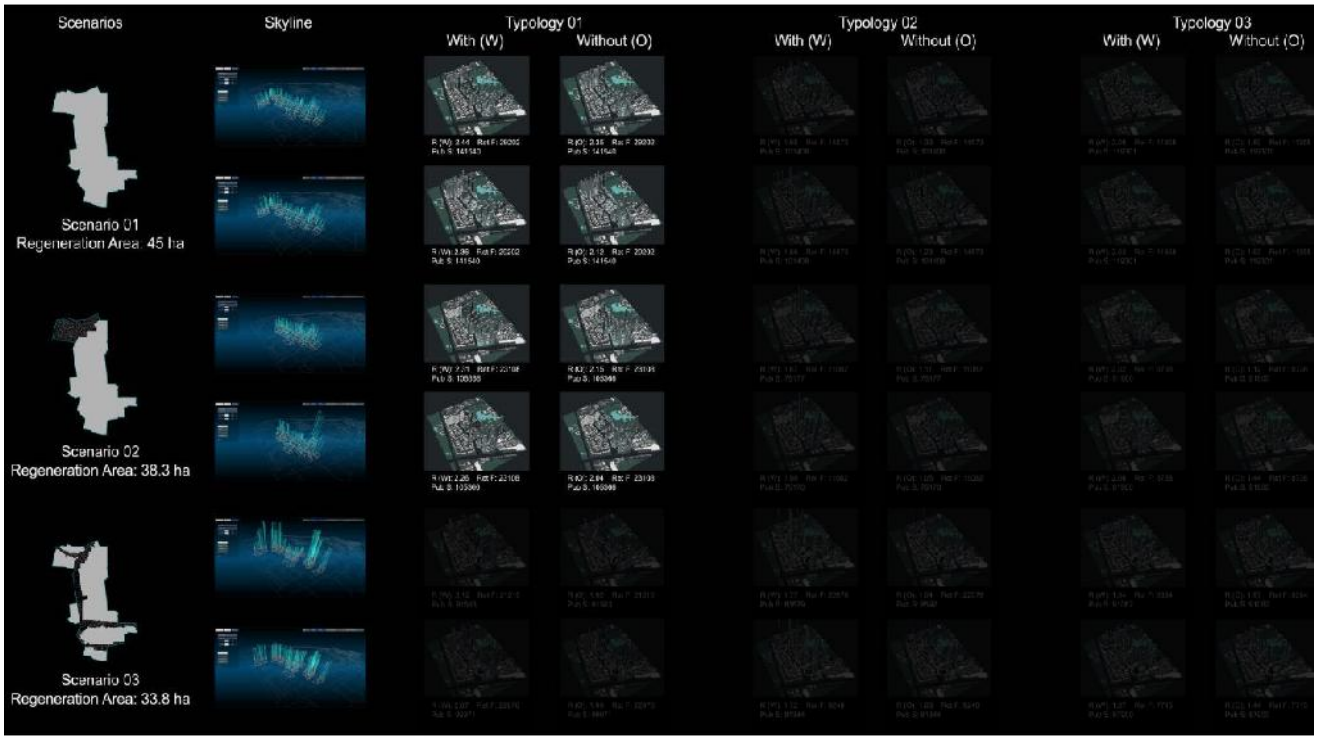


Fig.30: design option with more than 2 mill of square meters of residential development

