

THE SETTING OF A SYMBIOTIC & DIGITAL ECOSYSTEM MERGING EMBODIED COMPUTING WITH URBAN AND TERRITORIAL CONCEPTION AND IDEATION

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Abstract

This paper examines how to align Embodied Computing with the digital and ecological transition re-inscribing the transcalar realities of bodies, communities, and cities in urban conception, contributing to Joan Tronto's call for "maintaining, perpetuating and repairing our world, so that we can live in it as well as possible. This world symbiotically includes our bodies and our environment, all the elements that we seek to connect in a complex, life-supporting network".

Keywords

Embodied Computing, Digital and ecological transition, Go beyond the Cassandras versus the Post-humanists, Symbiotic urbanism in the era of digital, Projective Ecologies and Ethics of Care.

Introduction

If the NICT high levels of development are explored from an ethical angle, faithful to the original intentions, then they should reintegrate humans into a symbiosis with the natural "environment", where high-tech technologies would allow us to act on social and environmental problems with a high degree of "surgical" precision, or in other words, by fine and targeted actions, "by acupuncture points", in order to intervene at a minimum and develop and exploit low-tech solutions *-renewable means compatible with the needs of building sustainability*. This implies a posture in an Ethics of Care, where care is applied at the global, collective, and individual social scale, to finally respond to the wishes of an existential experience where solicitude responds to the reality of the interdependence of Beings and the concern for the Other.

Feminists like Donna Haraway (2016) emphasize the micropolitics of embodied encounters between humans and nonhumans in a world of *more-than-human* (Lupton, 2017), the ways in which all agents work together to generate agential capacities that drive and shape human action that is inextricably linked to the physical and symbolic contexts in which humans are bathed. As such, humans are always inevitably "blended-bodies" (Pedersen and Iliot 2017). This framework posits an ontology of the living and non-living situated in their associated environment consistent with the animism described by Philippe Descola (2019) and which characterizes the *First Peoples'* paradigm of action and gaze; this reframing being necessary for the restoration of an ecological intelligence aligned with Bateson's thinking (2002).

In this framework, individual technical objects can be used for habitus mapping purposes, individual and collective particularities/characteristics in the form of morphologies/acting phenomena, which would contribute to, as Joan C. Tronto (2009) defines it:

Maintaining, perpetuating, and repairing our world, so that we can live in it as well as possible. This world symbiotically includes our bodies and our environment, all the elements that we seek to connect in a complex network, in support of life.

Embodied Computing -*whether ambient (around the body), topological (on the body), or visceral (in the body)*- tends toward the constitution of an ecosystem based on network systems absorbing bodily processes in developed architectures that could evolve into platforms (Pedersen, 2020 p.74). Platformization brings to the forefront the concepts of programmability and "hardware-technical perspective" (Helmond, 2015); informing an economic model behind platforms, the former concept alerts to the potential for the original programming intentions to be sidetracked by a posteriori redevelopment facility as has been observed on the evolution of GAFAM's platforms. Beyond the IoT, it is indeed the Internet of People (IoP) set up as a platform that betrays the infrastructures of political economies that escape individual and state governance.

Taking a step back or the voice of the "cassandra"

The destination of this platformization through "datafication of body and self" questions democracy, individual liberties, and ontology in general. Vincent Mosco warns us against the convergence of Cloud, Big Data and IoT leads us to the peril of the New Internet (2017). Paul Virilio points out that there is no technological achievement without loss at the level of the living, the vital (1996). The *Cyberworld* impacts the transcalar realities of the body and the incidence is a loss of the locus, the dasein, and alterity (1996, p.41). The crushing of perspective operates as well on the visual perception, as physical and mental of the world. Our cities become stage sets devoid of depth of field. To lose the close and the distant, it is to lose what makes the

life in human community: the city, physical and organized form of the considering of the otherness (1996, p.42).

OBJECTIVE

The objective is to define the positive integration of Embodied Computing in a territorial, urban, and architectural systemic approach oriented towards an ethic of Care, with the aim of establishing the primordial physiological, psycho-behavioral, therapeutic and care functions profiling symbiotic ecumene.

MATERIAL

The article crosses three tools and methodologies using map overlays for a Systemic Design, ecologic and therapeutic approach conceived by researcher and teacher in architectural and urban project studio:

- Christine Wacta's GeoEmotions_Capture approach (2020), using gamified geomatics to capture to emotion and ambiance through smartphone, Adjunct professor at ENSAPVS, Assistant professor in the College of Behavioral and Social Science, School of Human Ecology, at Georgia Southern University.
- Maurits de Hoog, Dirk Sijmons and San Verschuuren's Dutch Layers approach (1998a, 1998b), improved by Fransje L. Hooimeijer& Linda Maring (2016,2018) professors at TU-Deft.
- And Patrice Ceccarini's Environmental Genetic Code (EGC) matrix (Ceccarini and Rasoloniaina, 2021) approach, professor ENSA PVS and director of the Systemic Design/Projective & Therapeutic Ecologies (SD/PtE) research axis at EVCAU laboratory.

