# The Post Environmental Age
# &
# Agent Based Computational Design

G. RIDOLFI
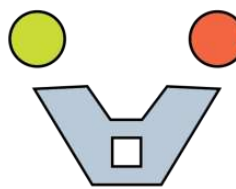
**MAILAB**
Multimedia
Architecture
Interaction

# part 1

**The Post Environmental Design**

**MAILAB**

Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the  agent based computational design**

# What is the Environmental Design?

According to the Technology of Architecture Discipline

MAILAB
Multimedia
Architecture
Interaction

UNIVERSITÀ
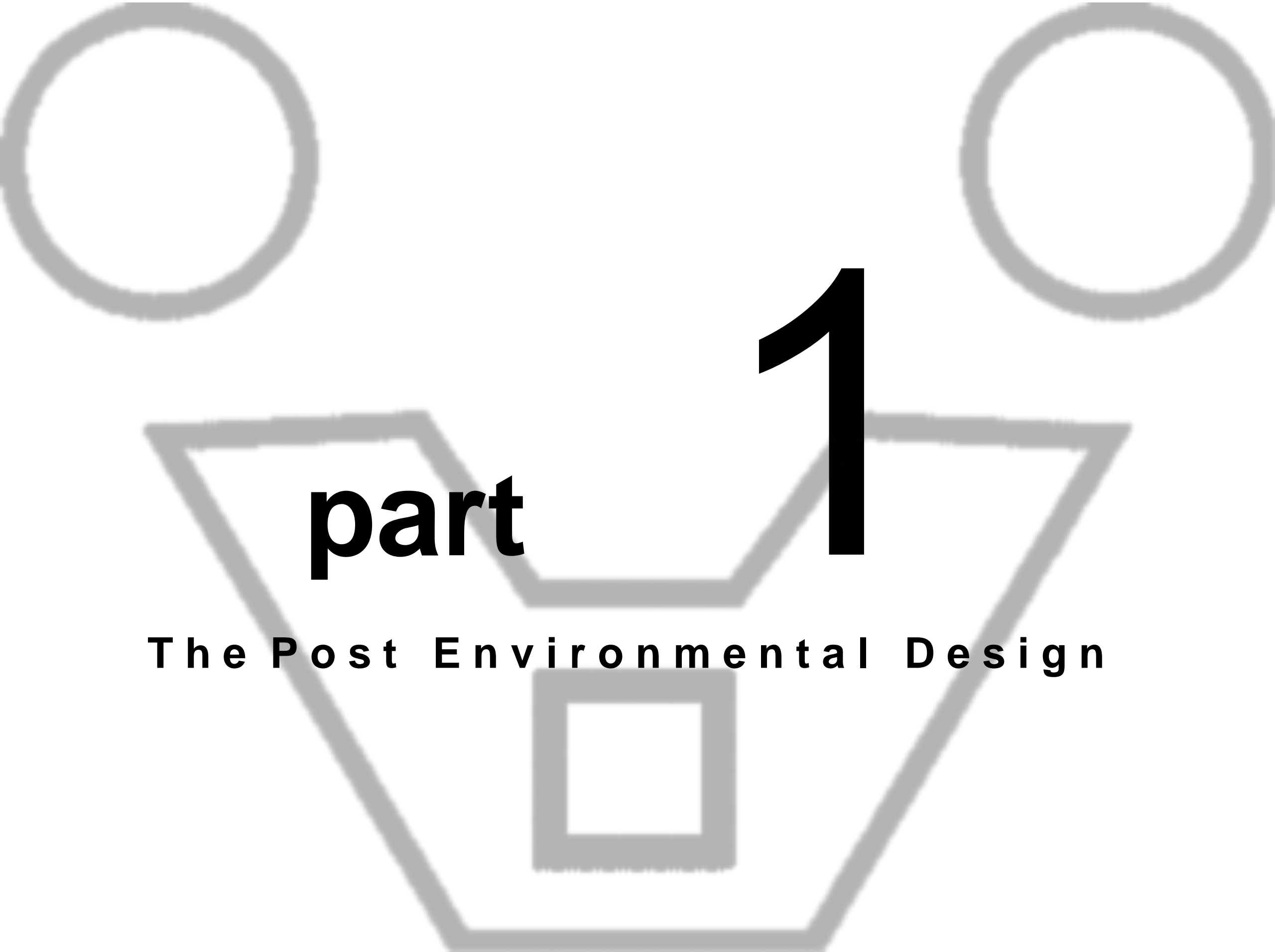DEGLI STUDI
FIRENZE
DIDA
DIPARTIMENTO DI
ARCHITETTURA

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE
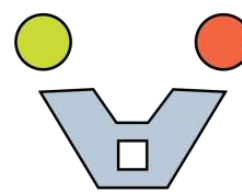
The post environmental age and the  agent based computational design

# What is the Environmental Design?

According to the Technology of Architecture Discipline

# [needs - requirements - performances]

UNIVERSITÀ
DEGLI STUDI
FIRENZE
DIDA
DIPARTIMENTO DI
ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the  agent based computational design

# INNOVATIONS IN THE BUILDING REGULATORY FRAMEWORK (second half of '70)

## From the descriptive-object approach
## to the performance approach

- **UNI 7867-1:1978. Edilizia. Terminologia per requisiti e prestazioni. (30/11/1978 ritirata nel 31/10/1999)**

  - UNI 7867-1:1978. Edilizia. Terminologia per requisiti e prestazioni. Nozioni di requisito e di prestazione.
  - UNI 7867-2:1978. Edilizia. Terminologia per requisiti e prestazioni. Specificazione di prestazione, qualità e affidabilità
  - UNI 7867-3:1978. Edilizia. Terminologia per requisiti e prestazioni. Verifiche di conformità relative ad elementi.
  - UNI 7867-4:1979 Edilizia. Terminologia per requisiti e prestazioni. Qualità ambientale e tecnologica nel processo edilizio.

- **UNI 8289:1981. Edilizia. Esigenze dell' utenza finale. Classificazione.**

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

# NOUVELLE APPROACH (1983-85)

## Performance Design e regulatory gradualness as tools to promote the market and innovation

*"...rimodellare l'armonizzazione tecnica nell'Unione europea (UE) su una nuova base*

*limitandosi ad armonizzare unicamente i requisiti fondamentali dei prodotti*

*e applicando il «rinvio alle norme» e il principio di riconoscimento reciproco*

*per abolire gli ostacoli tecnici alla libera circolazione delle merci."*

> Direttiva Comunitaria n. 83/189/CEE del Consiglio del 28 marzo 19883 Procedura d'informazione nel settore delle norme e delle regolamentazioni tecniche

> Allegato I - Conclusioni in materia di normalizzazione approvate dal Consiglio della Comunità Europea il 16 luglio 1984

> Risoluzione del Consiglio della Comunità Europea del 7 maggio 1985. Un nuovo approccio dell'armonizzazione tecnica

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# [needs- requirements - performances]

LA DESCRIZIONE PRESTAZIONALE DI UN PRODOTTO E' EQUIVALENTE AD UNA SUA RAPPRESENTAZIONE PER "ASTRAZIONE ANALOGICA" DELLE SUE CARATTERISTICHE

Kg
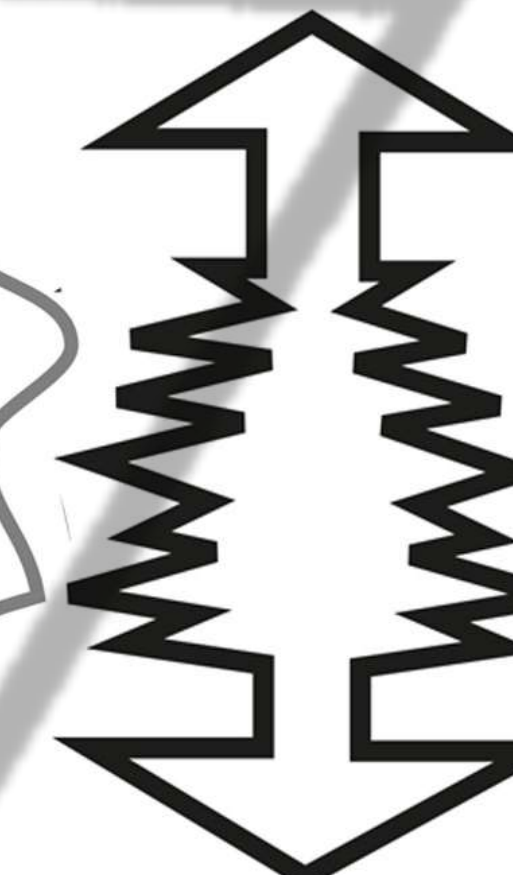
FORMULAZIONE LOGICO-ASTRATTA

la categorizzazione delle caratteristiche é un punto di criticità

FENOMENO NATURALE

MODELLO PRESTAZIONALE

CLASSIFICAZIONE DELLE ESIGENZE SECONDO LA NORMA UNI 8289

• SICUREZZA
• BENESSERE
• FRUIBILITA'
• ASPETTO
• INTEGRABILITA'
• GESTIONE
• SALVAGUARDIA AMBIENTALE

LA **FORMULAZIONE** DEL MODELLO PRESTAZIONALE APPLICATO AL SISTEMA EDILIZIO SI FONDA SULL' ANALISI DELLE **ESIGENZE** DELL'UTENTE

**MAILAB**
Multimedia
Architecture
Interaction

# UTENTE ▶ PROGETTISTA ▶ COSTRUTTORE

## GLI OGGETTI DEL SISTEMA FUNZIONALE

## GLI OGGETTI DEL SISTEMA AMBIENTALE

## GLI OGGETTI DEL SISTEMA TECNOLOGICO

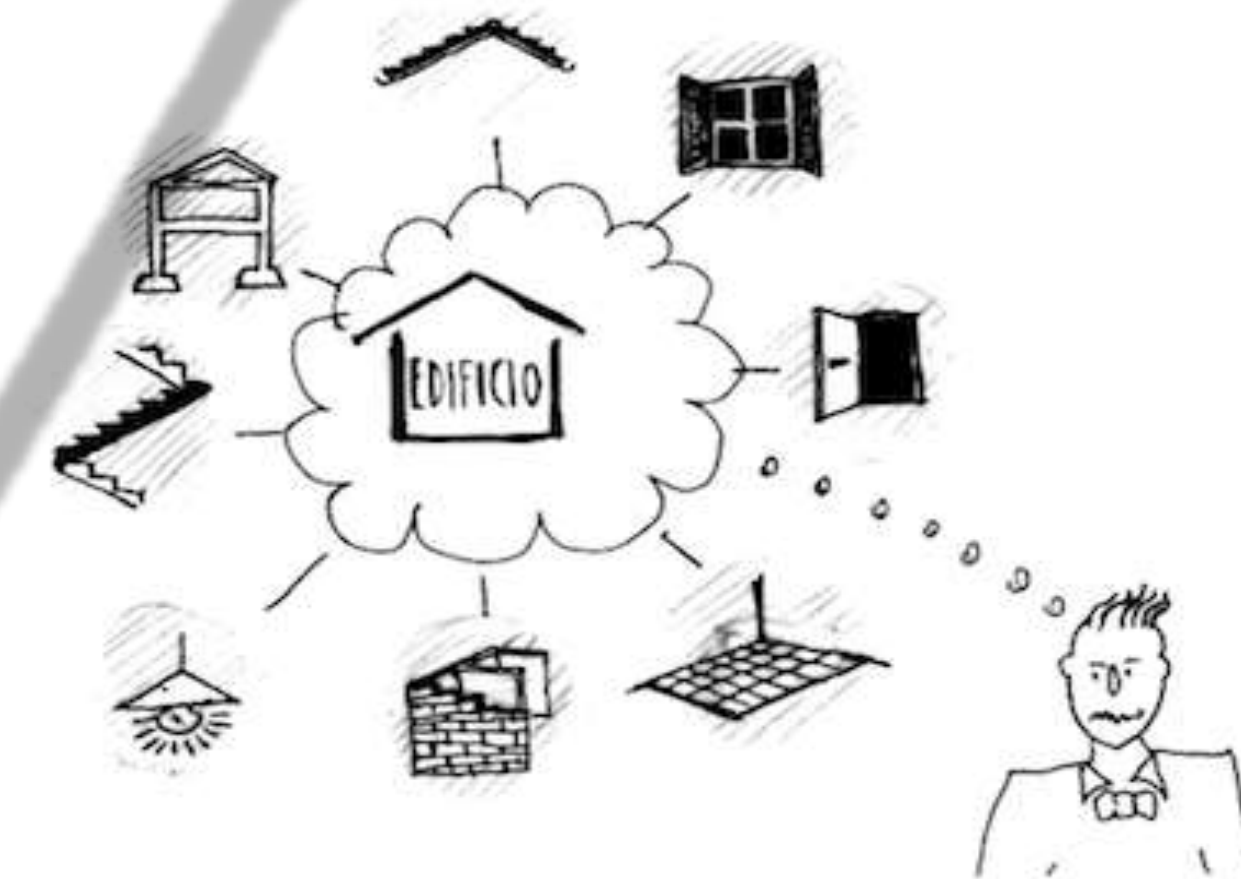I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DALLE **ATTIVITA' E DALLE FUNZIONI**

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DAGLI **SPAZI** E DAI **VOLUMI**

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DALLE **OPERE** E DAGLI **ELEMENTI TECNOLOGICI**

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**MAILAB**
Multimedia
Architecture
Interaction

UNIVERSITÀ DEGLI STUDI FIRENZE
**DIDA** DIPARTIMENTO DI ARCHITETTURA

**The post environmental age and the  agent based computational design**

# [needs- requirements - performances]

Ciò, che di necessità, si richiede per il normale svolgimento di una attività
**Norma UNI 7867/1,2.2…**