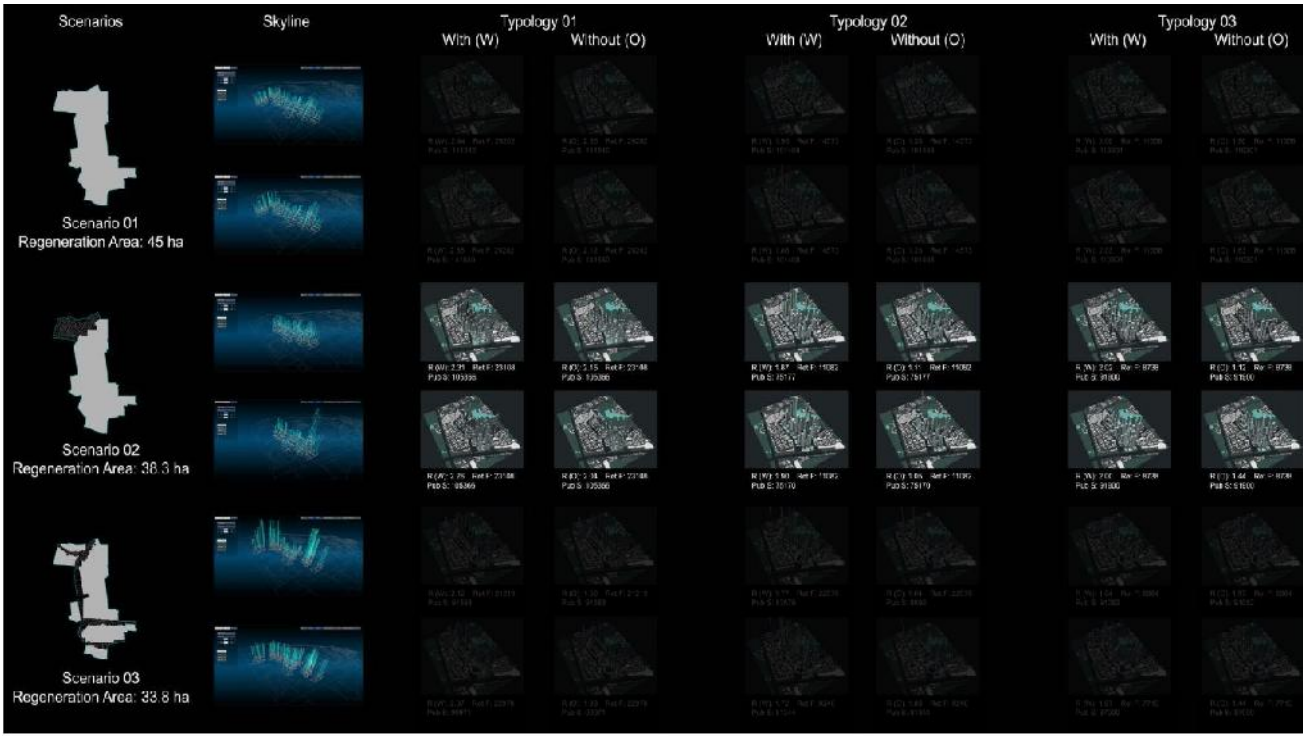


Fig.31: design option largest area of retained UVs

Fig.32: design option with largest more than 100.000sqm of public space

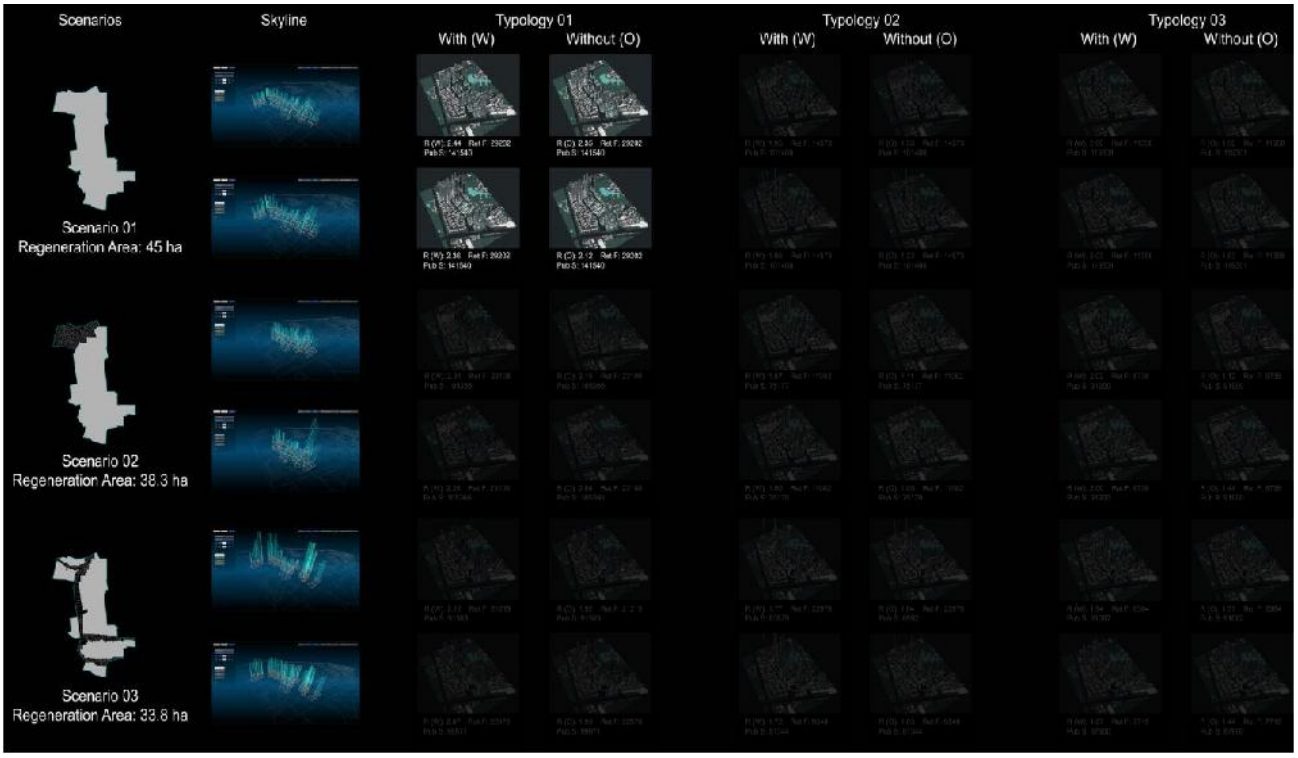


Fig.33: design option with largest retail facade at the ground level

The criteria for the variable skyline are that skyline decreases as the new development gets closer to the existing UV. (*Fig.34*)
During this iteration the interface will run twelve times testing the 3 demolition strategies described above and the 3 typologies separately. See *Fig. 35* for Strategy 01
A series of parameters have been selected in order to assess the different iterations:

1. Residential area complying with lighting regulatory requirements
2.Residential area not complying with lighting regulatory requirements.
3.Percentage of residential area that complies with lighting regulatory requirements.
4. Retail Facade at the ground level.
5. Provision of Public Space at the ground level. *Fig. 29* show the data produced by the relational urban model

The different iterations allowed the designer and the stakeholders to understand during either negotiation meetings or private online accessed desktop sessions which typologies and demolition options suits better for the development.
Fig. 30 highlights the options that accommodate more than 2 mill of m2 of residential area. The RUM findings show that Strategy 02 Typology1allows to accommodate 3.6 mill of square meters, meaning that with the precise urban morphology and demolition scenario is possible to retain partially a sector of UVs without compromising the overall business model.