METHOD

After a description of the methodologies a combination of the positive aspects observed are articulated to sketch a hybrid solution that can be later realized through a digitally augmented version.

Results

GeoEmotions_Capture approach & "La Dérive: Capture Urban Emotions"

GeoEmotions_Capture is the name of the design approach and like any practice of architectural and urban design, the project starts with the collection of data. This is a 4th year architecture exercise at SCAD in the fall of 2018, the traditional heuristic

dataset is first initiated with a field experimentation of walking the studied area and capturing a variety of emotion and memorabilia using one's own smartphone or any GPS device, whereby simultaneously the drift of the user is geolocated and mapped with the captured data his/her decided to collect.

The theoretical framework

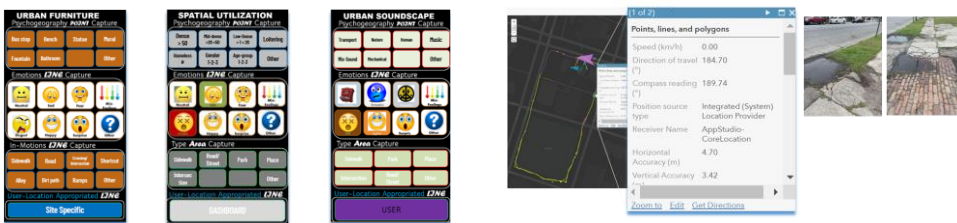
GeoEmotions_Capture is based on Guy Debord situationist manifesto that have coined the psychogeography that relay on the drift. Drifting is a mode of experimental behavior related to the conditions of urban society, a technique of rapid and recorded passage through various ambiances. It is an unplanned journey through a landscape, usually urban, in which participants abandon their daily tasks or occupations and their daily routines to *"let themselves be guided by the attractions of the terrain and the encounters they make there"* (translated by author, Debord, 1955). This concept is of great importance in the theory of geo-investigations that define the game-architecture and human-object relationship. The ludic-constructivist theory allows the development of an active learning aiming at the construction of knowledge increased



1: Excerpt from Guy Debord's psycho-geographical drift slopes and location of ambient units - 1957.

by the non-directed quality of the activity which facilitates the gain and the intellectual construction of the user through the lived experience and stimulates a curiosity towards the over-innovation. Encounters, psycho-geographical effects, and intuitions from the field are self-recorded with handheld devices and are instantly updated in a hub of usable data to increase/multiply spatio-temporal and sensory "perspectives" (Figure 8).

The technical framework



2: The 3 capture registers and interfaces – Captured traces on map, geodata and memorabilia. Wacta (2018)

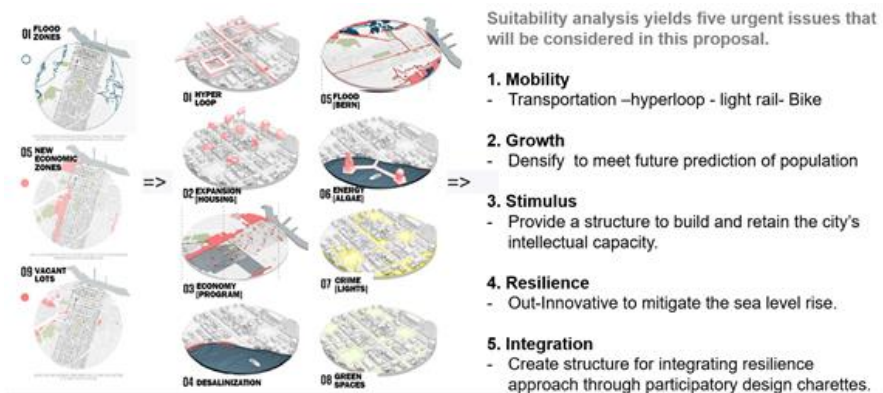
"La Dérive: Capture Urban Emotions" is a geo-spatialized, gamified, and augmented tool to psychogeography and therefore the drift from which it takes its name.

It is an integral part of the Geodesign approach organizes into 3 aspects: mine and manage **data**, assess information, and make **analysis**, and create or recreate **design** (Miller, 2012). It is a customized version of ArcGIS-Quick Capture by ESRI, which is a surv capture of the user and facilitates the recording of mental data. Like any GIS tool, data are made into captured points, lines, and polygons, but beyond that, it has been completed with sound, camera and video live capture facilities and a psycho-emotional library on the three registers: 1- Infrastructure (including urban furniture), 2- Spatial use, 3. Sound capture, which are translated into three distinct interfaces (Figure 2). The interface allows the application to be refined by directly associating context + emotion + urban morphology, all of which are located, perceived, and felt at the same time.