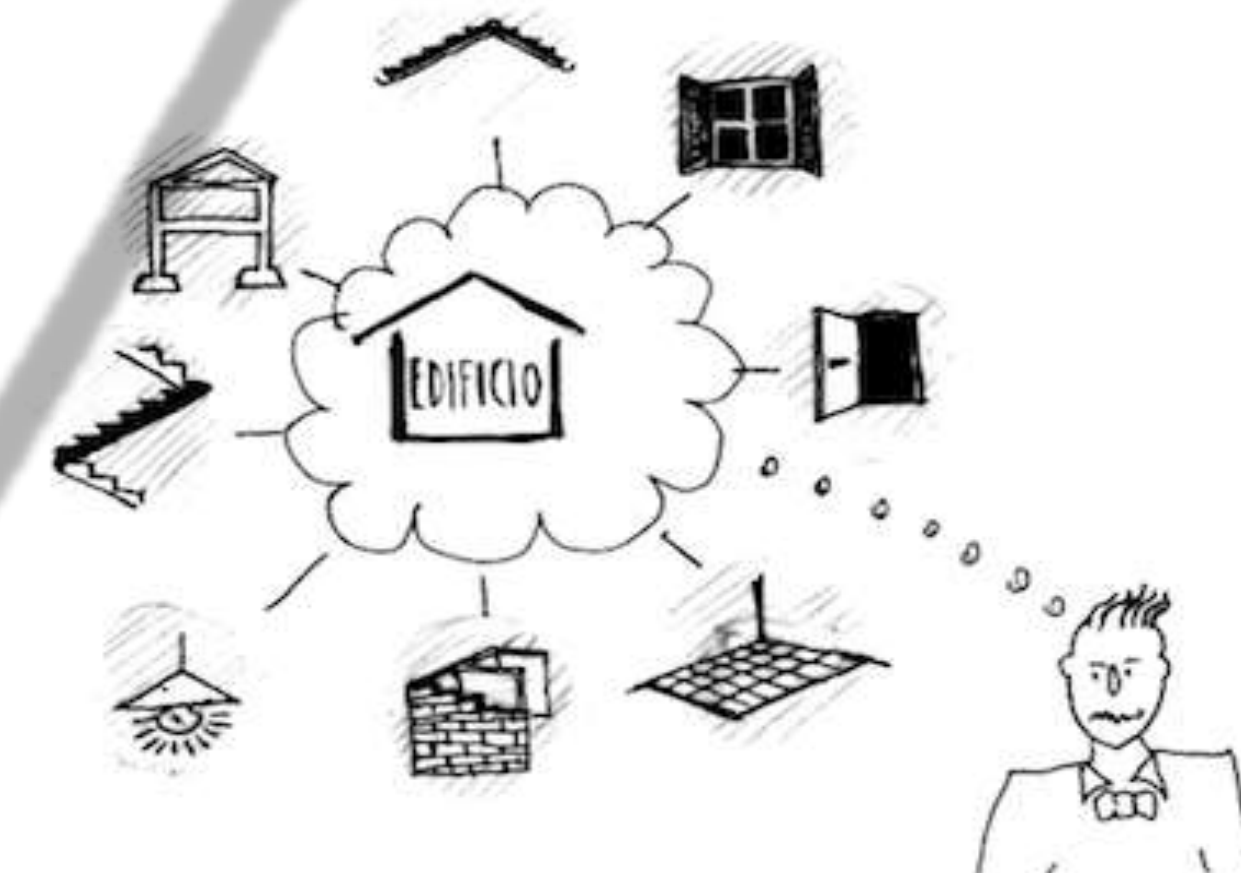## UTENTE ► PROGETTISTA ► COSTRUTTORE

GLI OGGETTI DEL SISTEMA FUNZIONALE

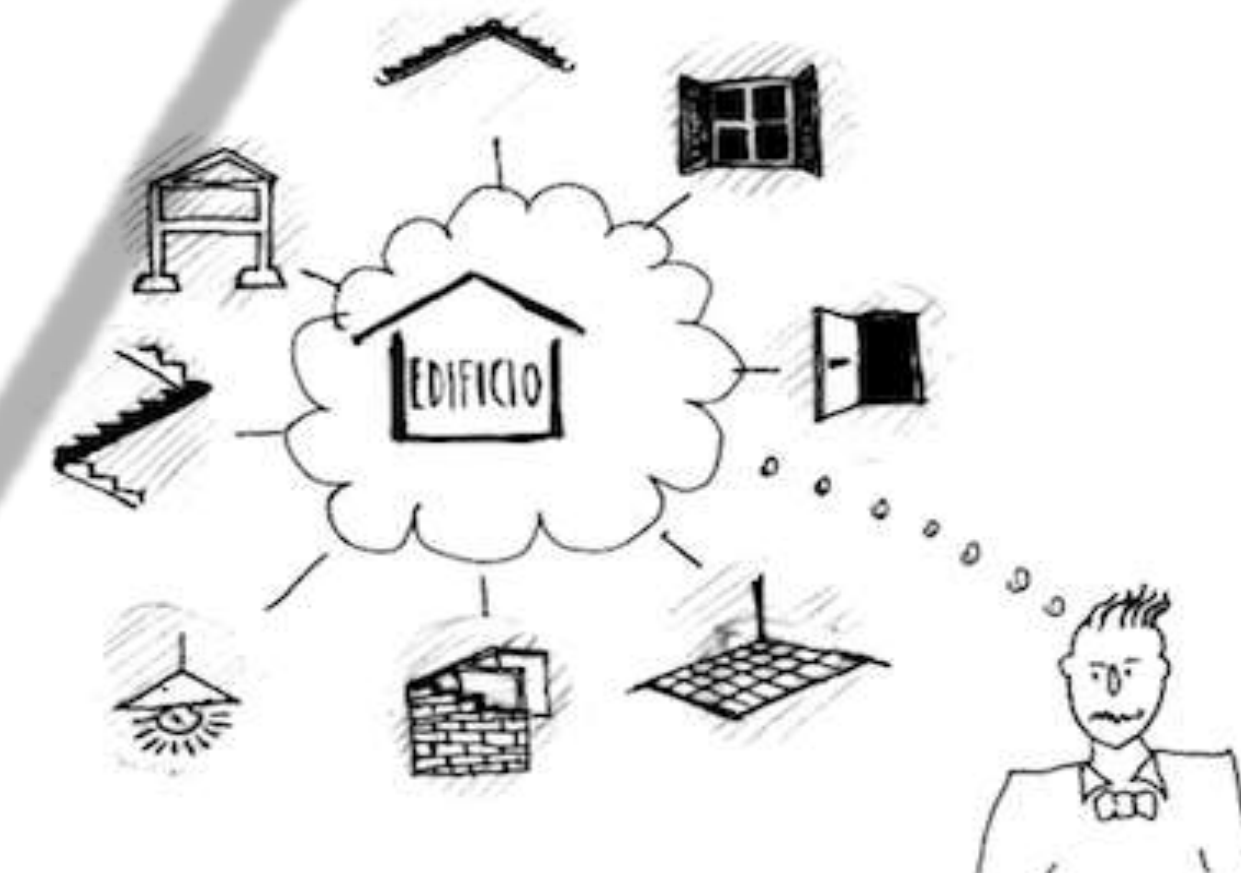GLI OGGETTI DEL SISTEMA AMBIENTALE

GLI OGGETTI DEL SISTEMA TECNOLOGICO

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DALLE **ATTIVITA' E DALLE FUNZIONI**
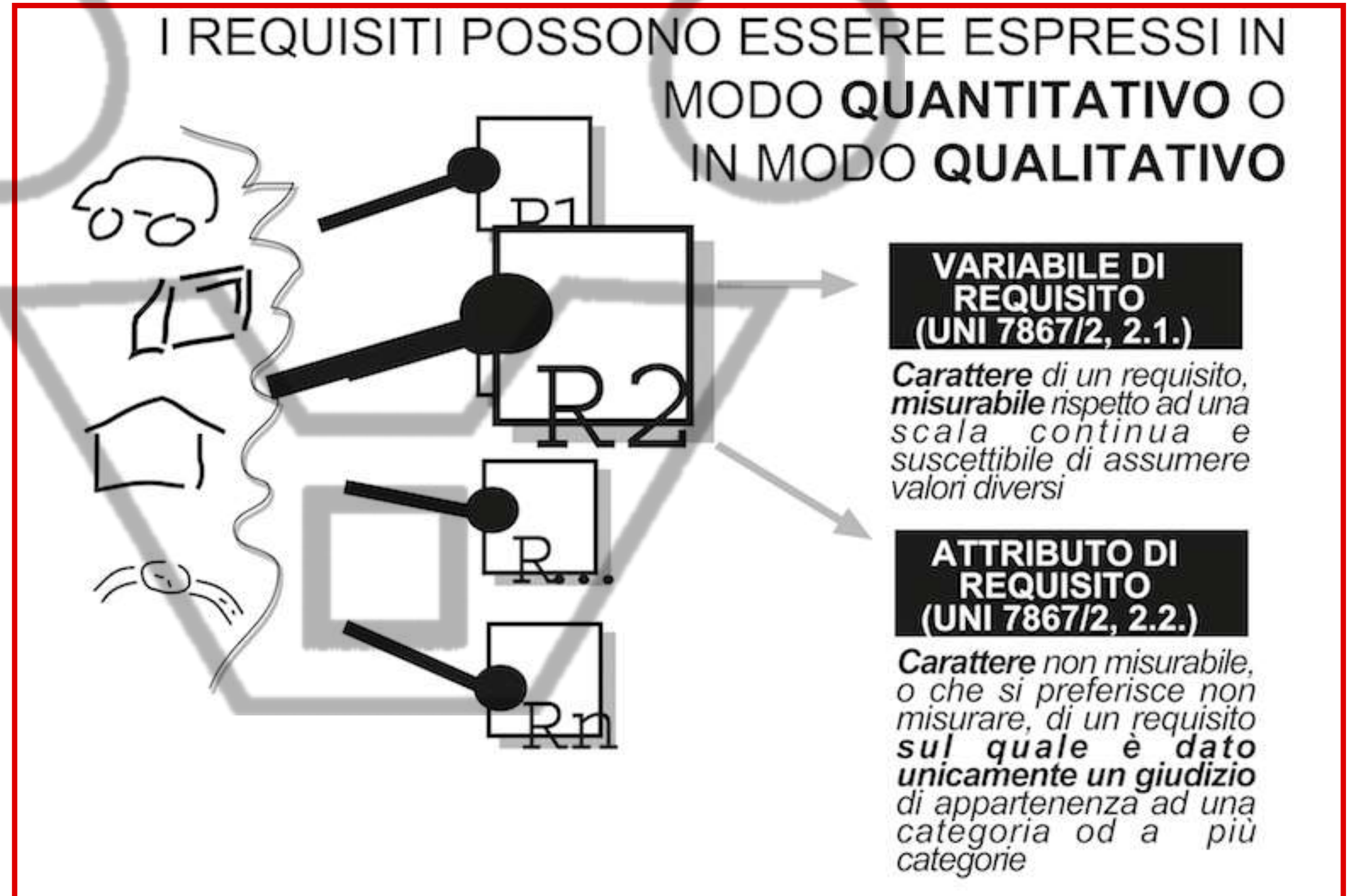
I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DAGLI **SPAZI** E DAI **VOLUMI**

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DALLE **OPERE** E DAGLI **ELEMENTI TECNOLOGICI**

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# [needs - requirements - performances]

traduzione di esigenze richieste per soddisfare usi previsti in disposizioni comportamentali del sistema tecnologico, sub sistemi o elementi e prodotti di un edificio in uso e nel loro ciclo di vita utile allo scopo di consentire misurazioni e verifiche di corrispondenza.

## UTENTE ▶ PROGETTISTA ▶ COSTRUTTORE



GLI OGGETTI DEL SISTEMA FUNZIONALE

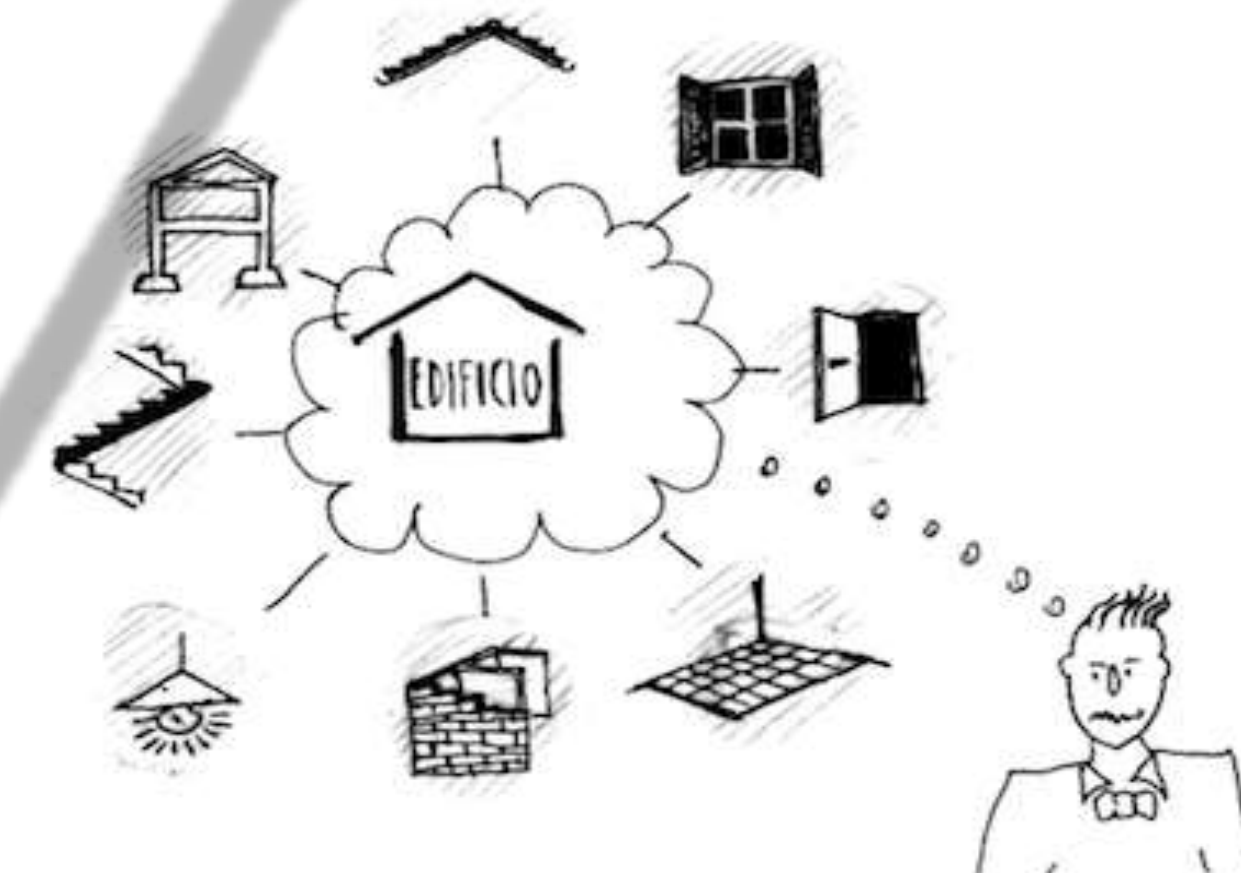GLI OGGETTI DEL SISTEMA AMBIENTALE

GLI OGGETTI DEL SISTEMA TECNOLOGICO

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DALLE **ATTIVITA' E DALLE FUNZIONI**

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DAGLI **SPAZI** E DAI **VOLUMI**

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DALLE **OPERE** E DAGLI **ELEMENTI TECNOLOGICI**

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

**MAILAB**
Multimedia
Architecture
Interaction

# [needs- requirements - performances]



I REQUISITI POSSONO ESSERE ESPRESSI IN MODO **QUANTITATIVO** O IN MODO **QUALITATIVO**

**VARIABILE DI REQUISITO (UNI 7867/2, 2.1.)**
*Carattere* di un requisito, **misurabile** rispetto ad una scala continua e suscettibile di assumere valori diversi

**ATTRIBUTO DI REQUISITO (UNI 7867/2, 2.2.)**
*Carattere* non misurabile, o che si preferisce non misurare, di un requisito *sul quale è dato* **unicamente un giudizio** di appartenenza ad una categoria od a più categorie

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

## [needs - requirements - **performances**]

Capacità di un prodotto di corrispondere alle funzioni richieste sotto determinate condizioni di uso, o comportamento quando in uso.
**Norma ISO 6707-1:2004** *Building and civil engineering — Vocabulary — Part 1: General terms*

## UTENTE ▶ PROGETTISTA ▶ COSTRUTTORE



GLI OGGETTI DEL SISTEMA FUNZIONALE

GLI OGGETTI DEL SISTEMA AMBIENTALE

GLI OGGETTI DEL SISTEMA TECNOLOGICO

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DALLE **ATTIVITA' E DALLE FUNZIONI**

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DAGLI **SPAZI** E DAI **VOLUMI**

I SINGOLI OGGETTI DEL SISTEMA FUNZIONALE SONO RAPPRESENTATI DALLE **OPERE** E DAGLI **ELEMENTI TECNOLOGICI**

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the  agent based computational design

The Performance Approach is mainly based on Humanitity's needs.

It rarely cares about Cholstomer, the Tolstoj's horse.

# The Antropocentric Vision of the Environment

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**
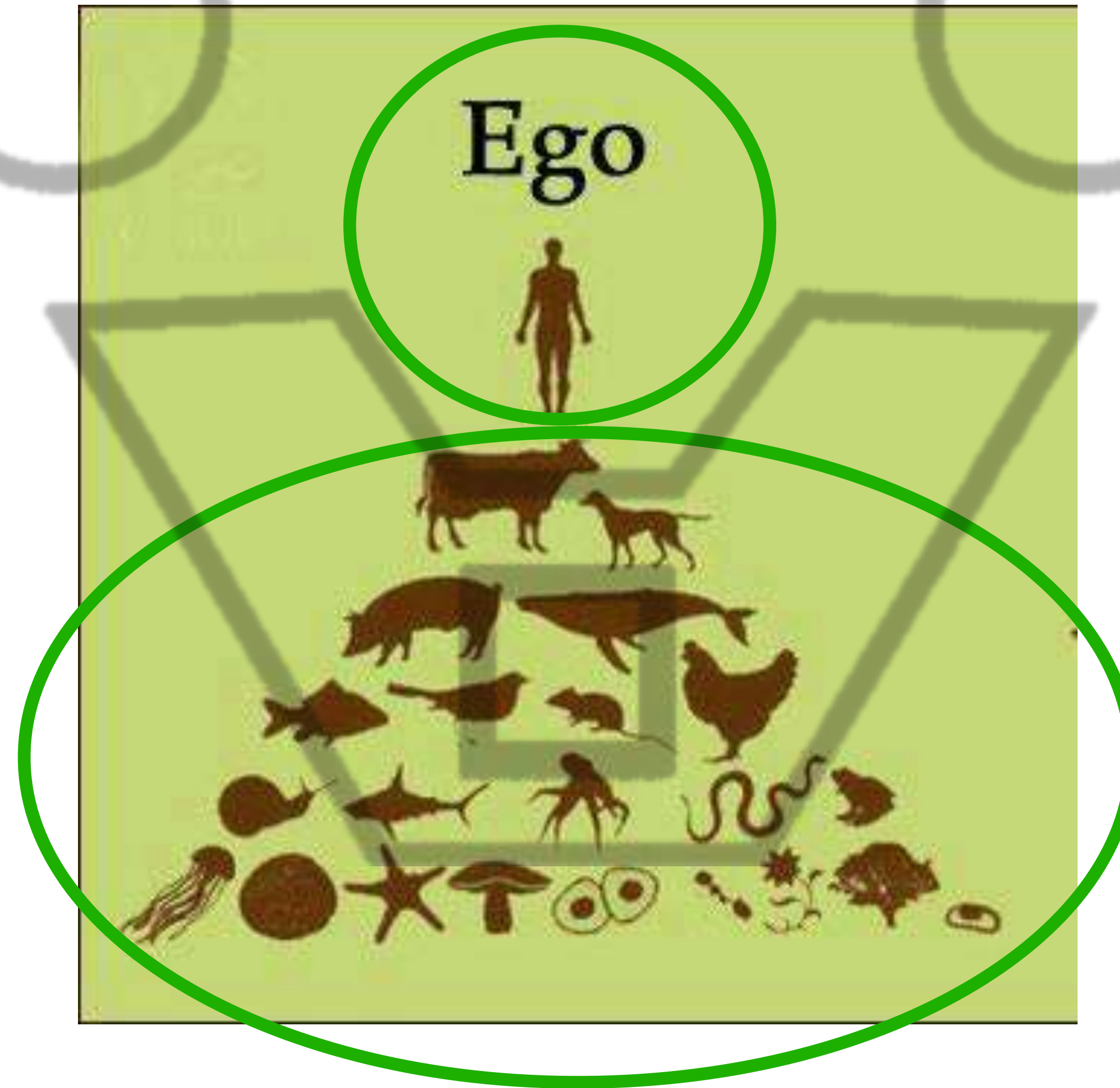
# Environment before Industrializarion: Environment as Periechon*

a place of cosmic totality within which the destinies of suffering and healing were realized
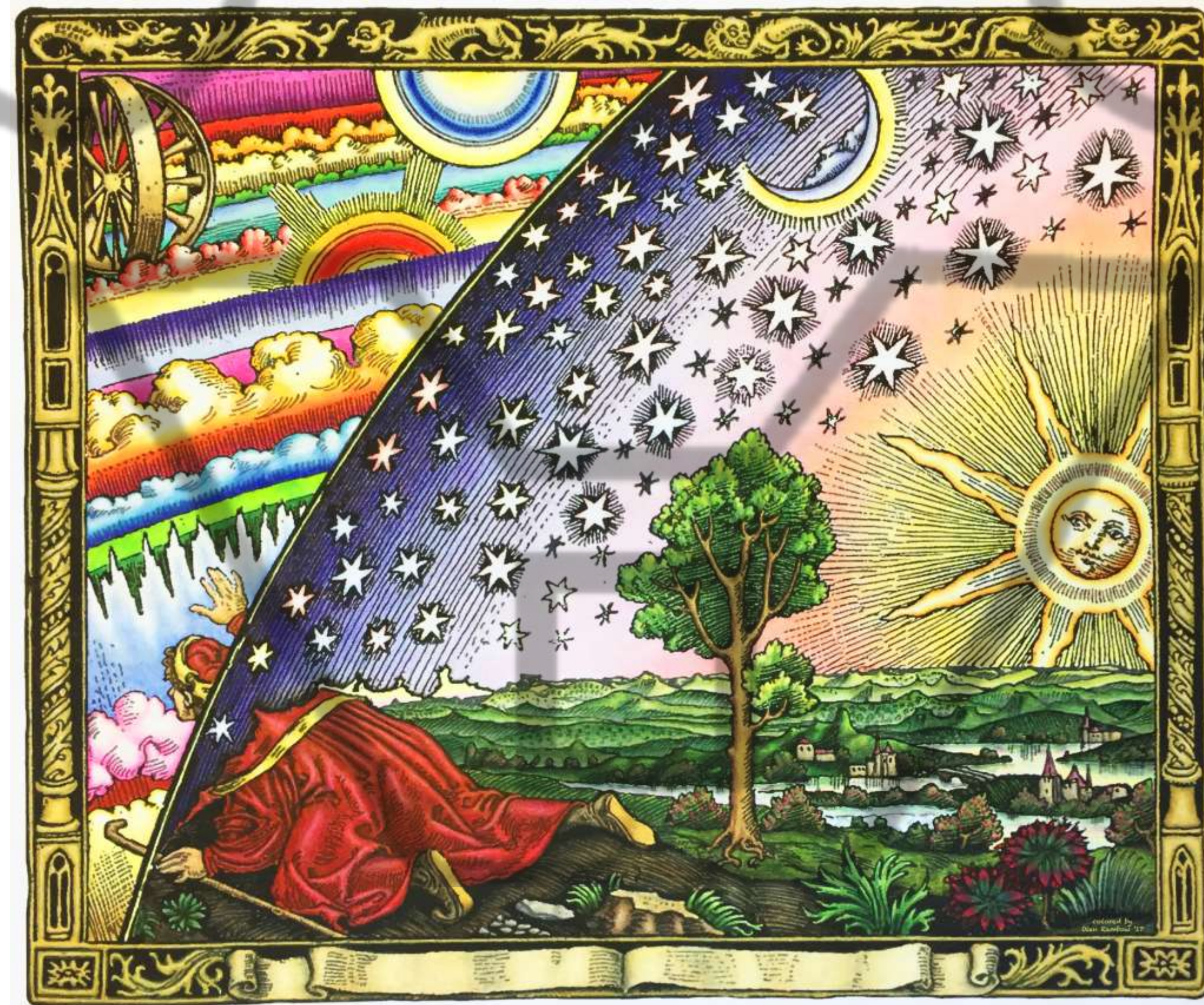


**\*) ancient Greek word expressing
the cosmological place including humanity**

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

# Environment before Industrializarion: Environment as Otherness

## An external entity and a hostile place to protect yourself from
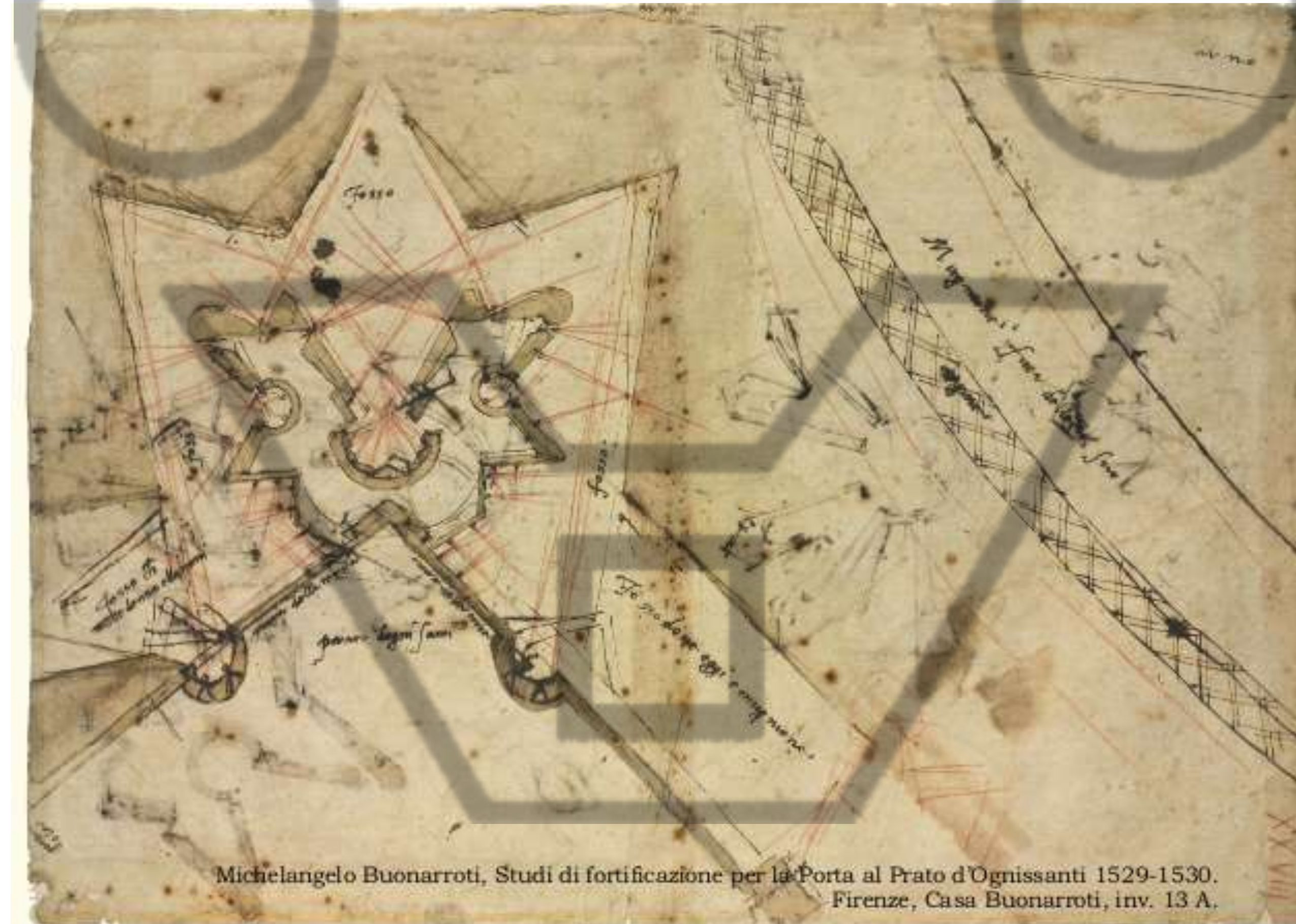


Michelangelo Buonarroti, Studi di fortificazione per la Porta al Prato d'Ognissanti 1529-1530.
Firenze, Casa Buonarroti, inv. 13 A.