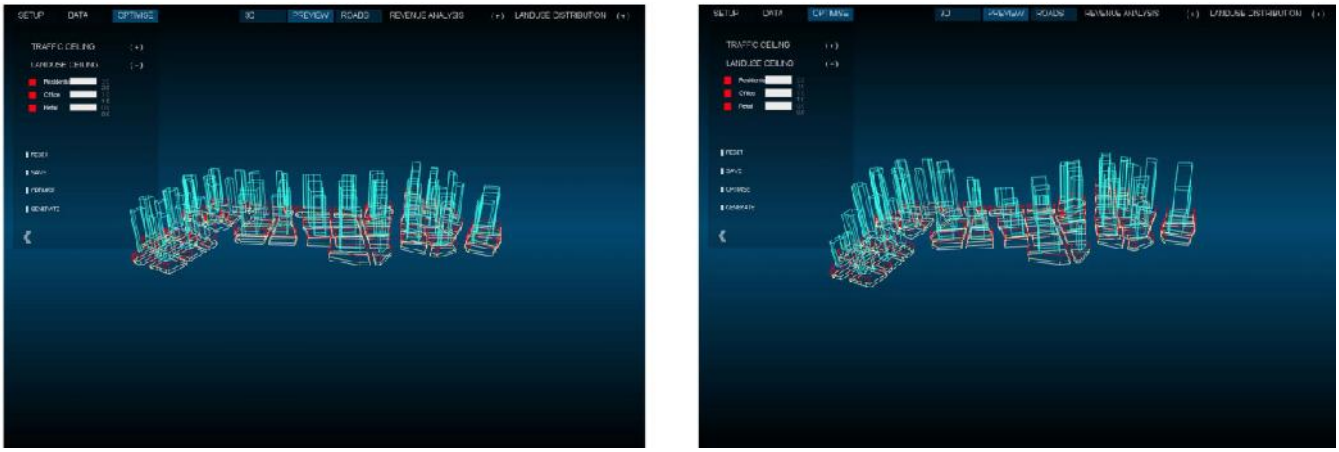


Fig.34: continuous skyline and variable skyline

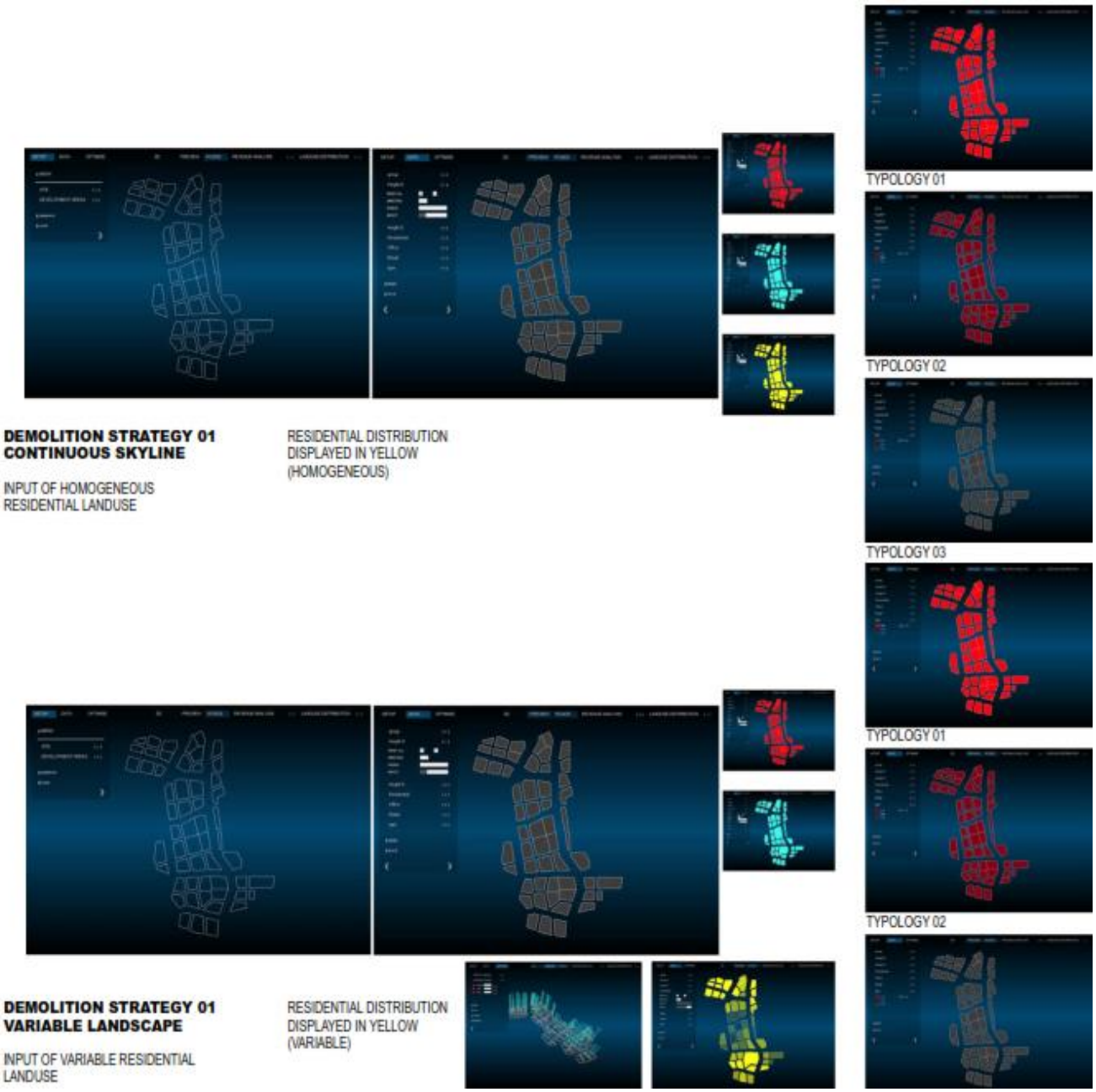


Fig.35: Interface display for strategy 1

6. Conclusions

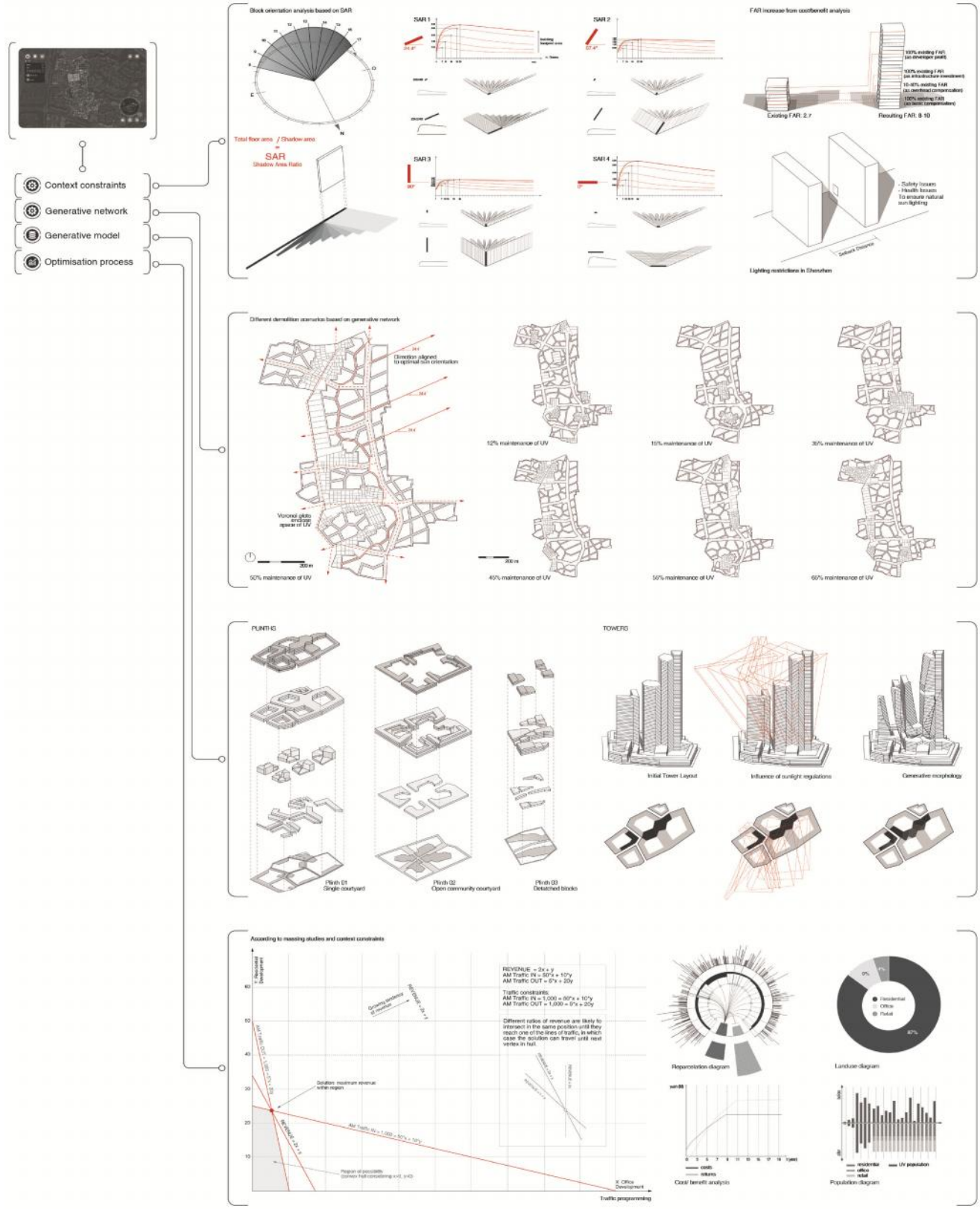


Fig.36: General Workflow

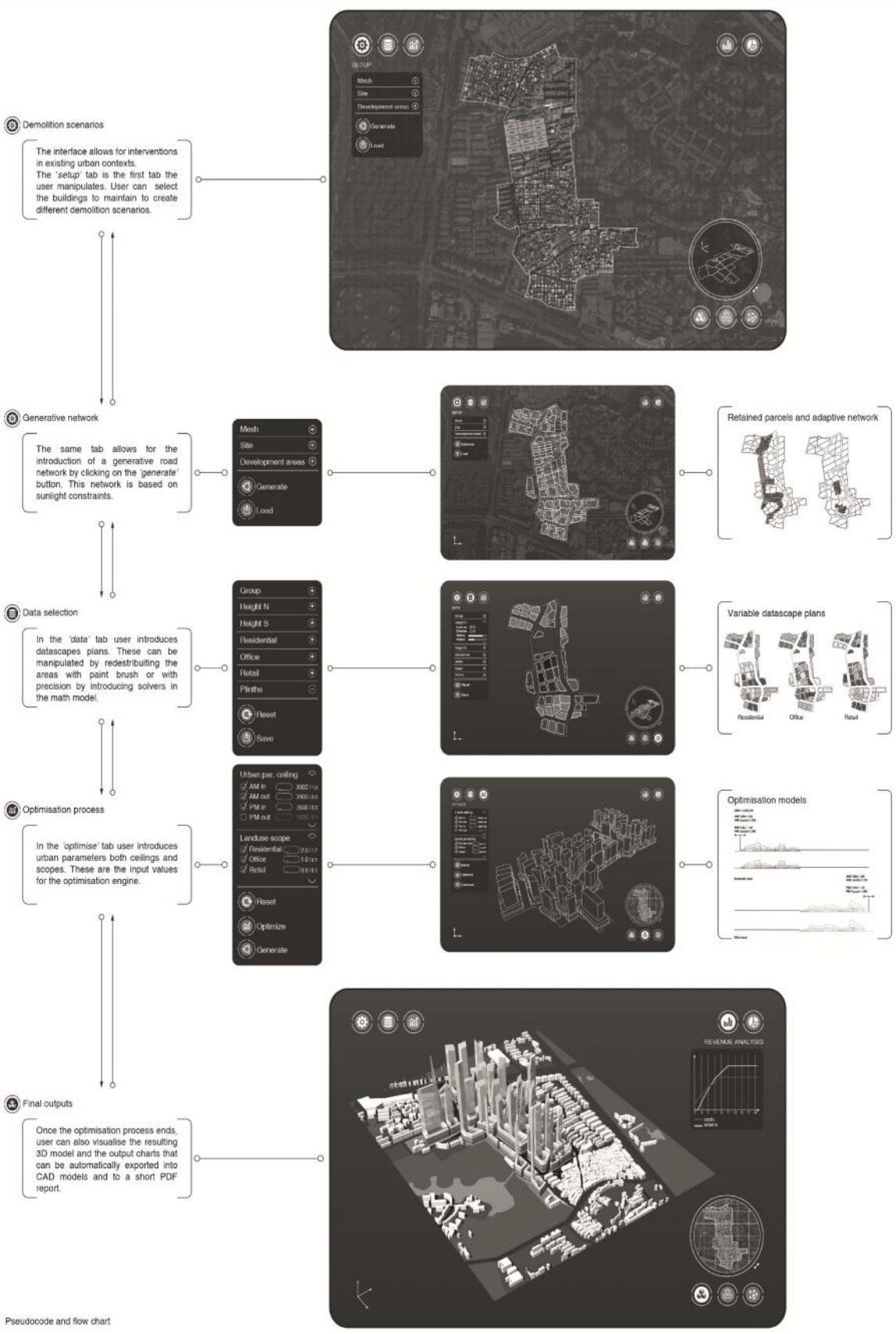


Fig.36: General Workflow

-RUM INNOVATION AND POTENTIAL/STRENGTHS:

1. They have the potential to correlate spatial and infrastructural outcomes to performative measures
2. They have constructed the ability to synthesize an enormous range of divergent and competing measures, organizing at once feedbacks seamlessly moving between economic, technical, spatial, morphological, environmental and statistical decisions;
3. They got the capacity to render decisions regarding urban outcomes in more accessible form