The procedure

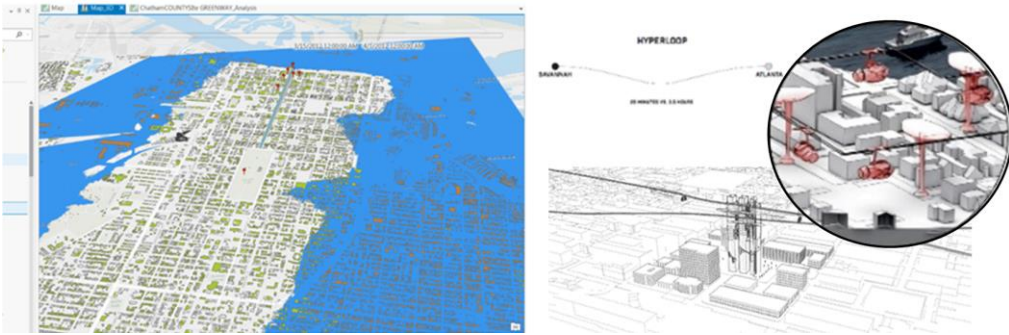
The GeoDesign procedure is straightforward:

1. Data - Students are discovering the concerned area while they *-individually or in group-* walk and capture emotion and memorabilia on their individual device. Each personal drift is simultaneously geolocalized and detailed by the psycho-emotional captures activated. Aware of this dual process, they pay more attention to environments, to space features, reactions, sensations, and emotions.
2. Analysis - The psycho-geographical mappings are analyzed as cartographic material, the revisiting of the individual and collective data emitted-collected are put in the light of the traditional information recorded on another map layer(s).
3. Design - **First step** is the narration of their experience/exploration and understanding of the space explored, the sharing of the same or nearby drift areas will enlarge the discussion, and straight away in the discussion come into light the students' Area of Interest (AOI). Then, students will synthesize their collective understanding of the whole combined areas to set their diagnostic based on the overall subjective maps. - **Second step** is the test of the subjective data collected and narrated through the confrontation with the official data and maps.- **Third step** is the discussed-shared-confronted AOIs that become topics of a discussion to



3: 5 scenarios developed by the whole group and redeveloped by sub-groups or individuals - Source: C. Wacta

redevelop into new ideas developed as set of scenarios based on the subjective-objective¹ dataset which will shape the design posture(s) of the students as a collective group and as individual designer committed to the benefits of the community and its well-being.



4: Rising water simulation and developed scenario of the hyperloop - Source: C. Wacta (2018)

Analyse

Pedagogy through gamified spatialization engages the students in a series of investigations that lead them to experience/explore their own intelligible understanding of built-environment. The perception of freedom and active participation is reinforced by the narratives that accompany it. Their narrative help them frame their actions through a meaning-making process that can be both personally and socially driven (Marrone, 2016). It is a cognitive constructivist approach promoting the development of the student's thinking system and understanding at the individual level and then at a collective level. The crescendo process is engaging the concern of the students, in addition with the staging of their AOI as a valuable data.

In this participatory culture, students are confident in their contributions and feel some degree of social connection to one another (Jenkins et al., 2009, p. 5), and the teacher plays a facilitator role. The method bypasses the phenomenon of "reduction of perspective" of embodied computing, on the contrary, it enriches the map with a multiplication of information captures of different natures (sound, image, video, emoticon, etc...). But the crossing of the maps and the medical analogy remain metaphorical, and the designed projects developed from the approach are not specifically related to ecological nor therapeutical design.

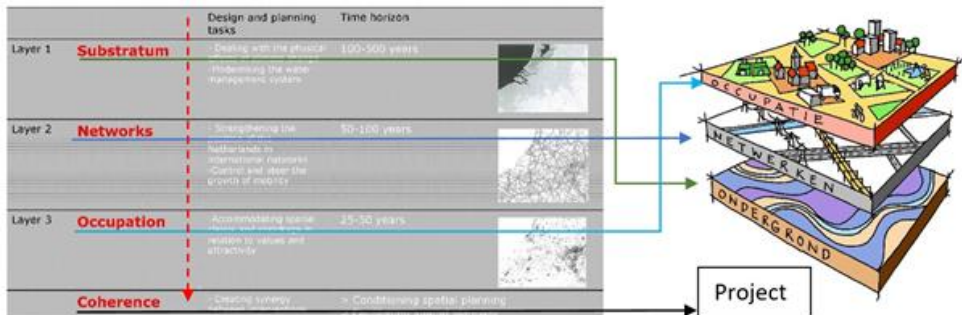
Dutch layered approach (DLA) & sEEs matrix #1 and #2

The Dutch layered approach known as the "layered model" (Figure 5) is widely applied in analysis, planning, and design in the Netherlands since 1998, devised by De Hoog, Sijmons, and Verschuuren of TU Delft (van Schaick & Klaasen, 2011).

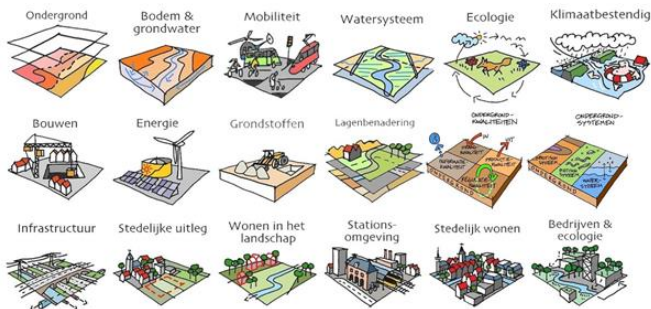
¹ Subjective psychogeographical data enlightened and completed by objective data.