**urban fortification studies governed by the 'evil art'**
**of ballistics and by military engineering**

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

# Nature is 'Other' than Humanity

## At the dualism roots and machinism vision
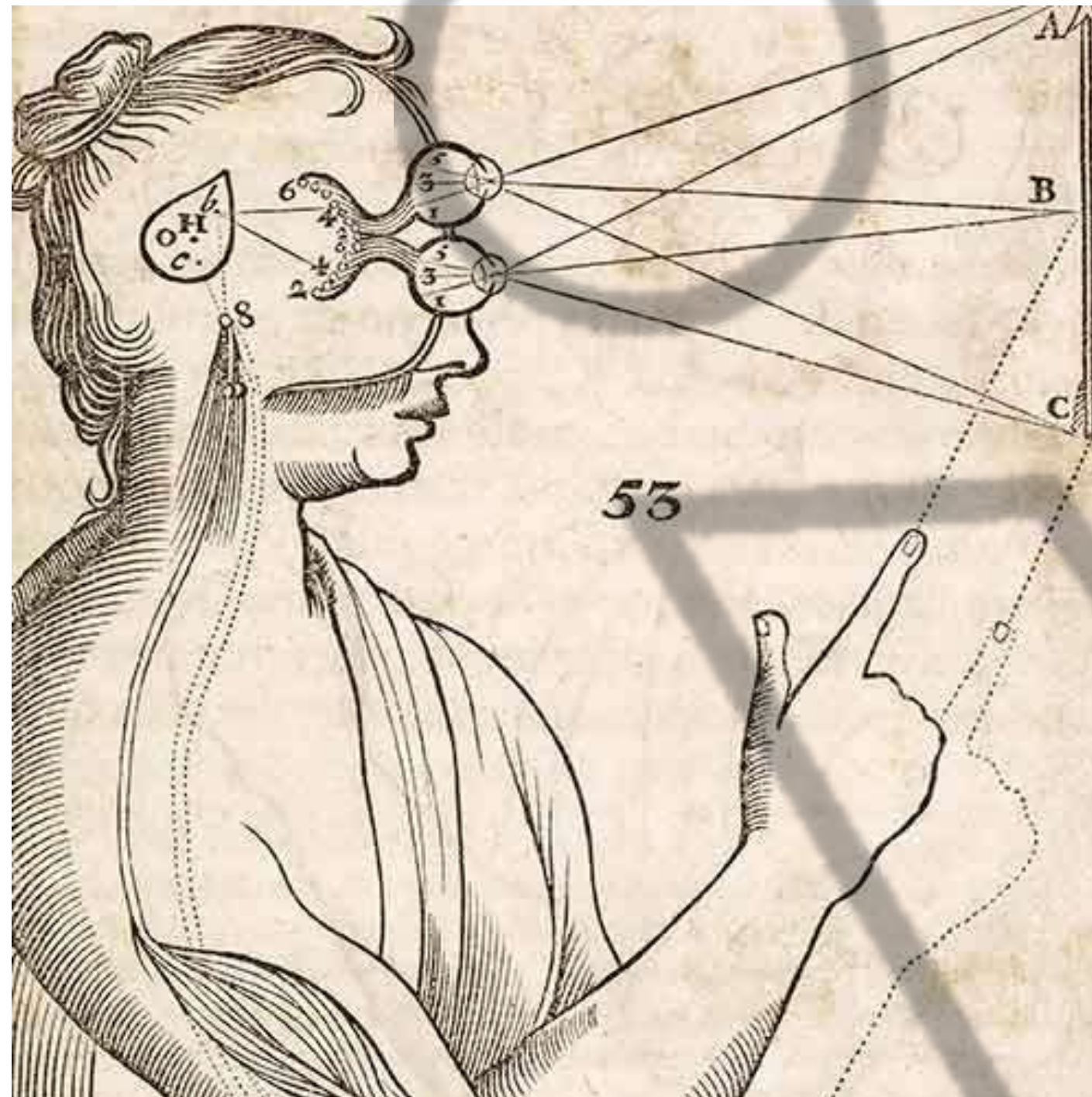


French edition of Descartes' Treatise on Man, which was published in 1664, 14 years after his death. It was drawn by Gerard van Gutschoven, a professor of medicine at the University of Louvain in Belgium.



La lezione di anatomia del professor Tulp" olio su tela di Rembrandt, 1632 custodito nel Museo Mauritshuis dell'Aja.

MAILAB
Multimedia
Architecture
Interaction

UNIVERSITÀ
DEGLI STUDI
FIRENZE
**DIDA**
DIPARTIMENTO DI
ARCHITETTURA

# Nature is 'Other' than Humanity
## the Environment as a problem and a solution

*fig. 1 - Eisen, C.E., 'frontispiece' (1755), in Lauger, M.A., Essai sur l'architecture. 2nd French edition (© The New York Public Library Digital Collections) Available at: http://digital-collections.npl.org/items/b2065a93-b245-8366-*
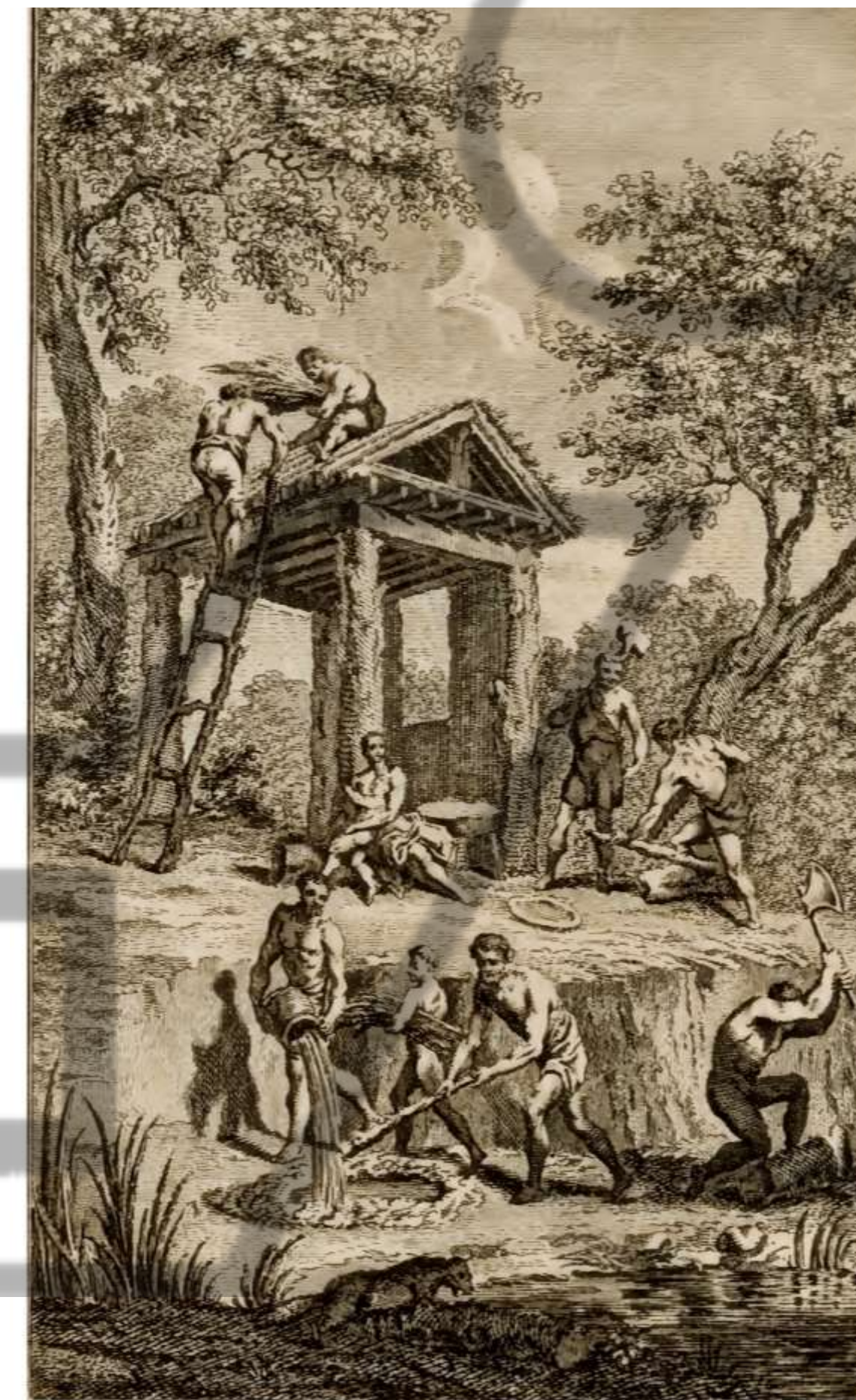
*fig.2 - Wale, S., 'frontispiece' (1755) in Lauger, M.A., Essay on architecture, 1st English edition (© The Bancroft Library) Available at: https://archive.org/details/essayonarchitect00laugri-ch/page/n1 [Accessed 20 May 2013]*

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the  agent based computational design**

# Environment as a Commodity for Human Comfort

The Environment under the utilitarian paradigm of industrialization
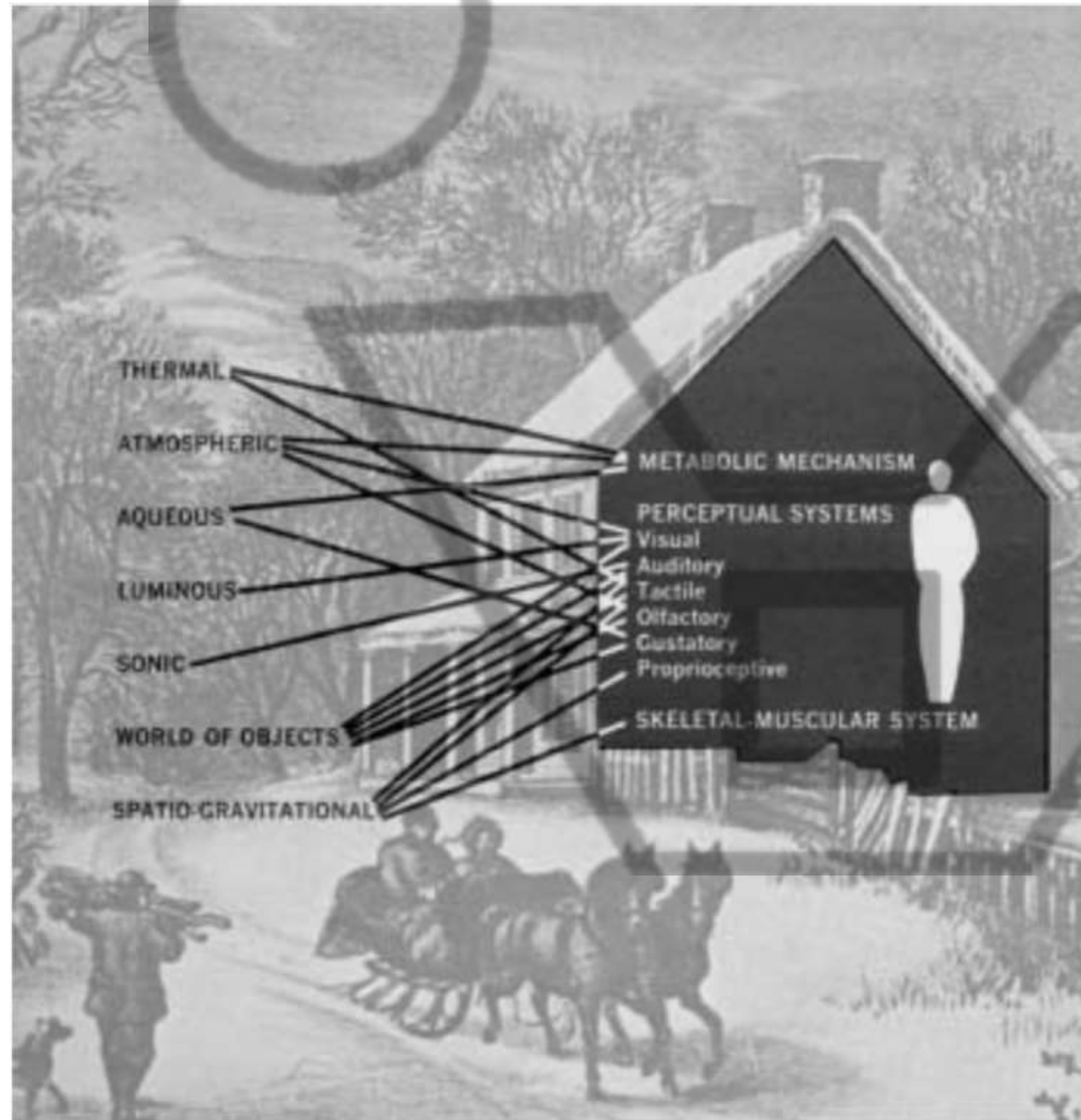


"The fundamental thesis of this book is that the ultimate task of architecture is to act in favour of man: to interpose itself between man and the natural environment"

James Marston Fitch (1947), *American Building. The Forces that Shape it*, The Riverside Press, Cambridge

# Environment as a Commodity for Human Comfort

The Environment under the utilitarian paradigm of industrialization



WEATHER

SUN

SLEEP

HUMIDITY

DAYLIGHT

HEATING

HYGIENE

SEX

GARDENING

PETS

COOKING
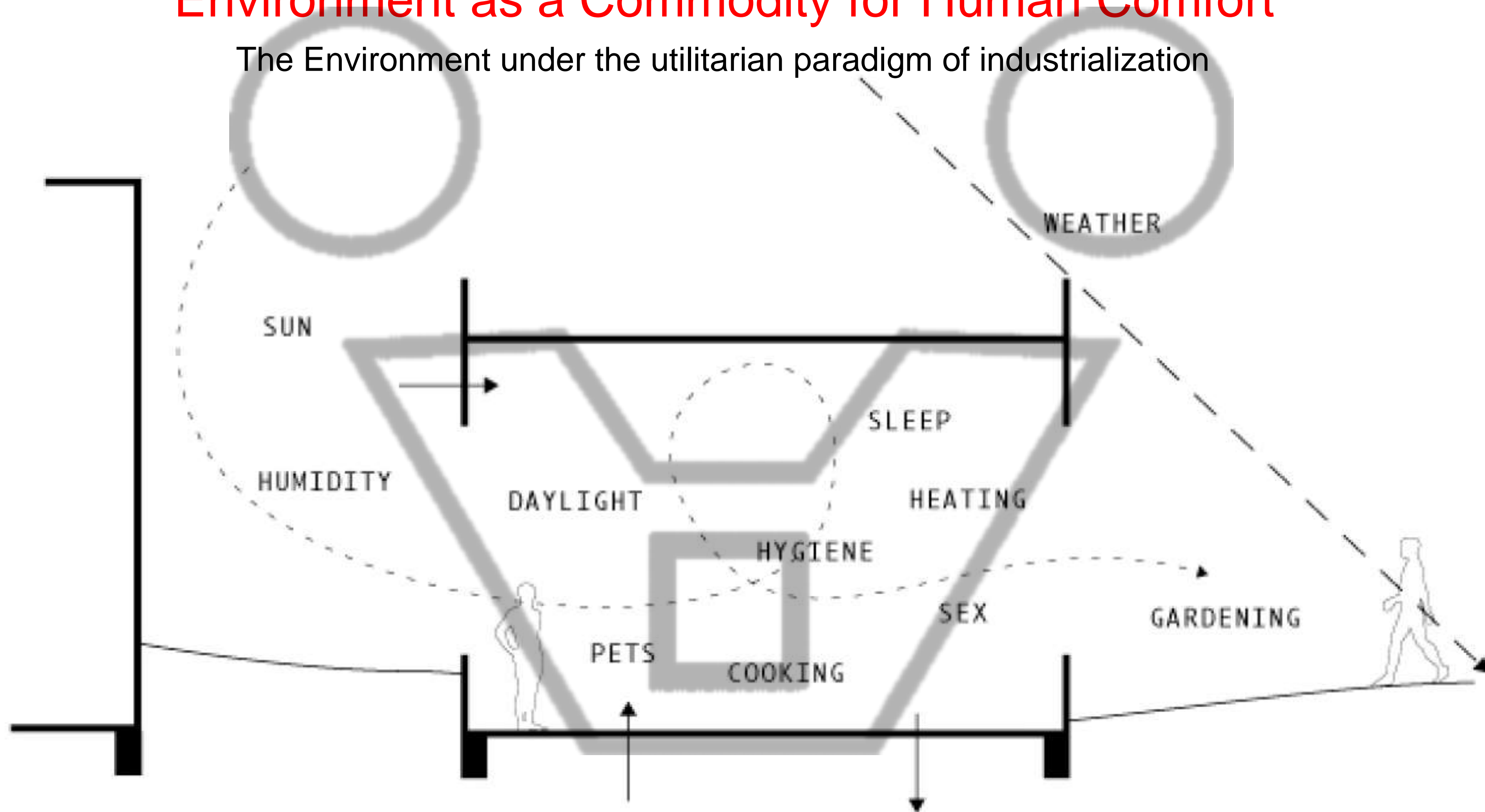
*Building is the deliberate organization of the processes of life.*

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# Environment as a Commodity for Human Comfort

## The Environment under the utilitarian paradigm of industrialization

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the  agent based computational design**
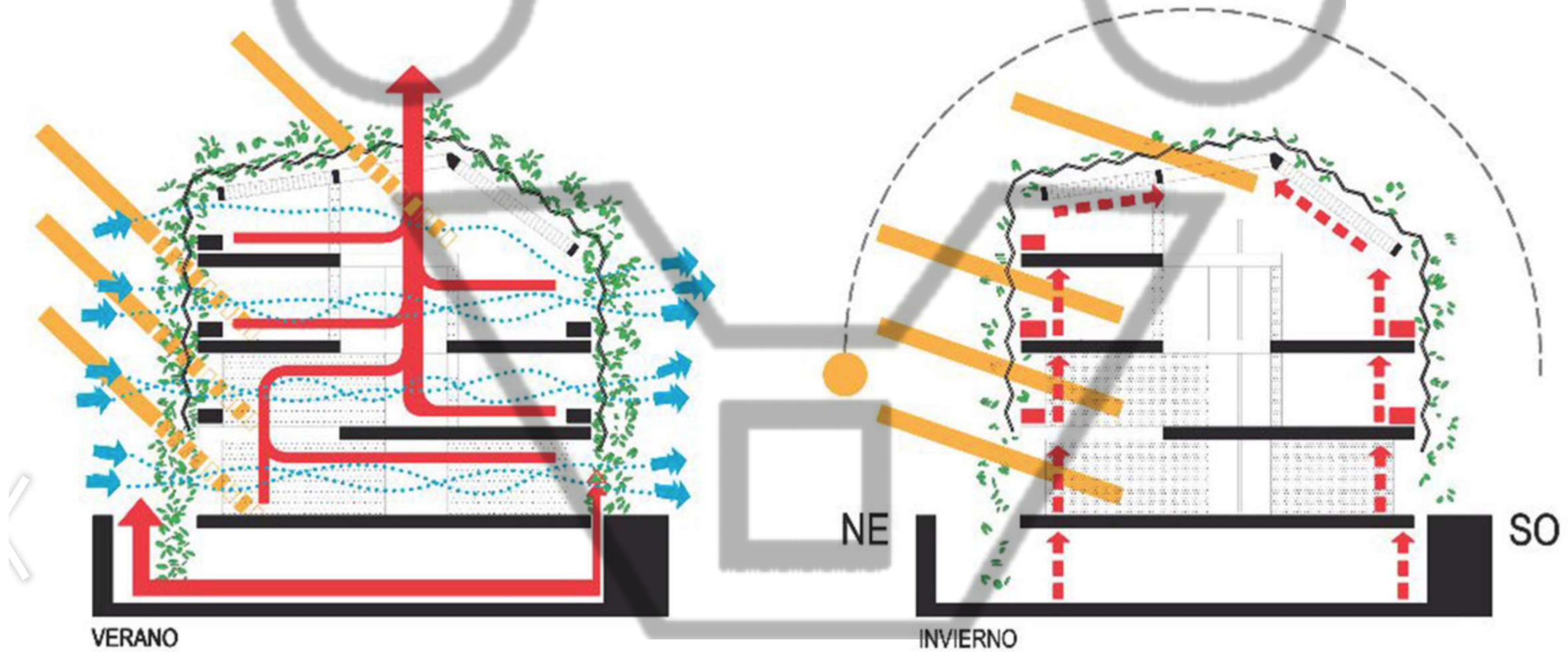
# THE POST-ENVIRONMENTAL DESIGN

How the  Post-Environmental Condition affects Design

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the  agent based computational design**