4. They proved the ability to rapidly iterate between various project outcomes in relation to measures
5. They created the potential for these tools and practices to be themselves of value to the industry

In addition to the above and more in specific focusing on the capacity of the RUMS to work as a shared platform for co-design allowing the *subjectivity* of the participants to emerge and create, we could add what previously mentioned in Chapter 3.2.2.:

6. They insure the possibility to welcome, integrate, manage and organize the input of a tremendous amount of people at the same time which in the past would not have been possible for the simple lack of adequate physical space and economic resources ;
7. They do it independently from the participants' actual geographical location and time zone since the participatory act happens through access from any computer or portable device connected to internet;
8. They process extensive amount of data and
9. Their design output is given back in real-time, being the process governed by self-organizing genetic algorithms;
10. They are able to produce an incredible number of design variations characterized by the same chosen requirements;
11. Last but not least, they have the capacity to develop and synthesize the *tacit knowledge.* They are based on the belief that 'we know more than we can tell' and therefore that people, provided with the relevant tools, can design and through design communicate things that they cannot tell or even think about. This is why the RUMS are customised design toolkit, customised to the project, audience and main issues at stake.

-RUM INNOVATION AND COSTRAINTS/LIMITS:

1. They are linked to the use of predefined typologies which restricts and confounds the possibility for the emergence of innovative self-organised solutions
2. They need to consider more fully the differential social and political aspects of the design process and develop it to the same level as the massing, densities and transport one
3. They need to develop the environmental and energy metrics as equivalent as the transport and density ones
4. Since the development model is initially tailored on specific requirements/requests the output could be missing out on other issues emerging during the design process and their incorporation in a later stage could be quite burdensome
5. The graphic interface needs to become even simpler, clearer and more elegant

CONCLUSIONS

Aesthetics of Sustainability.