The theoretical framework

DLA is aligned with the design approach of landscape architect McHarg (1967). DLA is an attempt to develop a data classification system that provides a scientific basis for understanding the functioning of the complex system and the cross-layered relationships between natural environmental phenomena with cross-scale functions and relationships between layers.



5: The 1998 Dutch layer approach - Sources: J. van Schaick, I.Klaasen (2009)&P. Dauvelier (1998)



6: Extracts of the icons as mnemonic aids - Source: <http://www.ruimtexmilieu.nl>

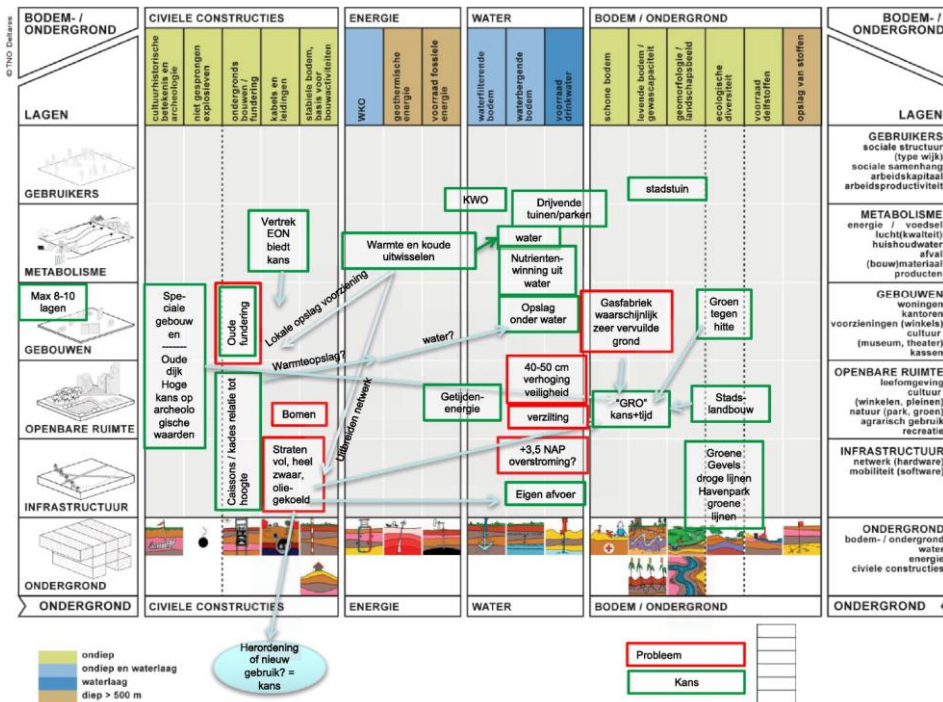
The methodological framework

If the representation suggests a stacking of data, however, it is still only figurative, theoretical, and not applicative. The data is divided into 3 main registers of data and data analysis, from the lowest layers to the surface: (1) the **substratum**, (2) the **networks**, and (3) the **occupation** (the existing), that last is sub-divided. The visual reversal of representation is very important since it allows the cognitive perception of the time horizon of phenomena evolution arranged by time length: substratum renewal takes 100-500 years; 50-100 years for networks and occupancy 25-50 years. Each layer implies different types of design and planning tasks. The lower layer part of occupation is coherence, which is now the design part. It is by working on the coherence of the impacts or influences between the phenomena from layer to layer that the coherence of the project is assured to produce adequate and sustainable design. The "time horizon" parameter introduced in this system is the spatiotemporal dimension dear to Virilio, it induces change of scale from regional to local or even micro-local. To make their approach didactic and playful, they also use icons as mnemonic aids (Figure 6).

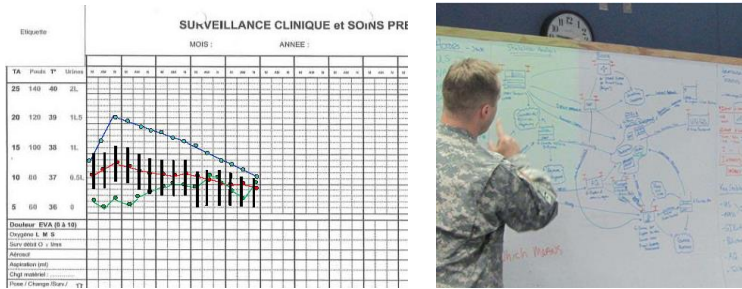
The *System Exploration Environment and Subsurface* (sEEs) is the design tool attached to DLA. A whole succession of Dutch theorists and practitioners have worked to improve this logic of the layer approach, culminating in 2013 with the building of the System Exploration Environment and Subsurface (sEEs #1) (Figure 7).