# Towards a new vision of the Universe: the Coevolutionism
## a process of participation of multiple agents



| 1976 | 1979 | 1987 | 1986 | 2015 |

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**
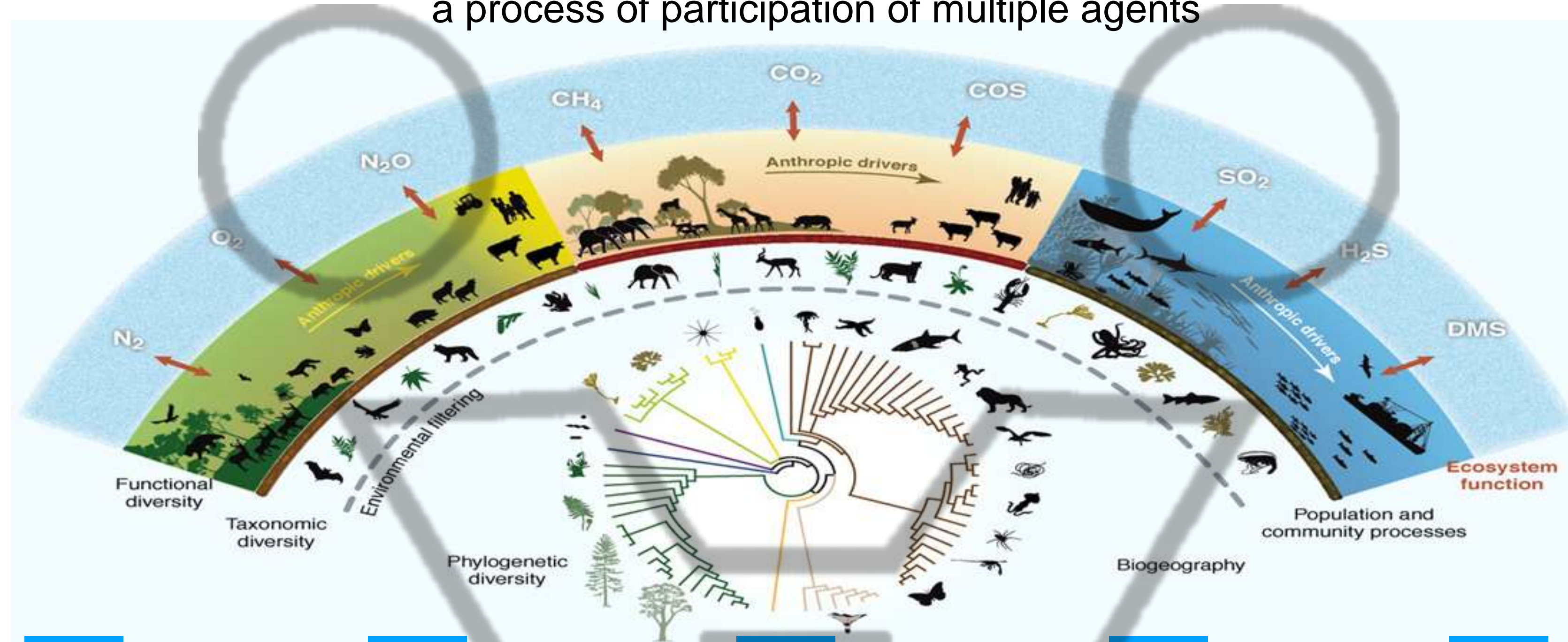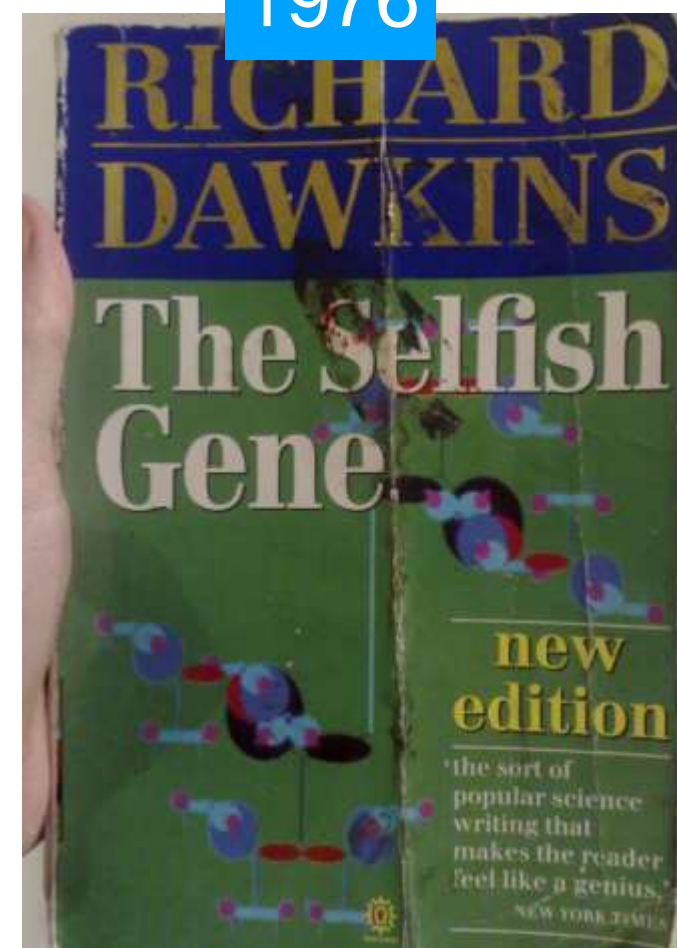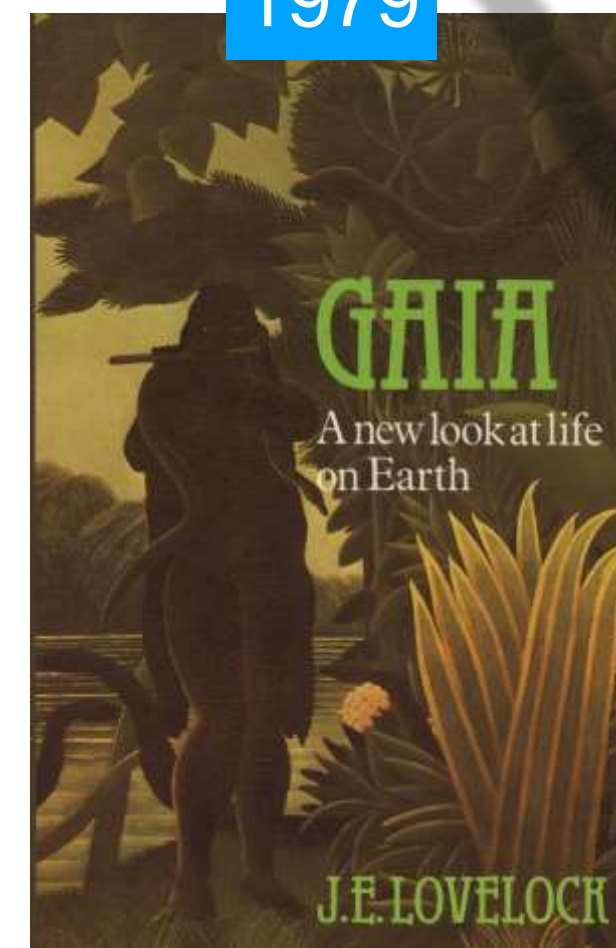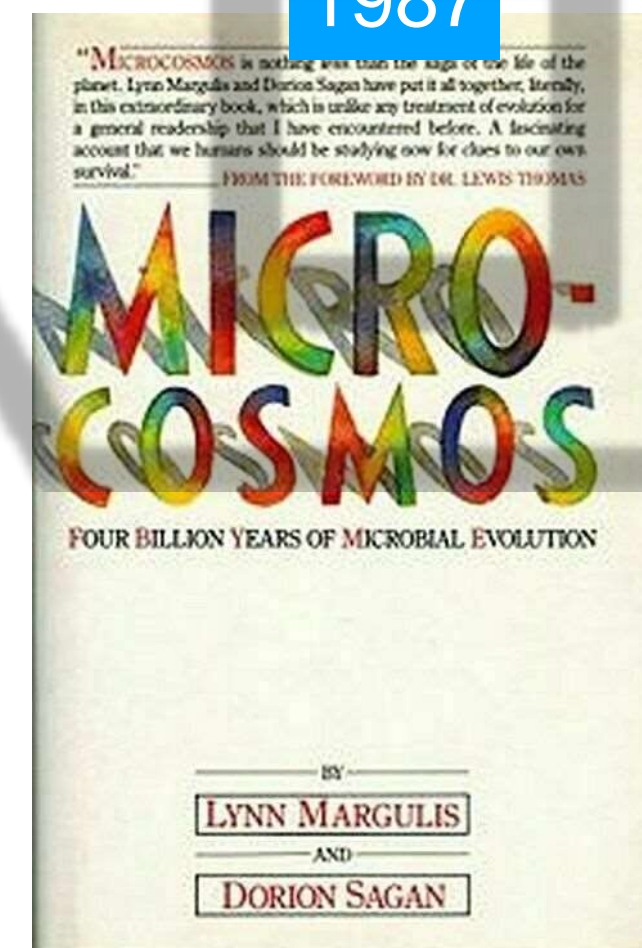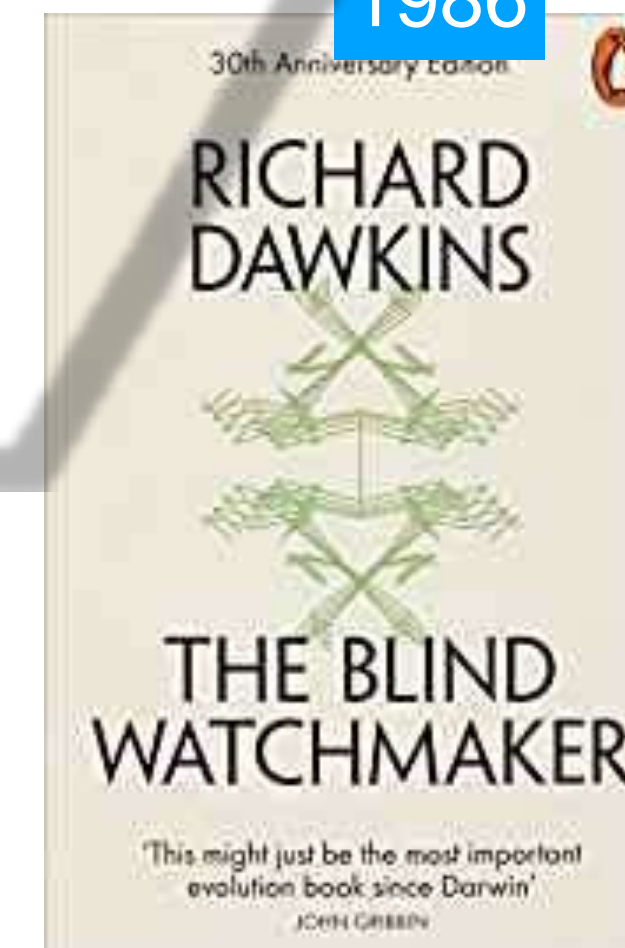
# The Co-evolutionary Approach
beyond the impracticable reconciliation with nature
or obedience to its morality because every dualism is lost
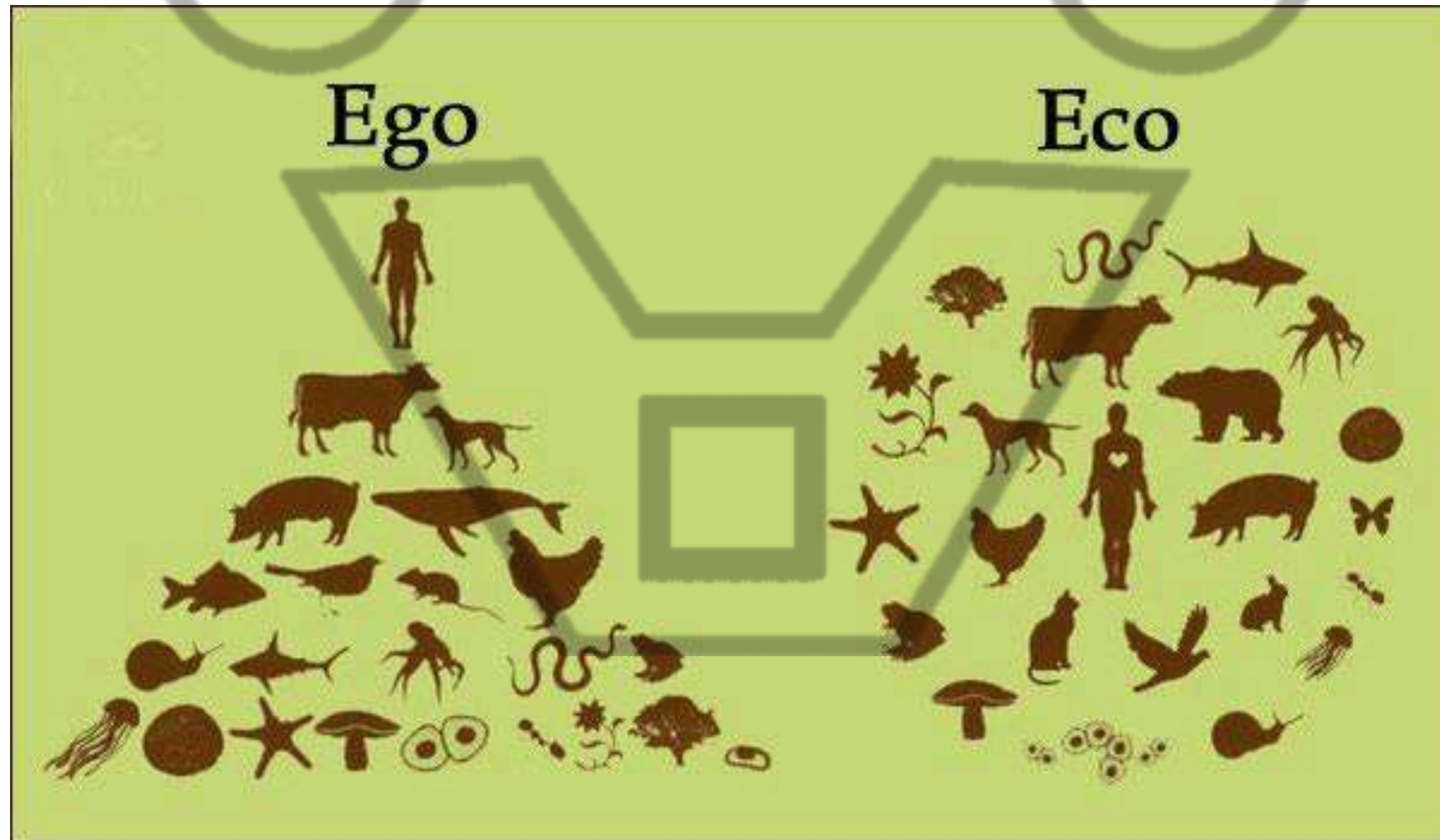
# For a New Design of the Wholeness
## without distinctions and hierarchies



*In traditional Hinduism, nature and the environment are not outside us, not alien or hostile to us. They are an inseparable part of our existence, and they constitute our very bodies.*

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

# Against Anthopocentric & Authorial Interpretations

*- we cannot anymore design acting from an antropocentric vision*

*- we cannot continue to use only the knowledge coming from the tradition, state of art, and rules of thumb*

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# Against Anthopocentric & Authorial Interpretations

*- we cannot anymore design acting from an antropocentric vision*

*- we cannot continue to use only the knowledge coming from the tradition, state of art, and rules of thumb*

## *We need to give voice to this Wholeness*

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

Against Anthopocentric & Authorial Interpretations

- we cannot anymore design acting from an antropocentric vision

- we cannot continue to use only the knowledge coming from the tradition, state of art, and rules of thumb

We need to act using a coevolutionary process involving many, even invisible, agents. We call this approach : Agent-Based & Computational Design.

MAILAB
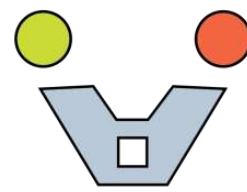
Multimedia
Architecture
Interaction

part 2

Computational Design

& Digital Modeling

MAILAB

Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

# Digital Data & Digital Mathema
# for a new Universal Language

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE
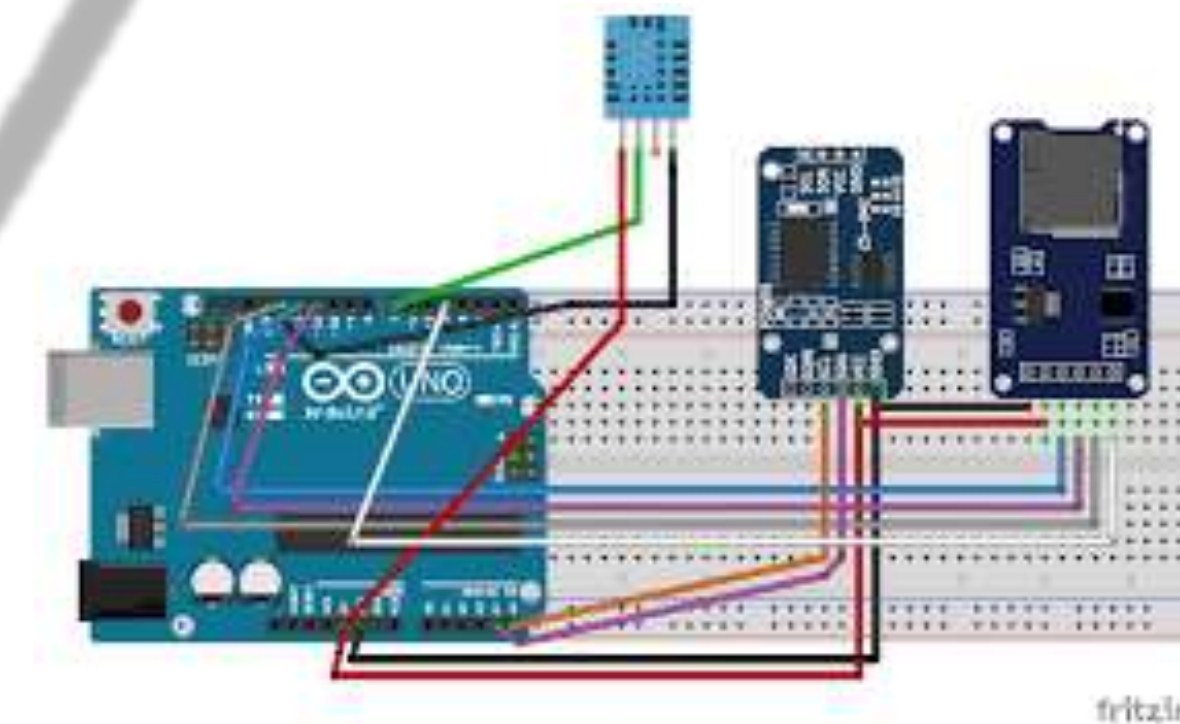
**The post environmental age and the  agent based computational design**

'Raw Material' and 'Operated Matter'  manifest  their connotative (FORM)
and behavioral (PERFORMANCE) nature through a new materiality which is the Digital Datum.

The Digital Mathema is its own language

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

# Digital Technologies and Computational Intelligencies

Dataloggers give us the multi-faceted life of our planet and represent
the first step in 'giving voice' to the multitude of agents that influence life.