"The idea of Beauty naturally associated to an apollonian perfection has long been consumed...."
(C. Najle, Organization or Design?, 2015)

This research has started as a heuristic journey into the themes of Aesthetics, Sustainability and Systemic Thinking.
It started with no preconceptions, with no positions to defend or to entrench on, with not such a thing as a thesis to defend.
It started simply because as a professional in the field of urban planning I was beginning to feel uneasy and, to some respects, even annoyed by the simple notion of SUSTAINABILITY which at that time seemed to have risen to symbolise the mythological figure of the panacea for all ills even though the world designed and planned in a 'sustainable way' by the traditional tools of urban planning looked basically ugly.
So the journey I undertook was meant to question the possibility to find alternative tools, techniques, models and perspectives to regain, if ever feasible, an AESTHETIC APPROACH to the issue.
In order to do that I found myself browsing other disciplines for a possible answer or direction and I met philosophy, biology, cybernetics, economics, medicine, geology, mathematics, statistics, sociology and many others.
I felt more at ease with a path which would not prefer one discipline over another, but would rather borrow from different ones.
I later discovered that this procedure was actually a codified praxis called TRANSDISCIPLINARITY and I stuck to it and when time for choices came I have also tried to be as coherent and consistent as possible with the mental and scientific framework I had embraced, the systemic structure that goes from the evolutionary thinking to the COMPLEXITY THEORY.

The result of the research, to my own surprise, is not a new aesthetic style.
It is a new aesthetic *concept* of style and authorship: the *interface [i/f]* and the *cartographer of subjectivity*.
Coherent with the Complexity Theory framework, the thesis promotes an approach to models that, to quote Peter Langley, should provide 'information' rather than 'solutions', should 'inform' rather than

'solve', therefore whoever was expecting from this work to discover a new enticing image/solution for Sustainability will be disappointed.
What you will encounter is rather *Aesthetics as Adaptive System*.
It is Aesthetics speaking about senses stimulated by participation and action, not just by a detached cognition or contemplation.
Nor green washing, neither sexy lines, but a new praxis, opened up to the city users: the citizens.
I found myself seduced and charmed by Simondon's idea of *techno-aesthetics* as a 'perceptive-motoric and sensorial' act where usage and action becomes something orgasmic.
I shared deeply Rancière's thought about the need for a *distribution of the sensible*, not just as a democratic political tool but also as a necessary educational step to recreate an emotional attachment to our urban environments.
I shamefully stole to Guattari the term *cartographer of subjectivity* and to Baricco the definition of Authorship.
I have been captured and surprised by the power and successes of the web and in particular of the OS phenomenon and its control systems, what Valery Châtelet called '*control tensegrity*', quoting in turn Buckminster Fuller.
Ultimately, as a designer myself, I had to deal with the frustration of not have been able to produce any *beautiful* image of sustainability.
But I did have found a lot of *beautiful* models and tools on the way.

Finally, there is one thing that really matters to me and I hope it came across properly in the document: although I present the city within a conceptual framework of self-organisation, I will never share the idea that sees the possibility for city and territory to be designed and organised just from the BOTTOM UP, as the architects status is 'a self-standing status that while acknowledges and promotes reciprocities with external conditions it also defines its own conditions of existence.[1]
The figure of a TOP DOWN curator, the *cartographer of subjectivity* indeed, is of paramount importance, like the director of an orchestra.

This research is also an attempt to pull back again towards a 'human science' the way we look at urban planning , most of all in an era, the digital one, where our profession has been drawn towards technology at the fastest pace it has ever been.

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[1] Najle C., as extrapolated from the lecture held at the Architecture symposium '*Organization or Design*?', Harvard GSD, October 2015, available on web @ https://www.youtube.com/watch?v=xRRYDzNg8hA

The digital era with its technological apparata, most of all in architecture and urban design, seems to be the time of the ‘hard sciences’, more and more detached from the narrative elements.
However this is a very partial and obtuse perspective.
It is in fact in the digital age and in the opportunities that it offers that we can introduce again that needed mental–aesthetic element Guattari, Simondon, Rancière, Prigogine, Stengers, Tiezzi, Polanyi and many others have been praising, each one in their own discipline.

It is that action on the *psyche*, negotiating between personal subjectivity and collective subjectivity, as a form of knowledge, a process, and a tool for aesthetic creation that cannot be separated from the *socius* and the *environment*: this is what I mean for the *Aesthetics of Sustainability*.

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