It is a 2-dimensional matrix that records data by crossing:

- **In abscissa axis**, public buildings in terms of built constraint, energy production capacities, drinking water production facilities and the territory's capacities in terms of Earth Sciences - geology, geodesy, geophysics, meteorology, and biodiversity (Living).
- **In ordinate axis**, sociological and economic data, metabolic data of the territory, typologies of the built-environment and landscapes, infrastructures, soil, and subsoil; it serves an interdisciplinary study of the territory. The selected and analyzed parameters are functionalist take up the logic of the development of the territory carried out by state and para-state authorities and agencies. The grid is filled in by textual axioms, interlinked, and their scope is indicated by a red or green frame: in red, the problematic data and in green the potentialities.

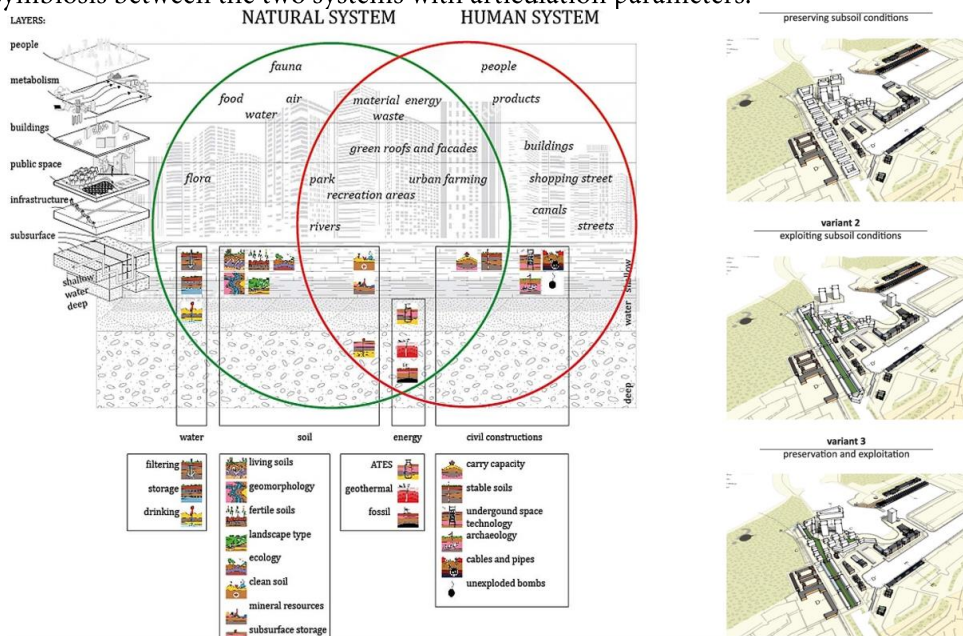


7: sEEs #1 filled with problems (red) and opportunities (green) with links between the information - Source: F. L. Hooimeijer & I. Maring



8 A clinical monitoring sheet - Systemic Design gigamap by the North American army Source: Alex Ryan

In 2016, Fransje Hooimeijer, Linda Maring, and Ignace Van Campenhout continue to improve the sEEs matrix by determining a crossover pocket between the natural system (green) and the human system (red) (Figures 9). This configuration determines the "locus" of the coupling between artificial and natural leading to the building of a symbiosis between the two systems with articulation parameters.



9: Matrix sEEs #2 of the 2 interacting systems and 3 variants of interpreting the feedback from the analysis. Source: Hooimeijer, Maring and Van Campenhout 2016

DLA, sEEs#1 and sEEs#2, the classification of the data is remarkable as well as the emphasis made on the overlapping of natural and human systems. sEEs#1 tracing of the *thread thought* is lost, while the most difficult is to document the pros and cons taking into consideration, so that the design process remain readable and sharable. Same regarding the variant design solutions, which implies different scenarios, their deduction/induction/abduction logic is no longer traceable. DLA, sEEs#1, and sEEs#2

are design tools for developing strategic action, planned in the long, medium, and short terms, as such they are addressing the requirement for planification. By dressing the “clinical monitoring sheet” of a context, the developed design logics are inductively oriented towards ecological and therapeutical design response. The crossing of the maps remains metaphorical, even if the “Layer Cake” is there, it doesn’t serve the global idea and ecosystem principle behind it.

In systemic design, cycles and times of change are thought of at every moment from the micro-scale to the very large, positing a systematic transcalar temporal analysis framework in the physical and anthropological fields would allow (1) thinking in terms of cycles of renewal as a function of scales/views/objects; (2) to establish environmental, urban and architectural "vitals"-as suggested by sEEs#1, which is reminiscent of the clinical care sheet for recording vitals (Figure 8) on a grid graduated by milestones and edges of the vital balance in order to identify series of micro-catastrophes announcing a breaking point of the system -*catastrophe point or threshold*; and (3) to measure the phenomena of reversibility.

sEEs #2 highlights the symbiotic connections that constitute the symbiotic junction at the intersection of natural and anthropized systems, responding to Joan Tronto's prescription to ensure connections in a "*complex, life-supporting network*" that includes our bodies and our environment. It requires to determine the knotting parameters and combination patterns of symbionts to establish a holobiont (Margulis, 1999). This change of view implies to consider the associated environment and the edifications-productions coming from this environment-in terms of biological organizations/organisms being part of the same living ecosystem (Geddes, 1915; Hems, 2019), inducing the ontological recasting of Philosophy, Science and Philosophy of Science.