Digital language give us the ability to interact and have dialog with the Environment

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the  agent based computational design**

# Digital Technologies and Computational Intelligencies

Digital data  give us the connotative (FORM) aspect of the world
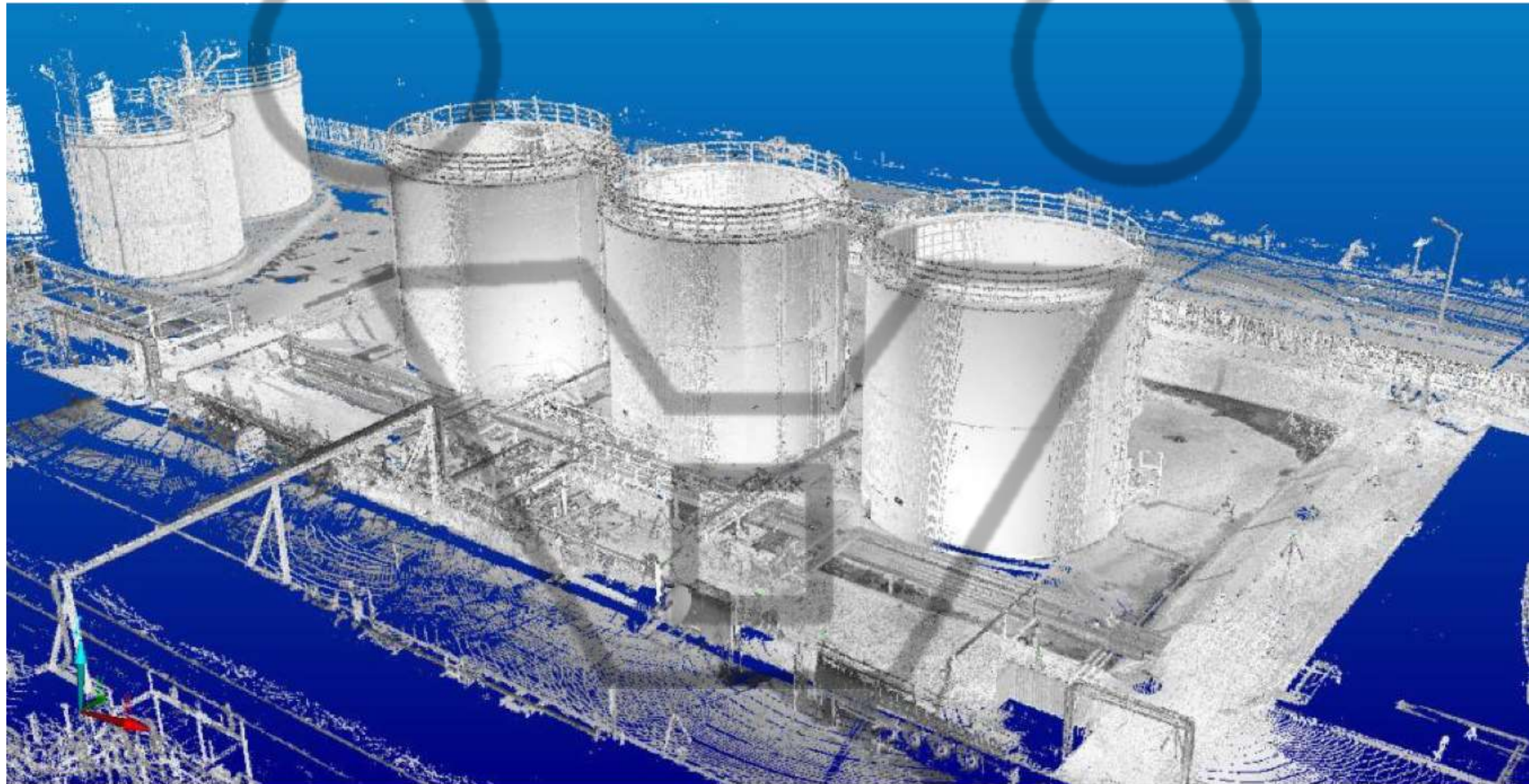


GIS+LASER SCANNERS+ CLOUDS OF POINTS  FOR **DIGITAL SURVEYING**

**MAILAB**

Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# Digital Technologies and Computational Intelligencies

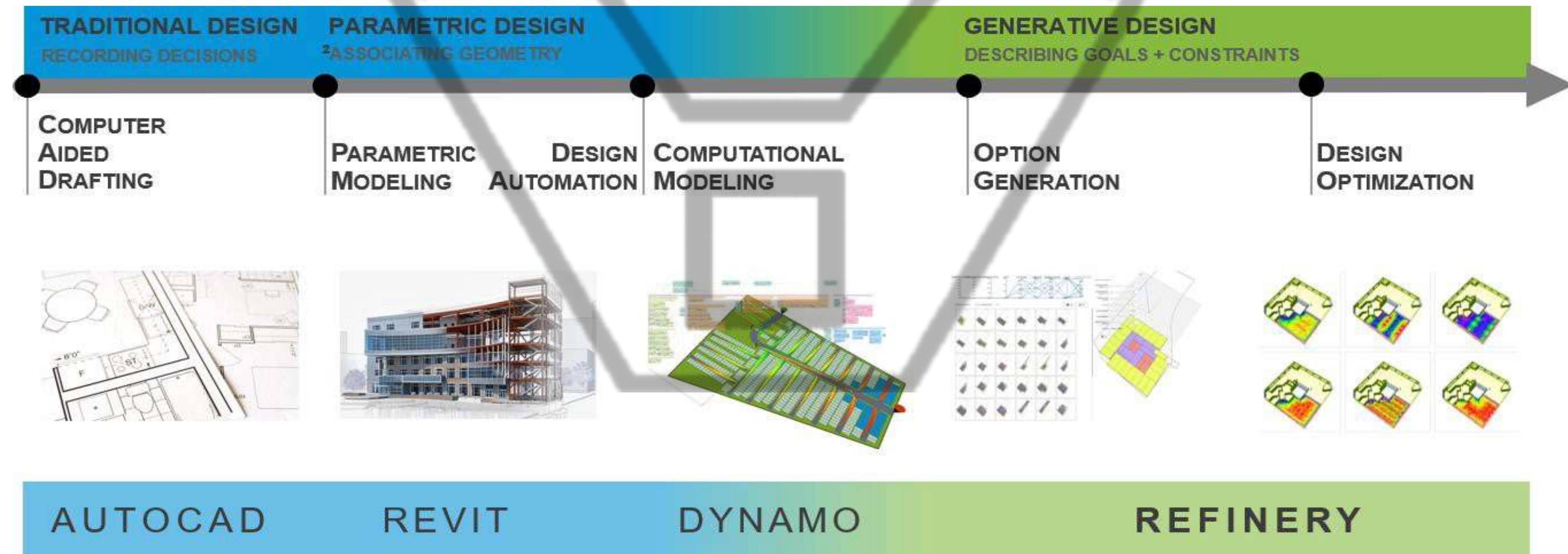Digital Data  give us the behavioral  (performance ) aspect of the world

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the  agent based computational design
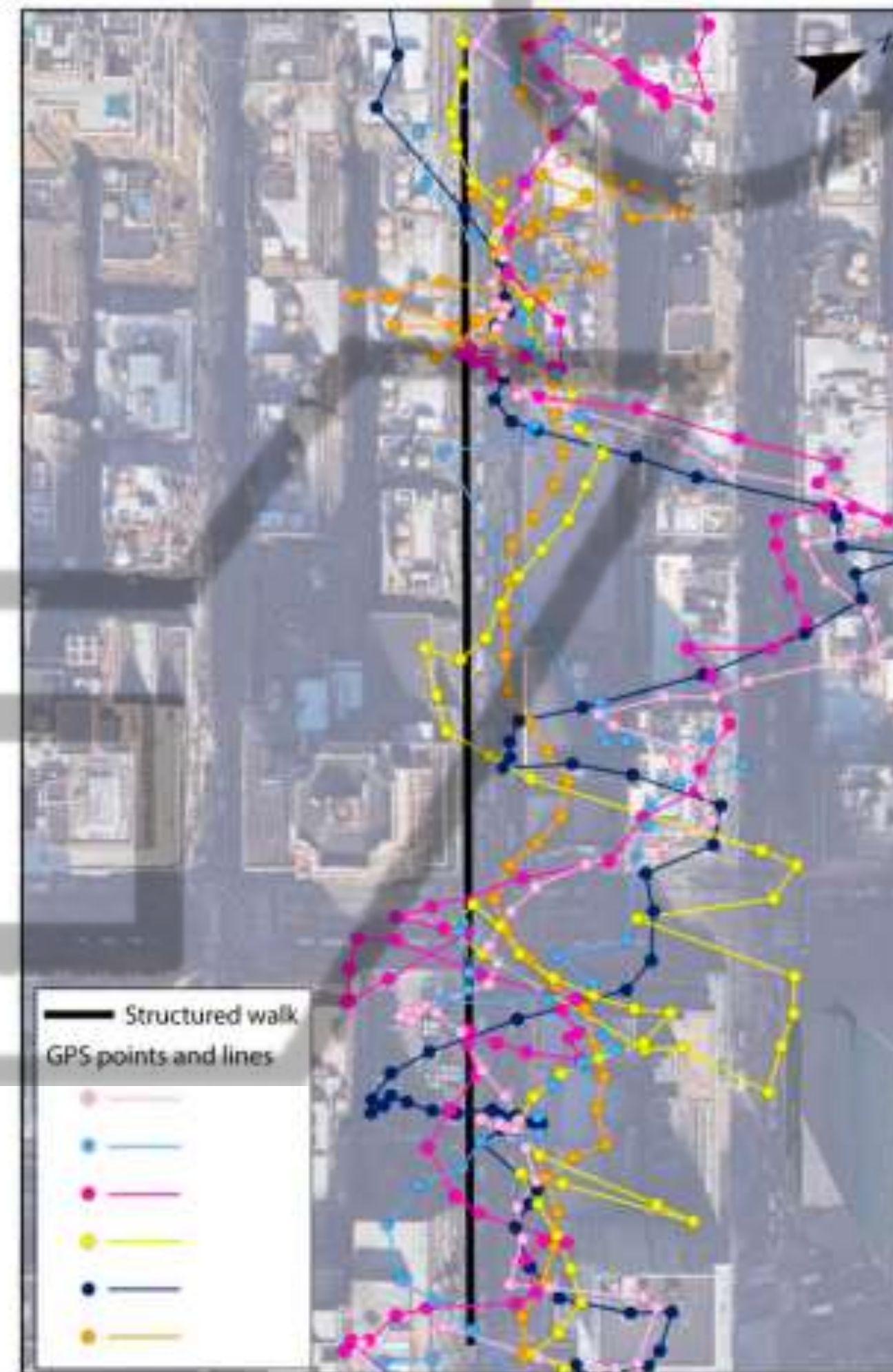
# Digital Technologies and Computational Intelligencies

Digital Technologies  give us a better control, flexibility  and to speed up fabrication

**CAD/ CAM or Files to Factory**

**MAILAB**

Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

# Digital Technologies and Computational Intelligencies

20/15 years a new scenario in constructions after the Computer Aided Manufacturing (CAM), and Computer Numerically Controlled (CNC)

**Grid Design in Version 6 of CATIA Composites from Dassault**

The first example, historically recognized where CAD/CAM was used to realize a large scale object related to building construction, was driven by the Ghery Partners firm with the Fish Sculpture or Barcelona Fish (1992) , a huge sculpture forming a landmark for the Olimpic village within a larger hotel development by Skidmore, Owing & Merill.

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# Digital Technologies and Computational Intelligencies

## Parametric Design

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**
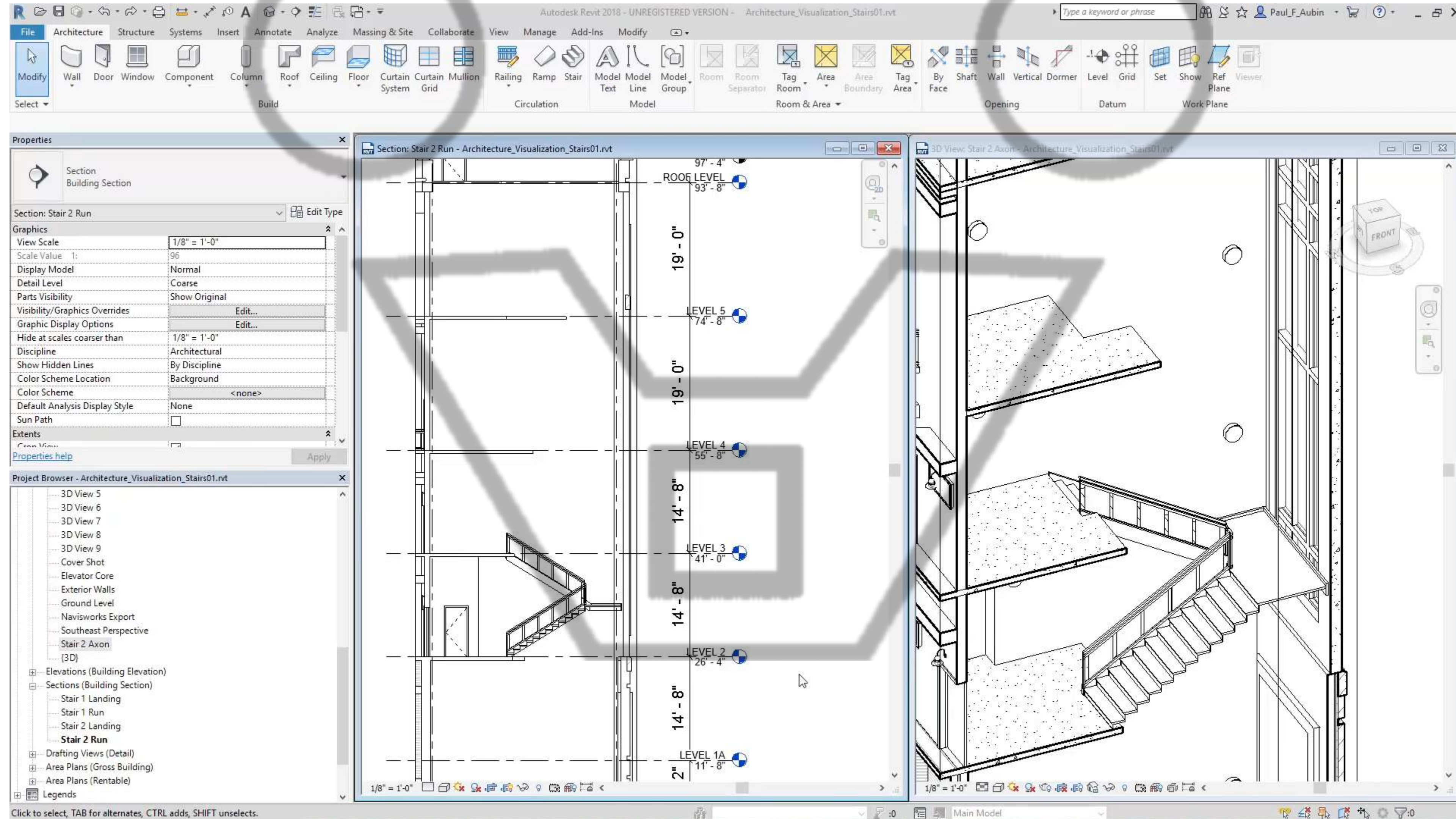
# Digital Technologies and Computational Intelligencies

Evolutionary approach and genetic optimization solvers: the **Generative Design**

UNIVERSITÀ DEGLI STUDI FIRENZE
DIDA
DIPARTIMENTO DI ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE
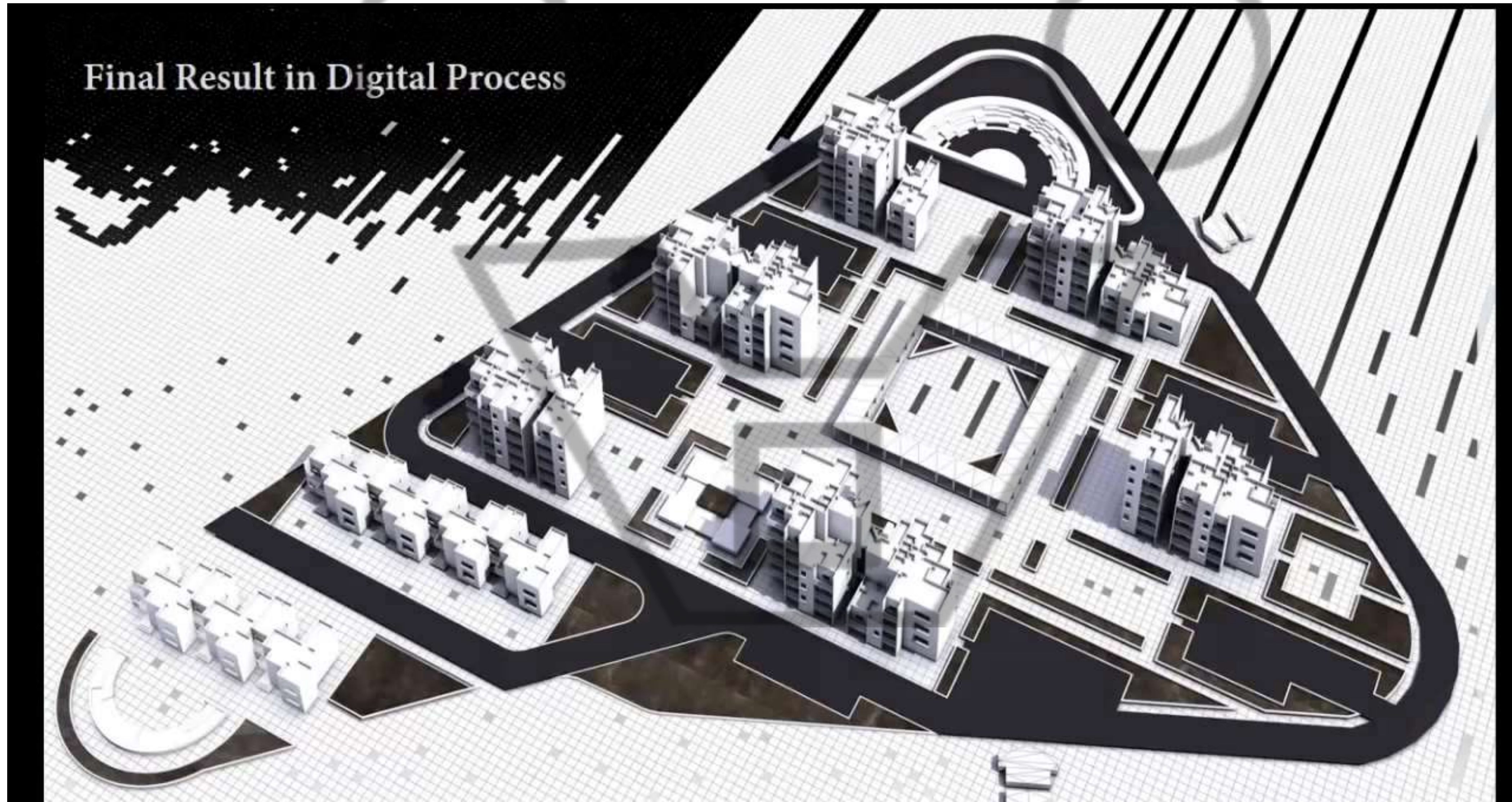
The post environmental age and the agent based computational design

**Digital data and Digital Mathema give us new form of intelligencies: Computational Intelligences (CIs)**

# Digital Technologies and Computational Intelligencies

## Different types and levels of Intelligences  in Computational Design Technologies
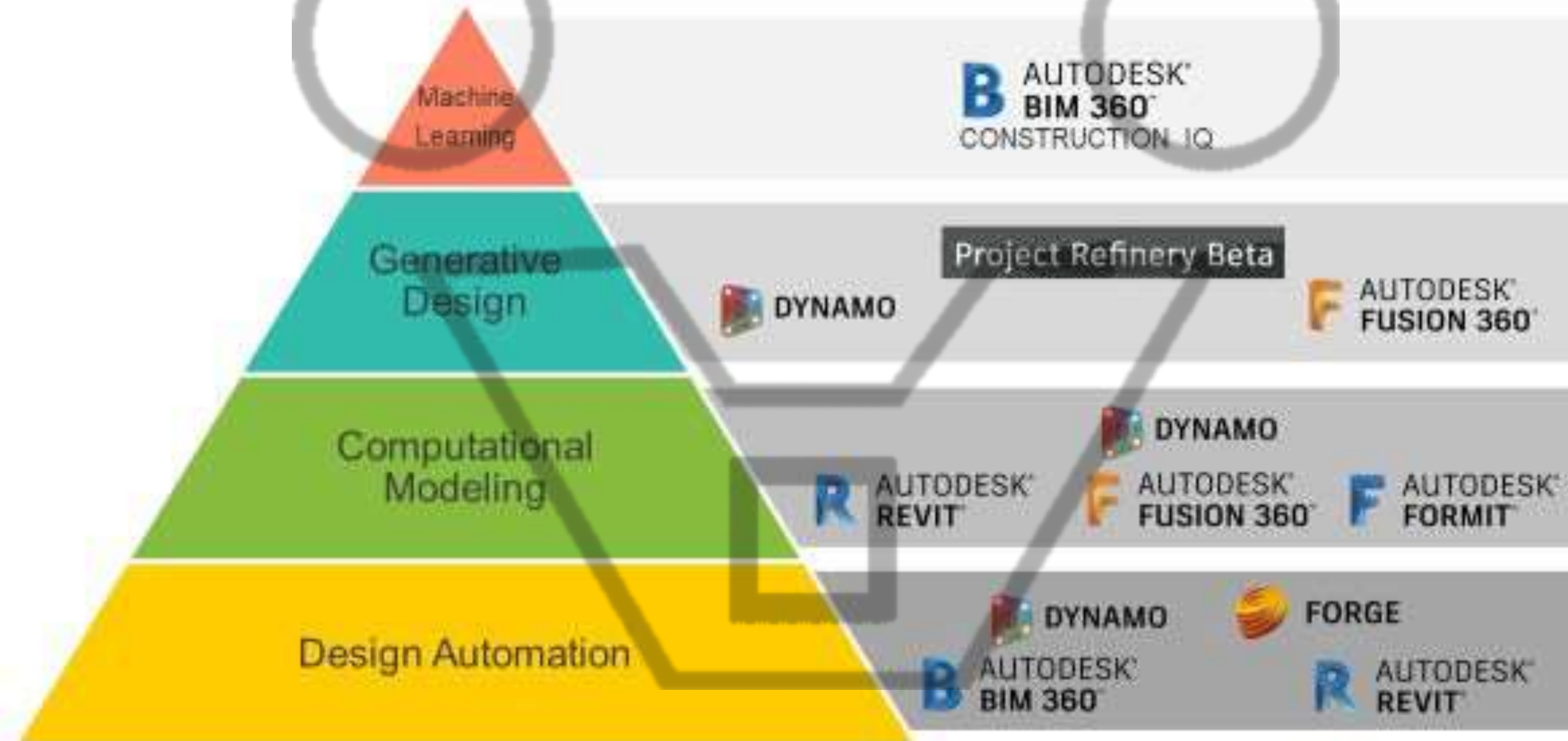


*« the only opportunity to escape
from obsequious observance of tradition »*

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# Digital Technologies and Computational Intelligencies