Systemic Design/Projective and Therapeutic Ecologies (SD/P&TE) & Environmental Genetic Code (EGC) matrix

Complexity and Morphogenesis (CMAu) and Systemic Design/Projective and Therapeutic Ecologies (SD/P&TE) design project studios are using the Environmental Genetic Code (EGC) that is been developed since 2005, 15 teachers had and are still contributing to it, the methodology is based on the research of Professor Patrice Ceccarini.

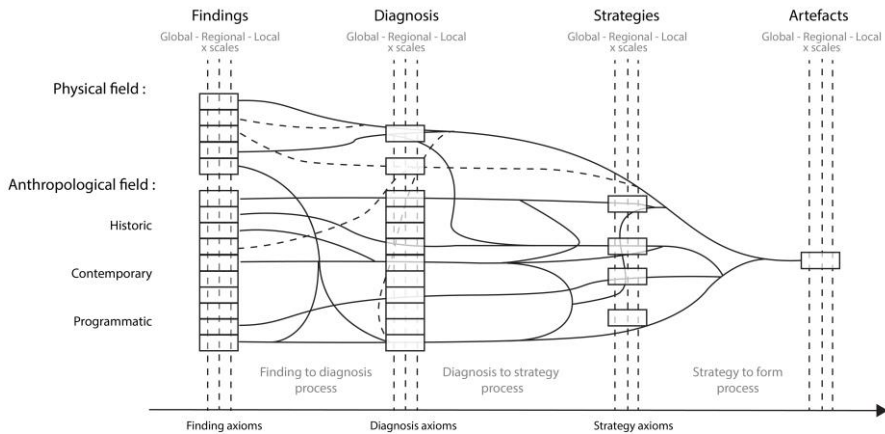
The theoretical framework

The EGC matrix's structure is based on the epigenetic landscape of embryonic morphogenesis (René Thom, 1989), which is modelled on the epigenetic landscape of Conrad Waddington's (1957) characterization of the genotype into the phenotype. Its

theoretical base on interdisciplinary knowledge including Linguistics, Semiotics, Visual perception Psychology, Catastrophe Theory, etc... All binding to the General System Theory (GST), a theoretical framework that emerged in the 1940s through the work of the biologist Ludwig von Bertalanffy in his attempt to set a new approach to study life and living systems.

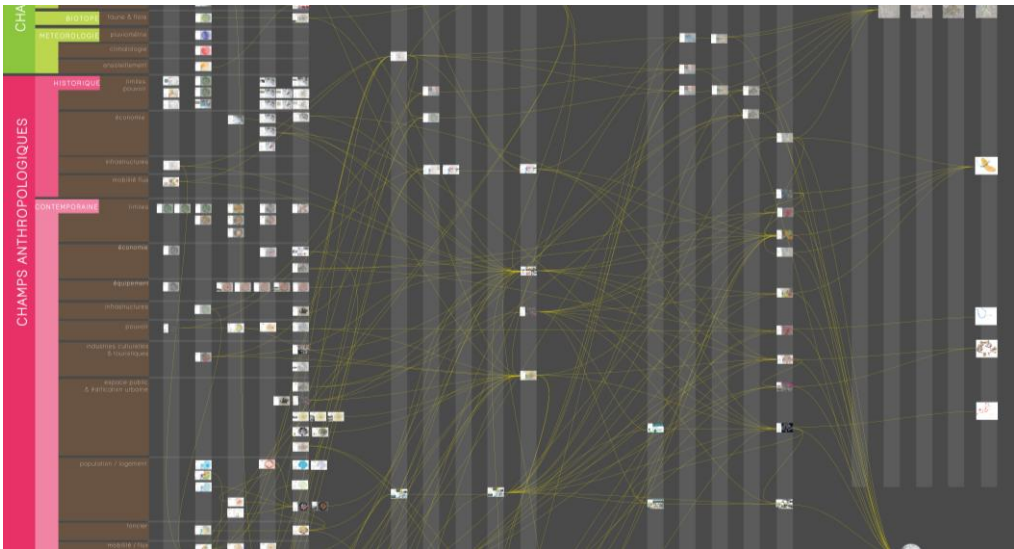
The methodological framework

EGC is a 2-dimension matrix structured as following:

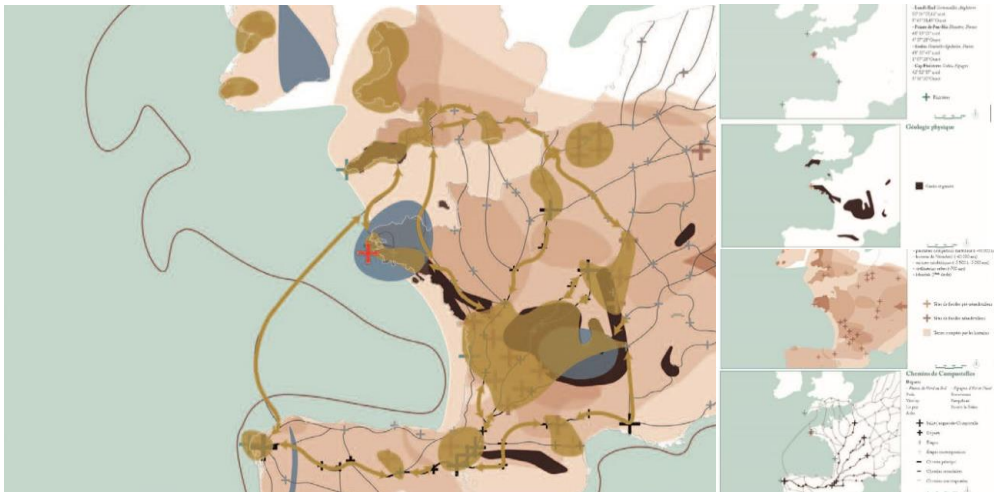


11: The phylogenetic matrix of the EGC – Source: Ceccarini. Author: FL Rasoloniaina.

- In abscissa axis**, the column of phenomena -*refers as the findings*- is brook down into two fields: (1) the physical, subdivided into meteorology/atmospheric sciences, earth sciences and biotope sciences data; (2), and the anthropological, subdivided into: historical, contemporary, and programmatic data.
- In ordinate axis**, the timeline is divided into 4 development phases: findings, diagnostics, strategies, and artefact. All data are made into morphological maps, they are orderly placed on the matrix, the diagnostics maps are the result of overlaying 2 to more finding maps; the strategies maps are the result of overlaying 2 to more diagnostic maps and finally (4) the profiled artefact is the result of overlaying 2 to more strategy maps (Figure 12). Along those operations, each overlaid maps are linked to the next phase of study generated map (Figure 12).



13: Extract of Niort city matrix – traceability of the thought. Author: Louissette Rasoloniaina (2013)



12: Overlay of 4 maps: (1) Finistères, (2) the Neolithic sites of dolmen (3) the Neolithic sites of menhir and (4) Compostela roads. The Sein Island (red cross) last emergence of the ancient Finistère of the Armorican massif – the gray spots: major concentrations of converging data - Source: Laure Manissadjian, 2021.

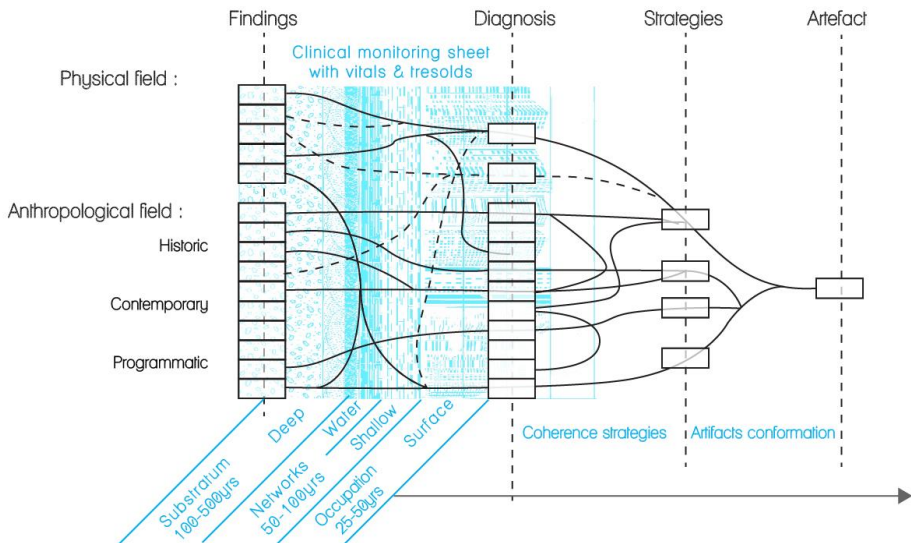
It is the weaving that addresses the complexity, just as the genotype can become an infinity of possibility of phenotypes according to the events and/or accidents and/or environmental conditions met along its morphogenetic course (space-time of evolution). The final artifact results from an uninterrupted transformation phylogenetic process, as it happens in the living, (Figure 12). An average 200-400 maps are produced by project, the most being the constitution on the findings phase.