## Machine Learning > Artificial Intelligence
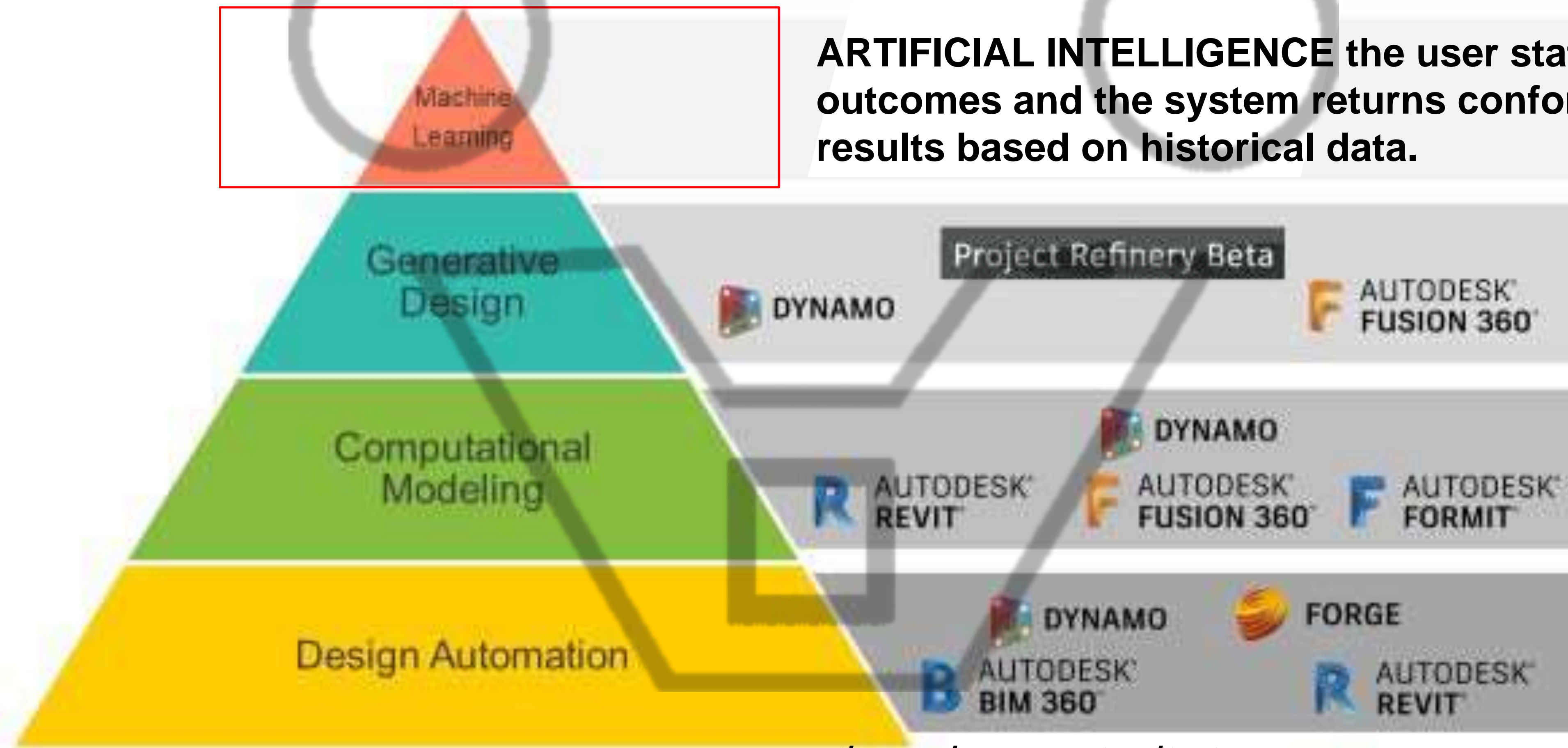


**ARTIFICIAL INTELLIGENCE the user states outcomes and the system returns conforming results based on historical data.**

Machine Learning

Generative Design

Computational Modeling

Design Automation

Project Refinery Beta

DYNAMO

AUTODESK FUSION 360

DYNAMO

R AUTODESK REVIT

F AUTODESK FUSION 360

F AUTODESK FORMIT

DYNAMO

FORGE

B AUTODESK BIM 360

R AUTODESK REVIT

*« the only opportunity to escape from obsequious observance of tradition »*

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

# Digital Technologies and Computational Intelligencies

## Generative Design (Evolutionary, Swarm,..)



**A goal-driven approach using automation where users set specific parameters and goals and the machine generate and evaluate many potential solutions that, under designer guide, fits better.**

Machine Learning

Generative Design — DYNAMO

Computational Modeling — DYNAMO · AUTODESK REVIT · AUTODESK FUSION 360 · AUTODESK FORMIT

Design Automation — DYNAMO · FORGE · AUTODESK BIM 360 · AUTODESK REVIT

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**
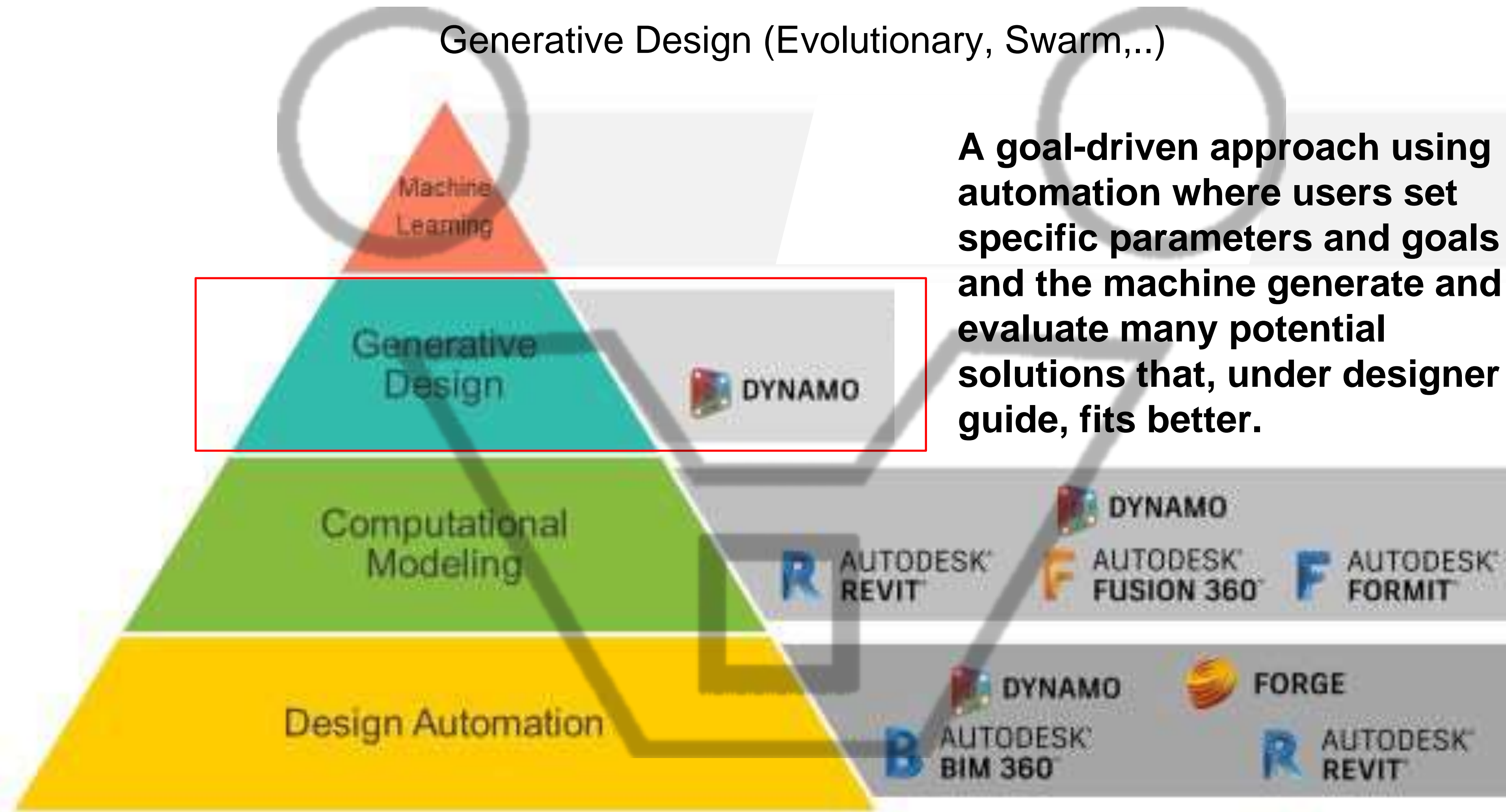
# Digital Technologies and Computational Intelligencies

## Generative Design Flow Chart
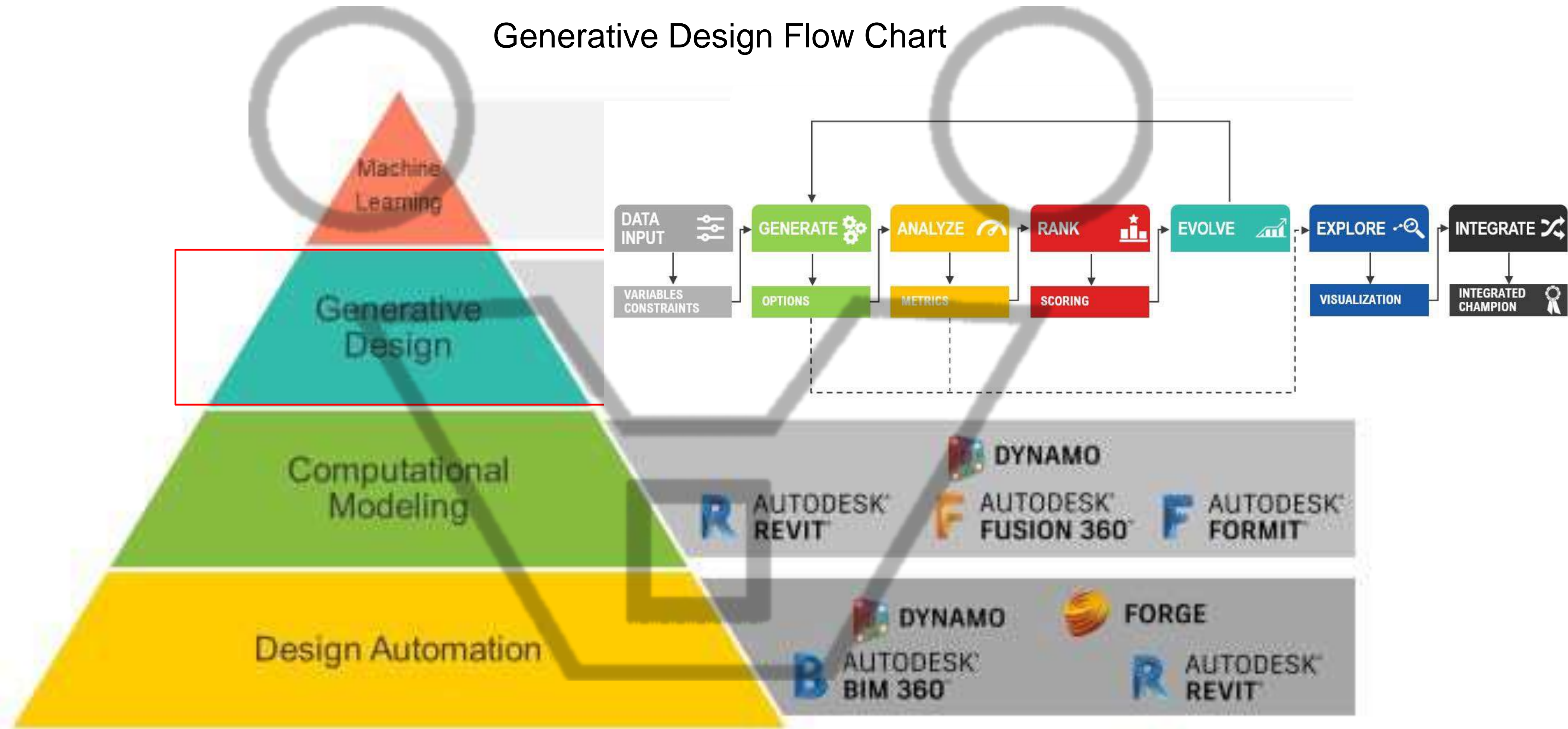
**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

# Digital Technologies and Computational Intelligencies
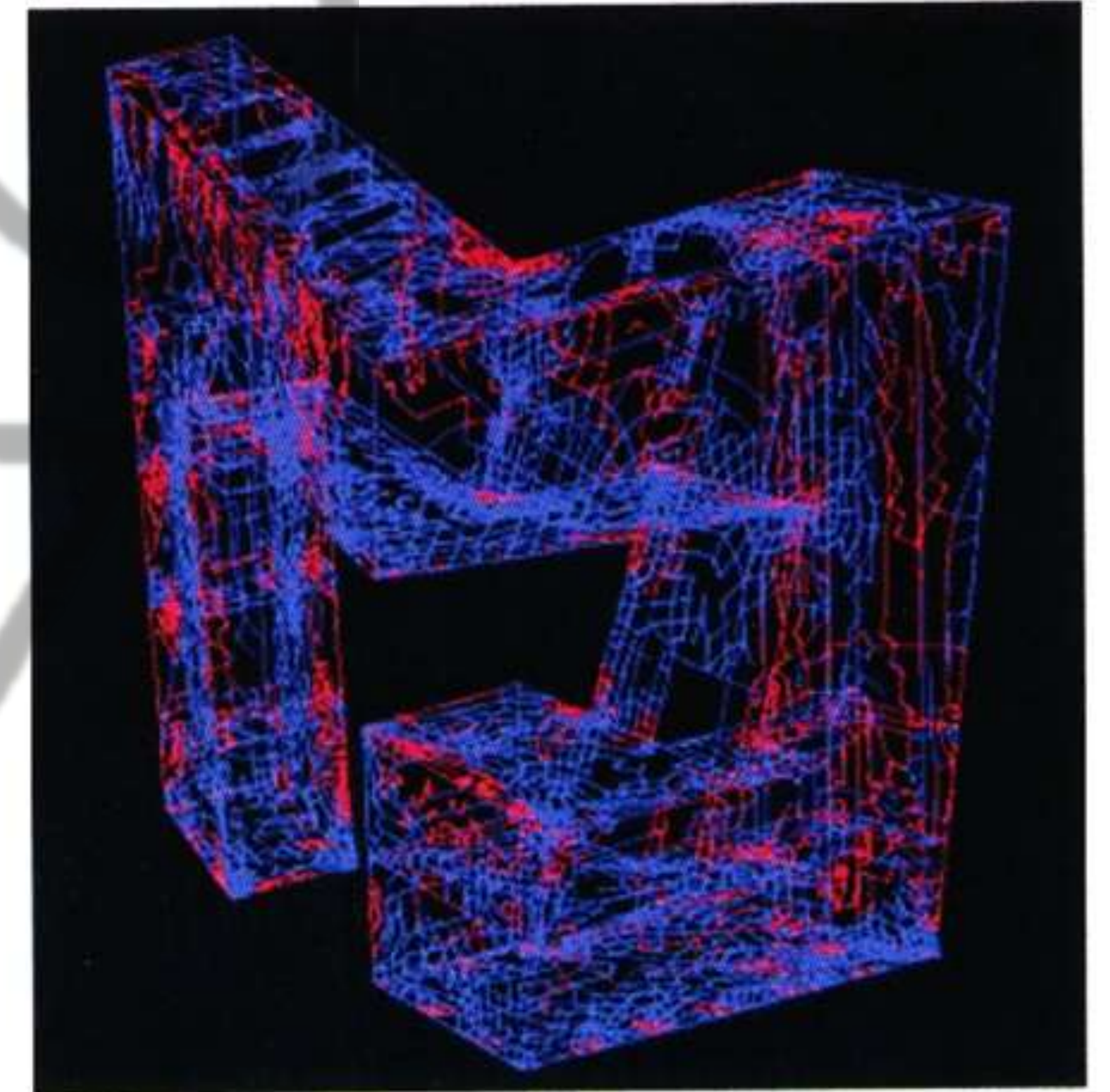
With **Design Optimization**, the user defines explicit goals and a computational or parametric model is automatically explored for states that fit those goals

With **Option Generation**, the user explores of variations of computed rules given different starting points for the calculations

In **Computational Modelling**, the user explicitly describes a process to create a design outcome.

In **Parametric Design** the user defines relationships between traditionally drawn or sculpted elements.

**Design Automation** the user gets the ability to automate tasks within parametric models, by driving the parameters with automated scripts.



| TRADITIONAL DESIGN | PARAMETRIC DESIGN | | GENERATIVE DESIGN | |
| RECORDING DECISIONS | ²ASSOCIATING GEOMETRY | | DESCRIBING GOALS + CONSTRAINTS | |

COMPUTER AIDED DRAFTING · PARAMETRIC MODELING · DESIGN AUTOMATION · COMPUTATIONAL MODELING · OPTION GENERATION · DESIGN OPTIMIZATION

AUTOCAD · REVIT · DYNAMO · REFINERY

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

# MODELING: the Language of Design

## *Simulation to understand how reality behaves and how it works*
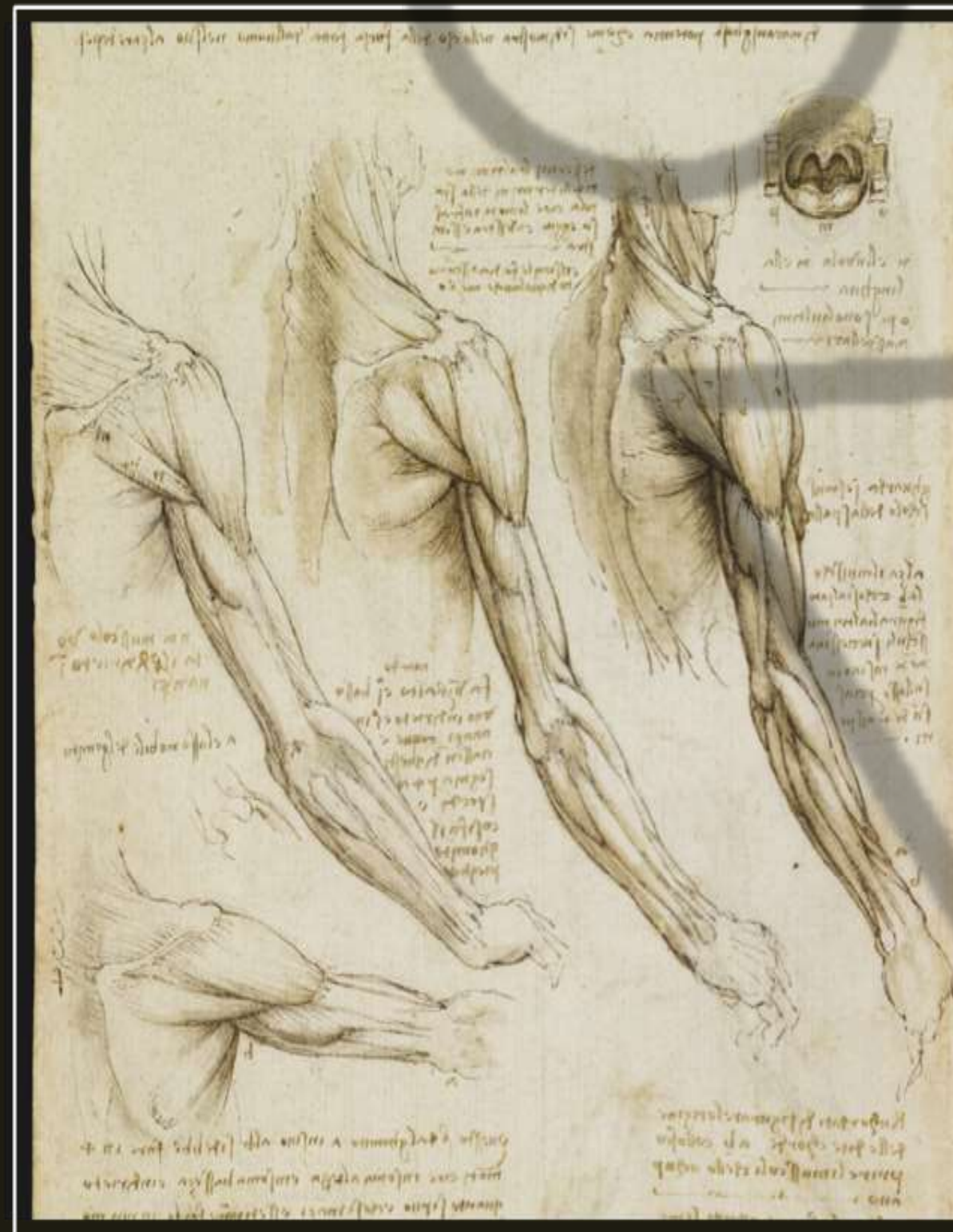


Leonardo da Vinci. Anatomical drawings (around 1510)



R. Mark. Force visualization on Gothic Cathedral
usign polarized light and plexliglass ('70s)
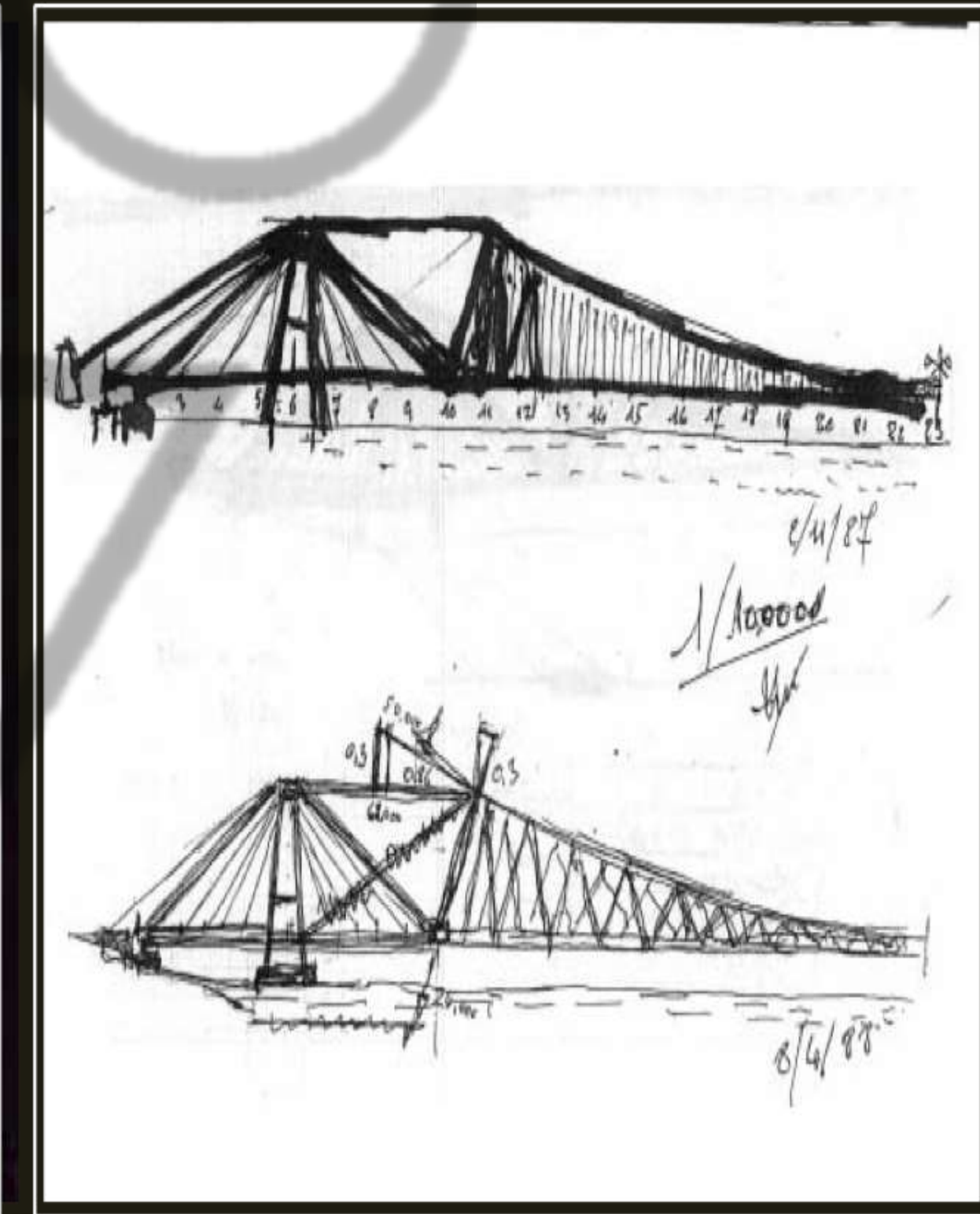


Riccardo Morandi. Bridge studies (1987/89)

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design
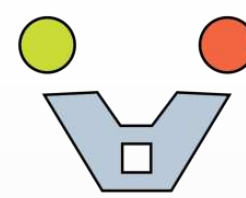
# WHAT IS MODELING

## SKETCHING • DRAWING • DRAFTING

## DESIGNING  - MODELING

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**MAILAB**
Multimedia
Architecture
Interaction

**The post environmental age and the  agent based computational design**

# RE-PRESENTATION

## SKETCHING

*Sketching is a freehand drawing representing the preliminary phase of a drawing.*
*It has a gestural character, based on immediate actions without corrections and few details intended to capture an idea or an experience. It expresses approximative essentiality.*
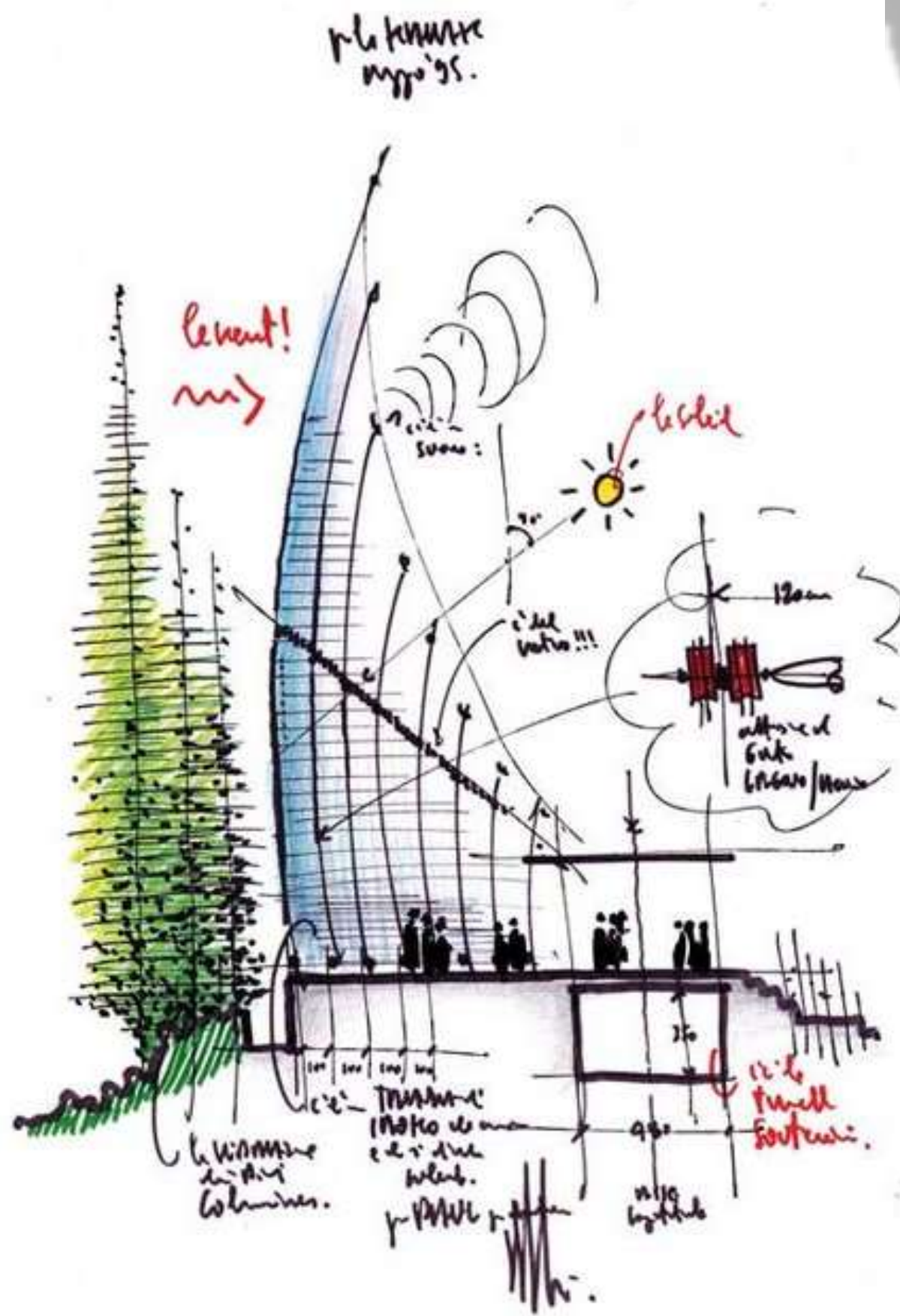
Renzo Piano, Tjibaou Cultural Centre,
Nouméa, New Caledonia, 1998

Picasso, Studio for Guernica, 1937

# The post environmental age and the agent based computational design



Van Gogh's Studies
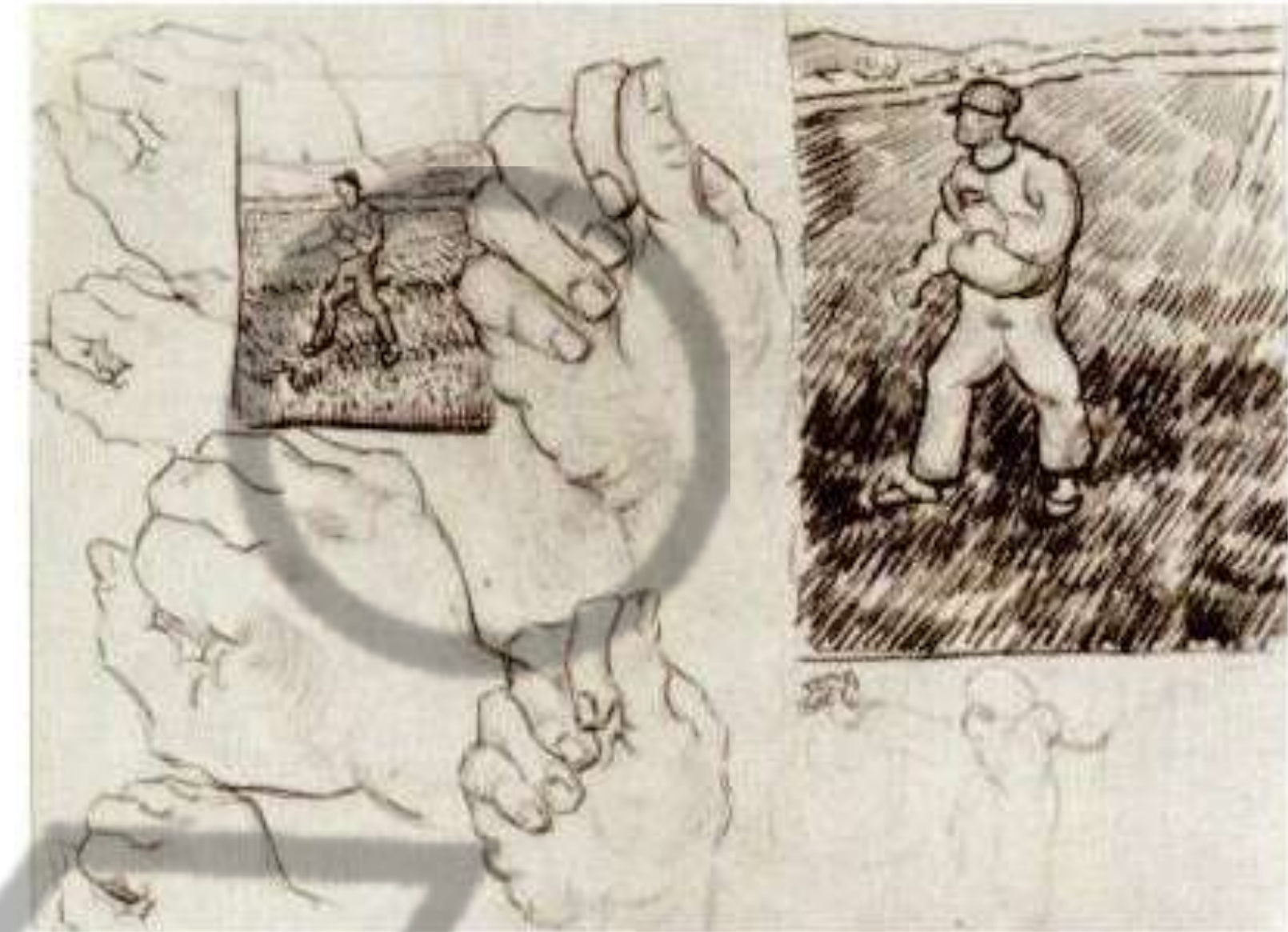


Vincent van Gogh Drawing, Pencil, black chalk
Saint-Rémy: March - April, 1890
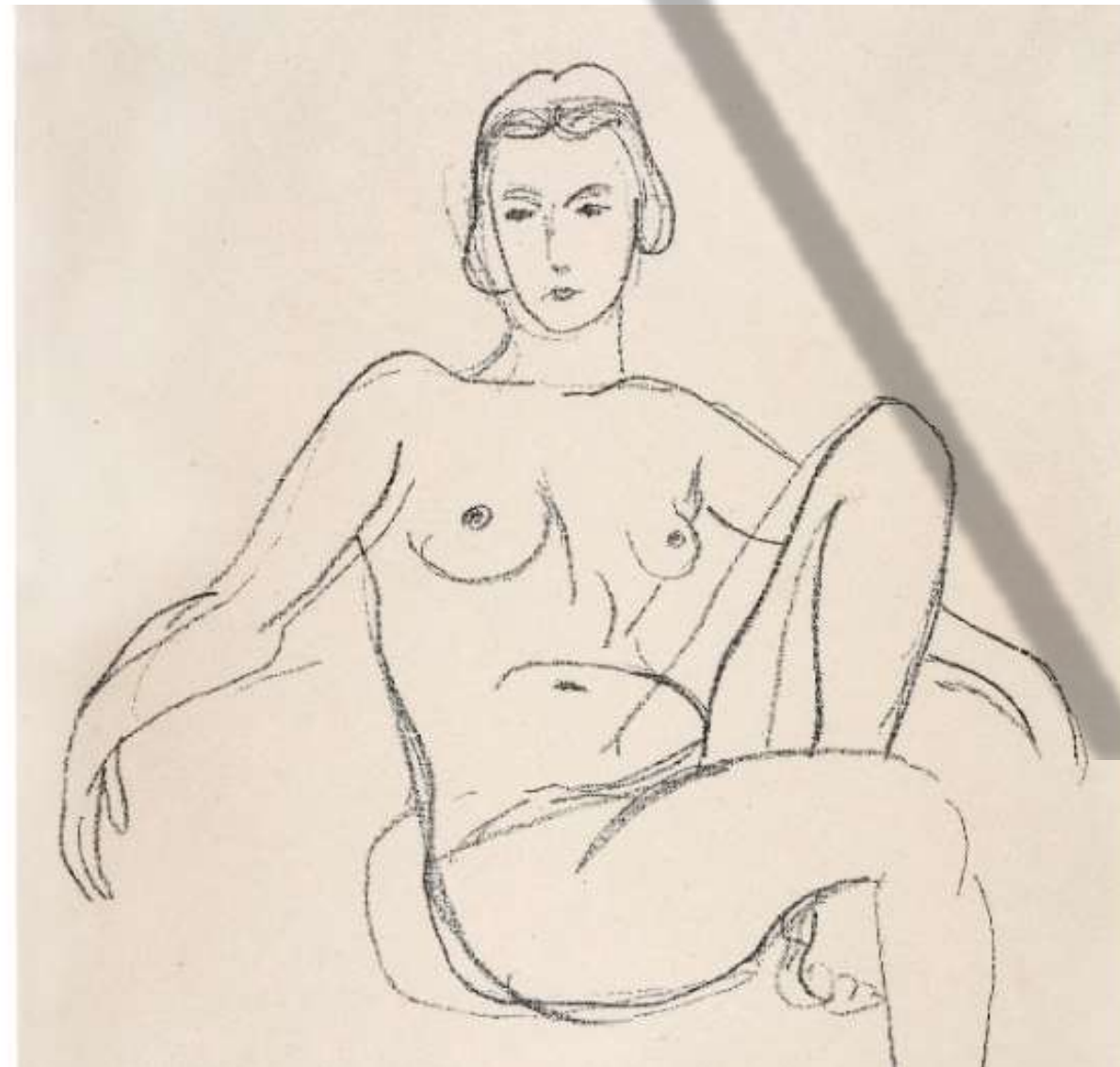


Henri Matisse. Nu assis les bras étendus
Print, Lithograph, Expressionist 1925



Gauguin's Sketchbook

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**MAILAB**
Multimedia
Architecture
Interaction

**The post environmental age and the agent based computational design**

# DRAWING



Mario Ridolfi, Casa De Bonis, 1971
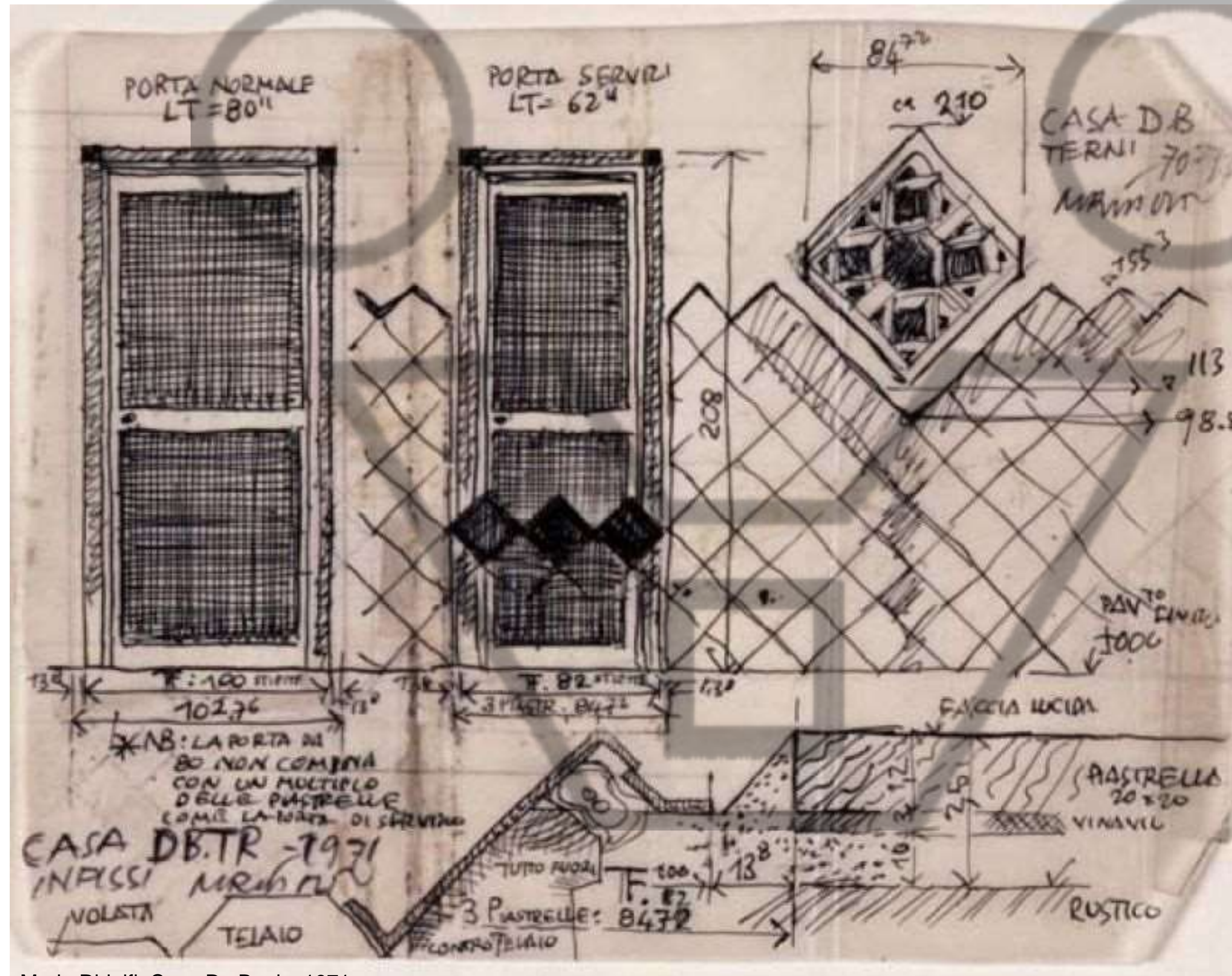
**Drawing has a more thoughtful character and its exceution is based on a form of planning represented by the use of construction lines. It is detailed although it can be freehand**
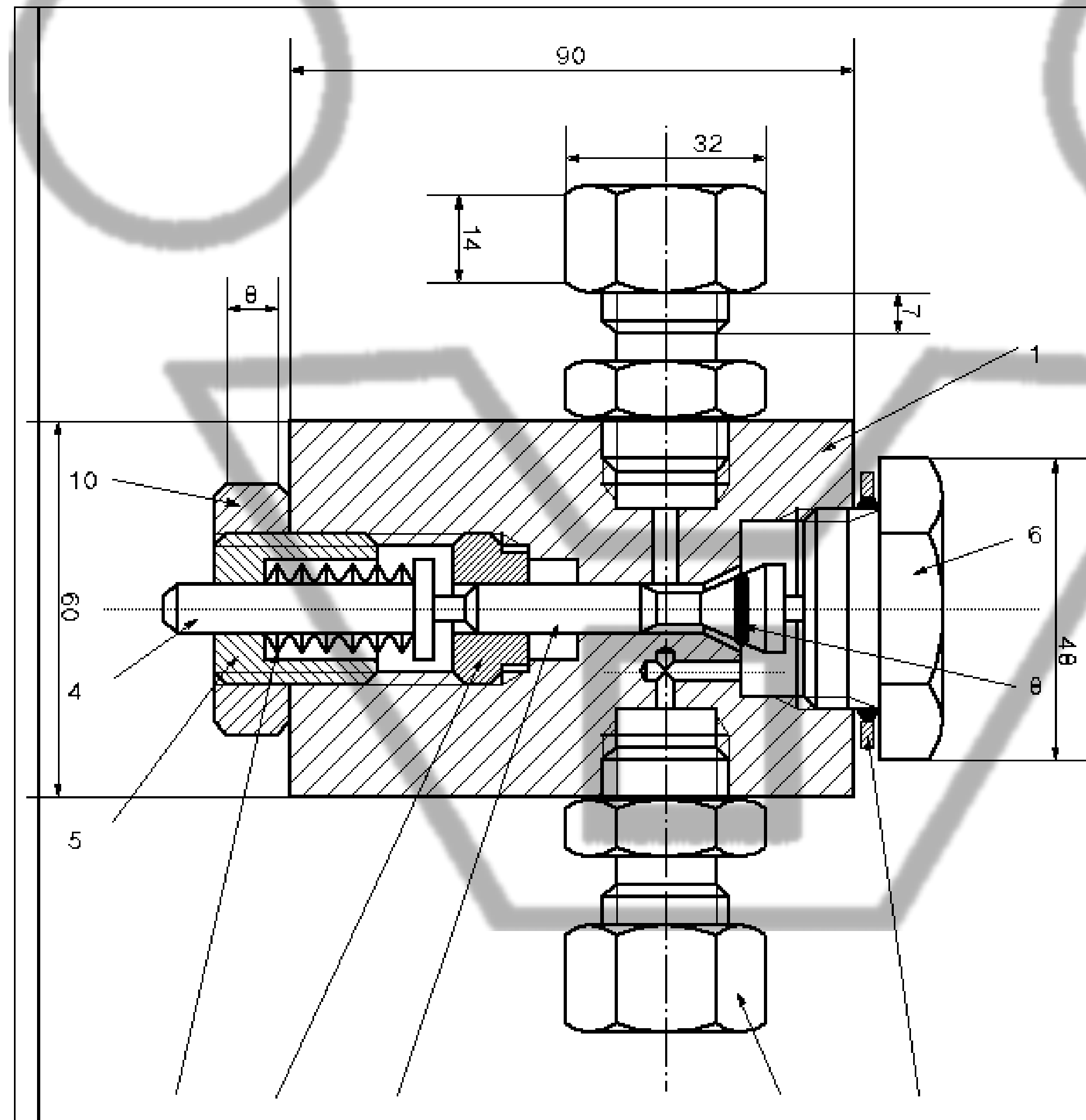
# DRAFTING