Combining values

From SD/PtE to DLA and sEEs#1-2

SD/PtE with EGC matrix set is the most extensive approach as systemic tool addressing complexity, but it will gain on the didactic level by integrating DLA and sEEs#1 and #2 a matrix mnemotechnic backdrop, that can be:

- A profile preset that displays critical link/relation/connection between parameters to be addressed aiming at profiling a symbiotic environment, imposing a substantial “layer cake”² as applied in SD/PtE, imposing an ecosystemic and symbiotic approach (Figure 10).
- A time-scale for major natural and artificial phenomena renewal articulating past present and future transformations with adequate classification system to redefining the sub-elements comprehended under Substratum, Network and Occupation.
- A clinical monitoring sheet for the diagnostic phase to visualize and evaluate symbiotic ecumene potential SWOT.
- A space of junction/interference/knot between physical and anthropological fields.



11: EGC matrix with mnemotechnic backdrop - Author: F. L. Rasoloniaina, 2022.

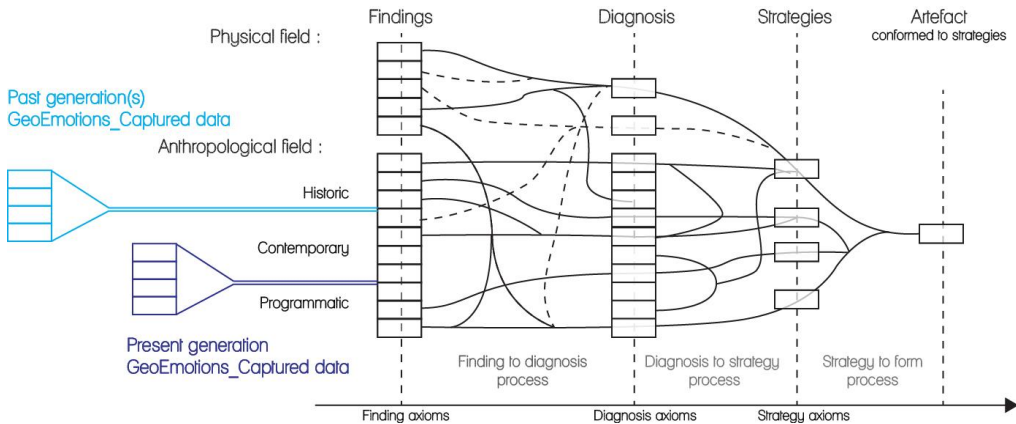
From SD/PtE to GeoEmotions_Capture

With "La Dérive: Capture Urban Emotions", stakeholders are able to contribute to additional layers of data -*captured traces, emotions, visual memorabilia (images & videos of site views, panorama, landmarks, etc.), audible or visual or textual narratives, etc.*, revealing the sensory territory left by the digital traces and emotions as a bottom-

² The pile of multiple map layers.

up co-design approach restating the role of Architects and Urban Planners as facilitators and mediators serving co-contributors of integrated architectural/urban built-environment co-profiled by collective intelligence through community dynamics. And, at the same time inverting the tide of digital tool misuse of citizen data by shunting the GAFAM predation dictate.

By paying attention to people likes and dislikes, shared memorabilia, it is a level of self-care provided by GeoEmotions_Capture; the use of those data for design allows to be more accurate for therapeutic and solicitude actions, it is an inverse model to the AI model, there is no predictive strategy, as we look for what matters to people *hic et nunc* and what makes their habits change suddenly the next moment, day, month, or year. It is this sensible variability that is important in the design of living environments that is more in tune with *those almost nothings* that make the difference. In figure 12, the 1st generation of GeoEmotions_Captured data set the present sensory territory of a situated location associated with different dates and times referred as contemporary data. In the future these datasets will become part of the past generation(s) of sensory territories heritage.



12: GeoEmotion_Captured data integrated to EGC – Source: F. L. Rasoloniaina, 2022

Conclusions

This hybrid set constitutes a new praxeological and theoretical framework involving a rethinking technological and conceptual ideation that brings (1) the renewal of hyper-connected design modeling for a pragmatic therapeutic and healing architectural approach in the manner of Projective Ecologies where biogeography re-asserts that caring for the environment is also caring for human (Reed and Lister, 2014); (2) to the establishment of a space-time for bodily cognition retaining its spontaneity and ease of

use that favors the passage from individual object to collective interaction and exchange, in order to generate and articulate an ecosystem that accounts for all the structural dimensions of the environment associated with the *more-than-human*; and (3) to the establishment of a systematic protocol of attention on the articulations or crucial points to guarantee (3a) the "good state of health" and the sustainability of the territorial, urban or architectural construction but also of its users in the associated environment and (3b) the symbiotic connections.

Embodied Computing must be enslaved to the processual continuity of profiling in order to articulate immediate (present), recorded (past) and projective (future hypothesis) complex data; that it must map, classify, cross and determine morphologies of prescriptive action by cross-checking from the constitution of contextual data, to their analysis and instrumentalization to profile the final artifact; but also and above all, instrument of the continuity of the cerebral activity of mapping -a cognitive mode of representation- and of language -a mode of structuring the representation allowing categorization, social cognitive capacity, etc...- (Dehaene 2020). In that perspective the input of GeoEmotions_Capture must be completed with some other GIS facilities like ArcGis ModelBuilder, to create an interoperability between GeoEmotions_Data and the digital and finally set an augmented version of EGC matrix.

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