**Drafting is the act of producing drawings based on calculation, measure, and precision.**
**It is a technical activity in which the design idea come alive in an accurate and formal representation intended for the production of the conceived objects.**

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

# DESIGNING



Walter Gropius. the Expansible House.
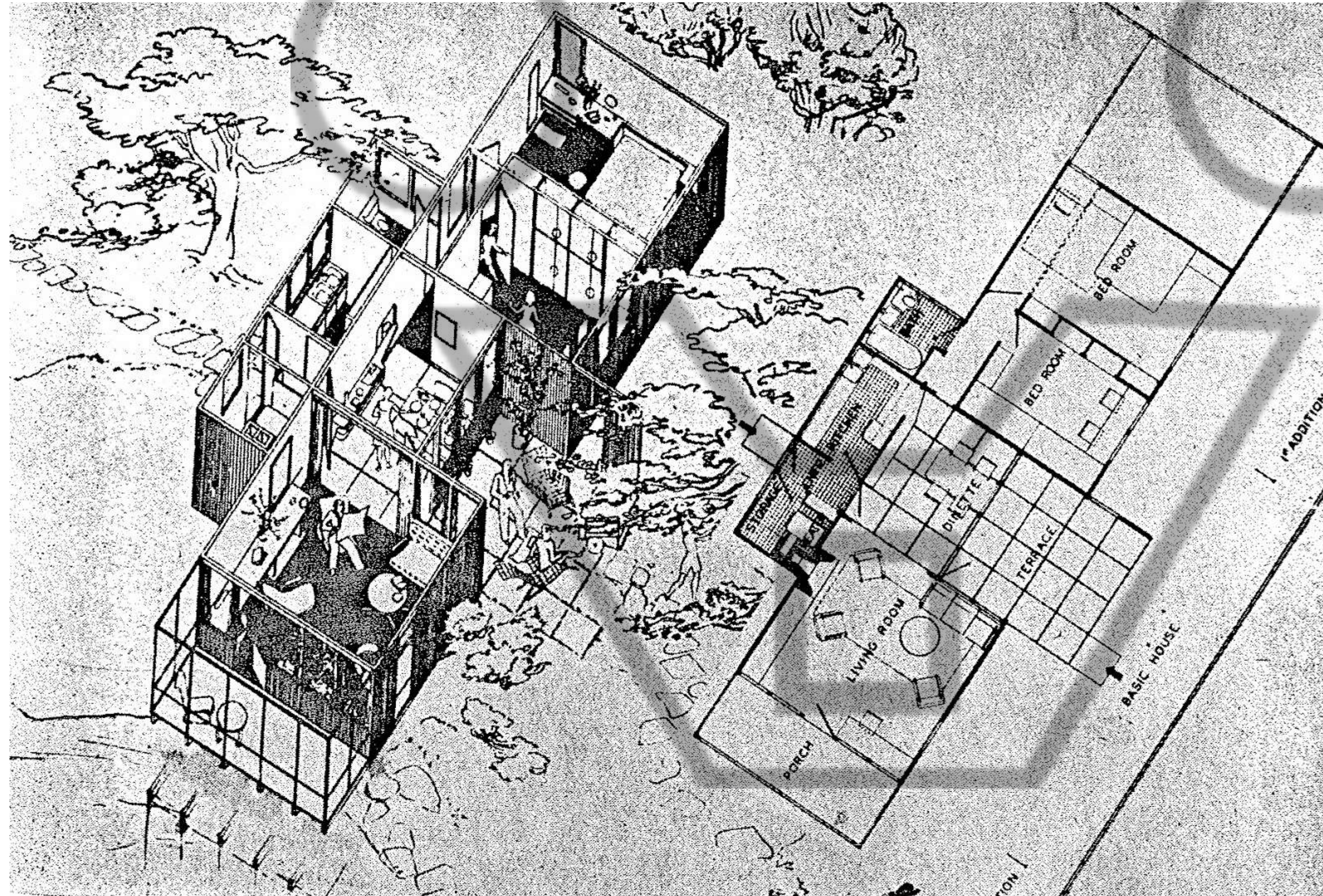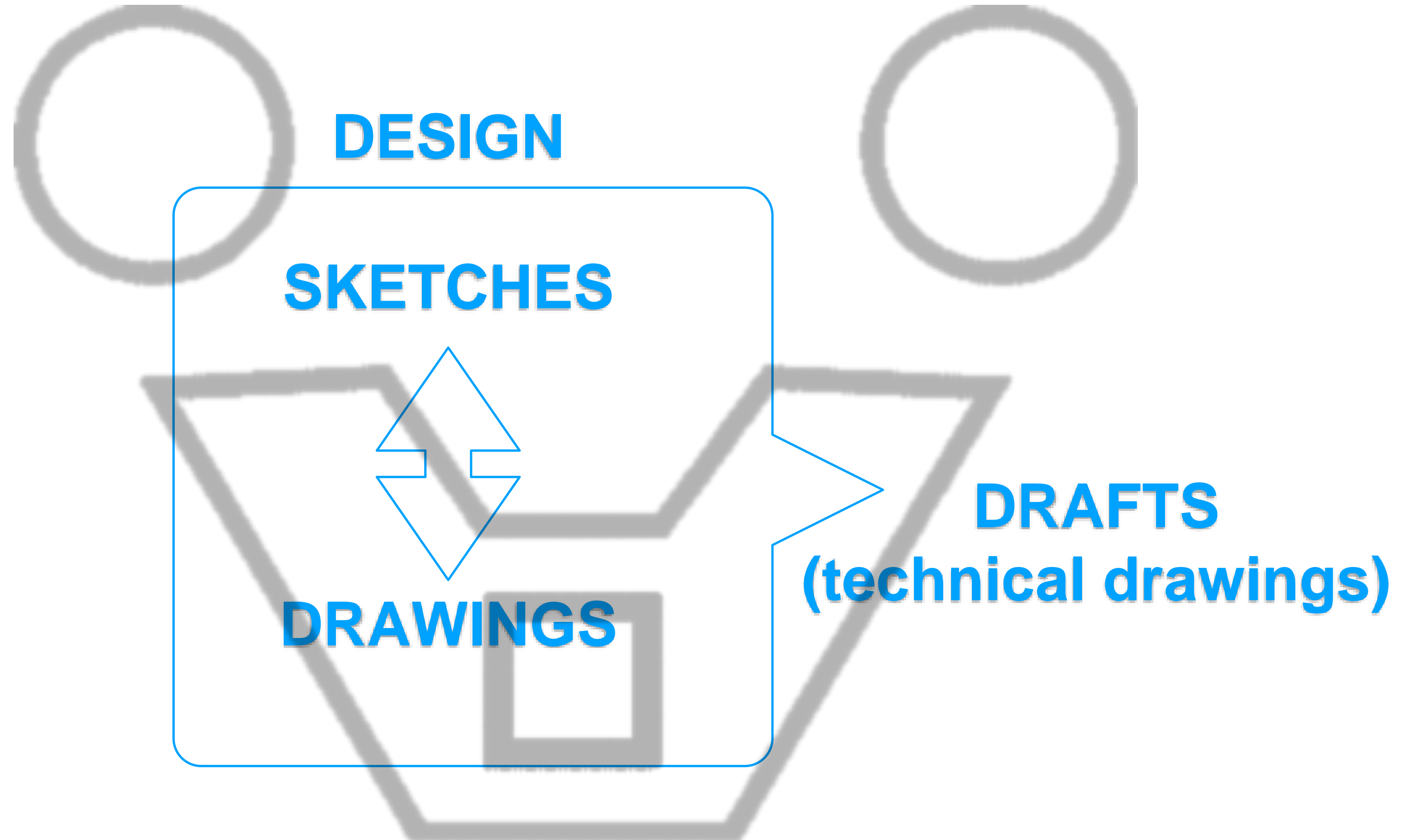
**Design is the process of generating and presenting ideas and projects through forms and tools of the visual language fitting expectd goals and requirements.**

UNIVERSITÀ DEGLI STUDI FIRENZE
DIDA DIPARTIMENTO DI ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the  agent based computational design



DESIGN

SKETCHES

DRAWINGS

DRAFTS
(technical drawings)

**MAILAB**
Multimedia
Architecture
Interaction
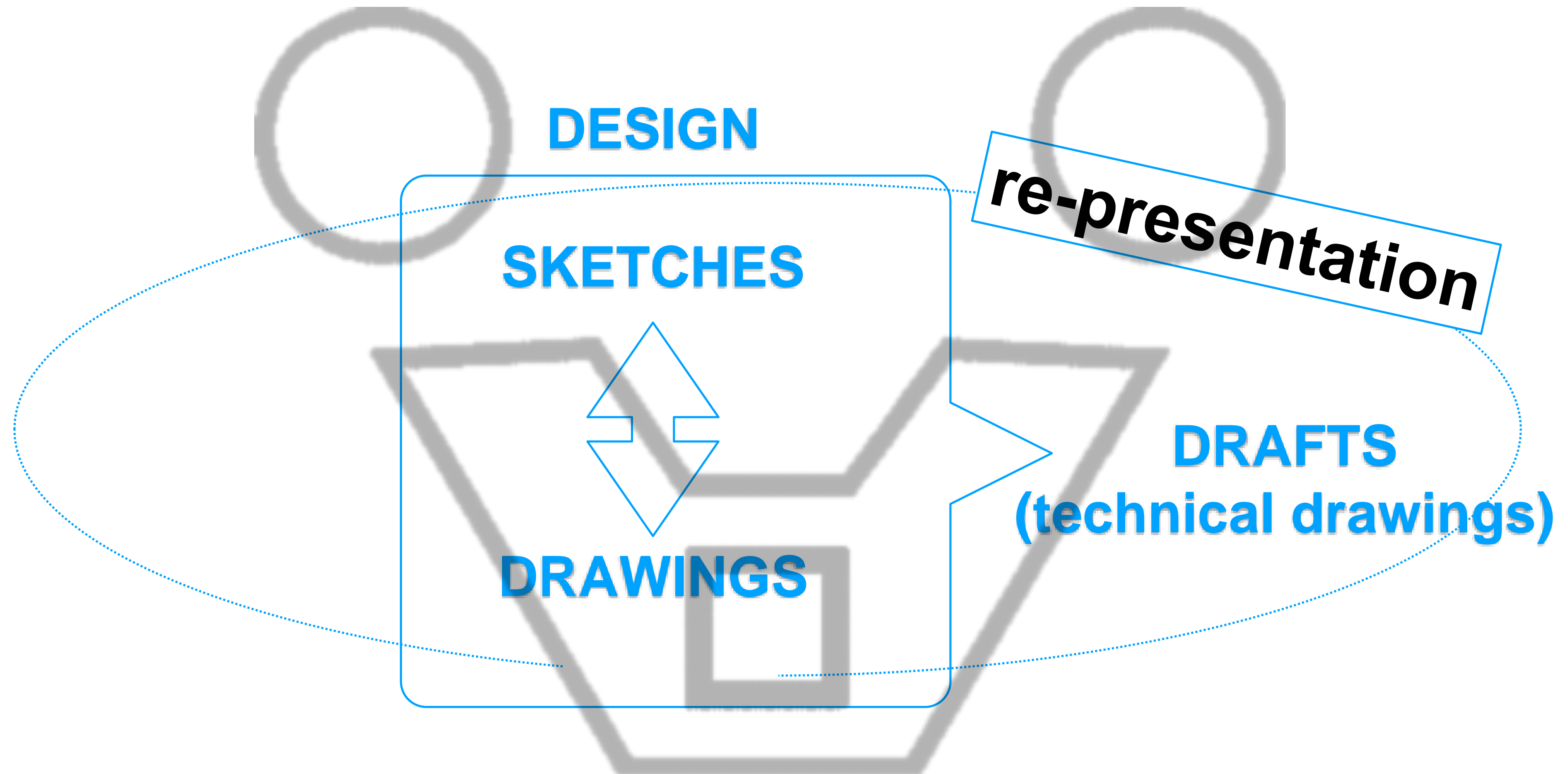
MAILAB
Multimedia
Architecture
Interaction
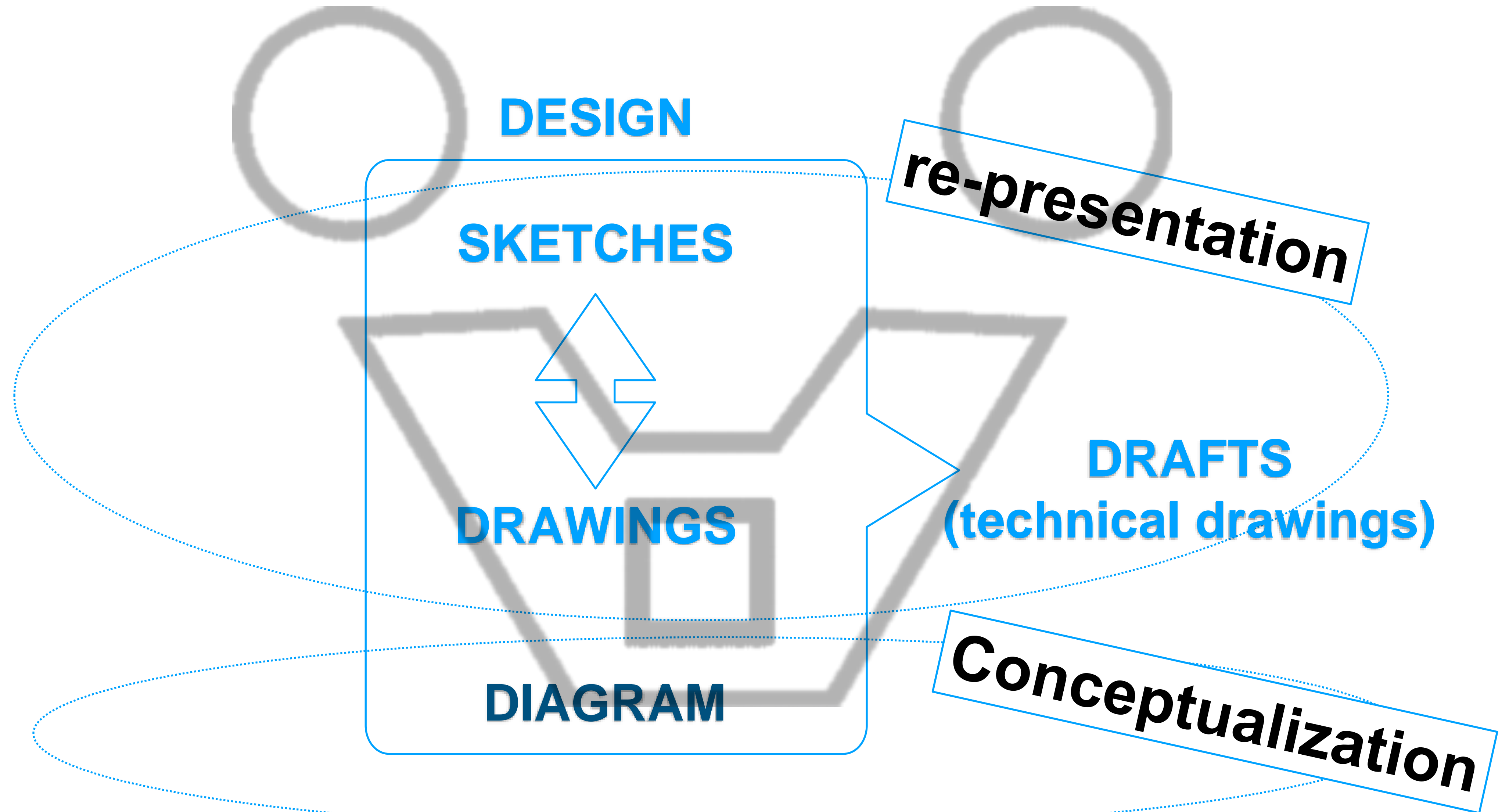
# DIAGRAM: THE ABSTRACT MACHINE    *..a map of relations between forces"*

Deleuze, A Thousand Plateaus (1988)
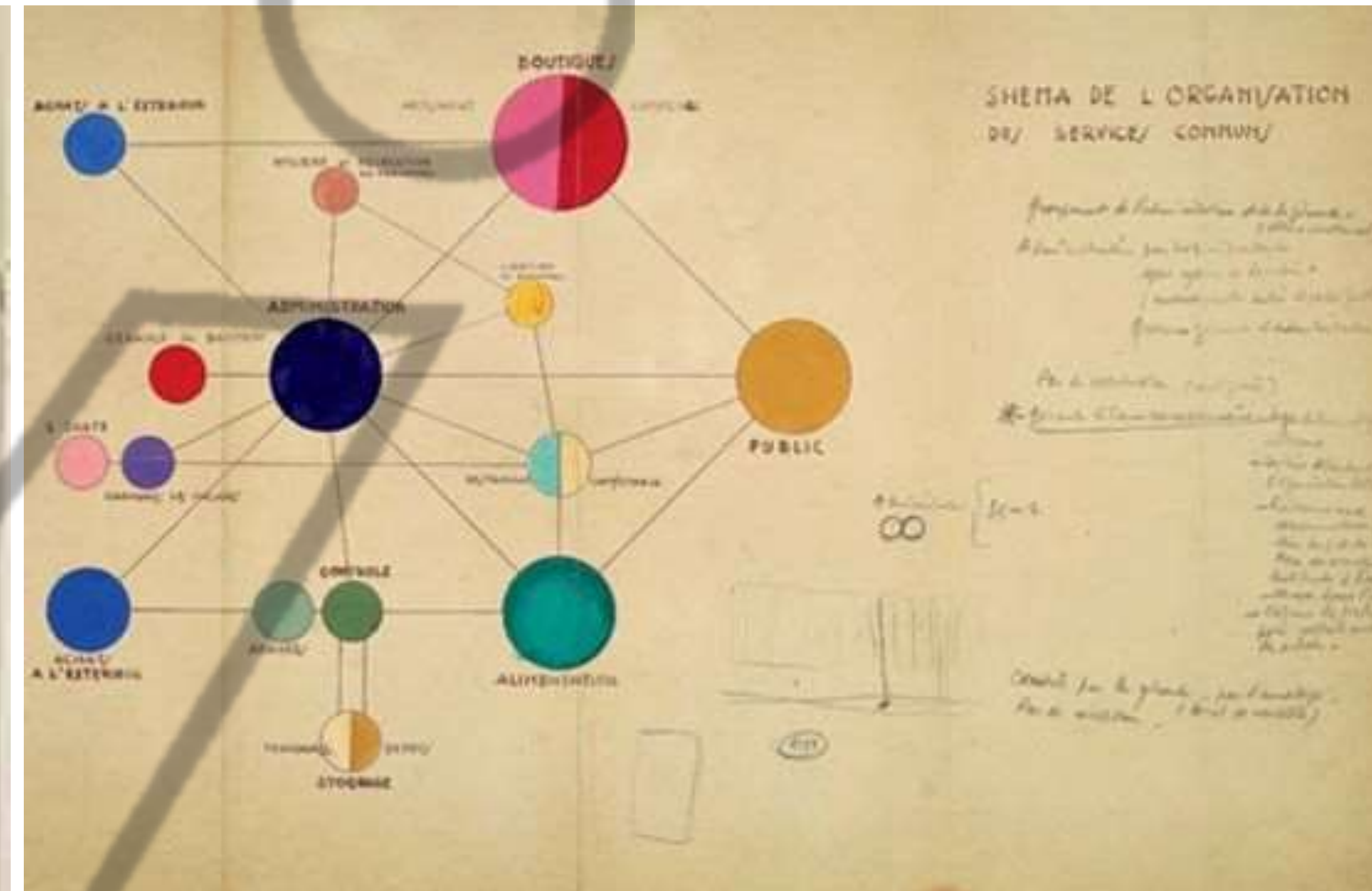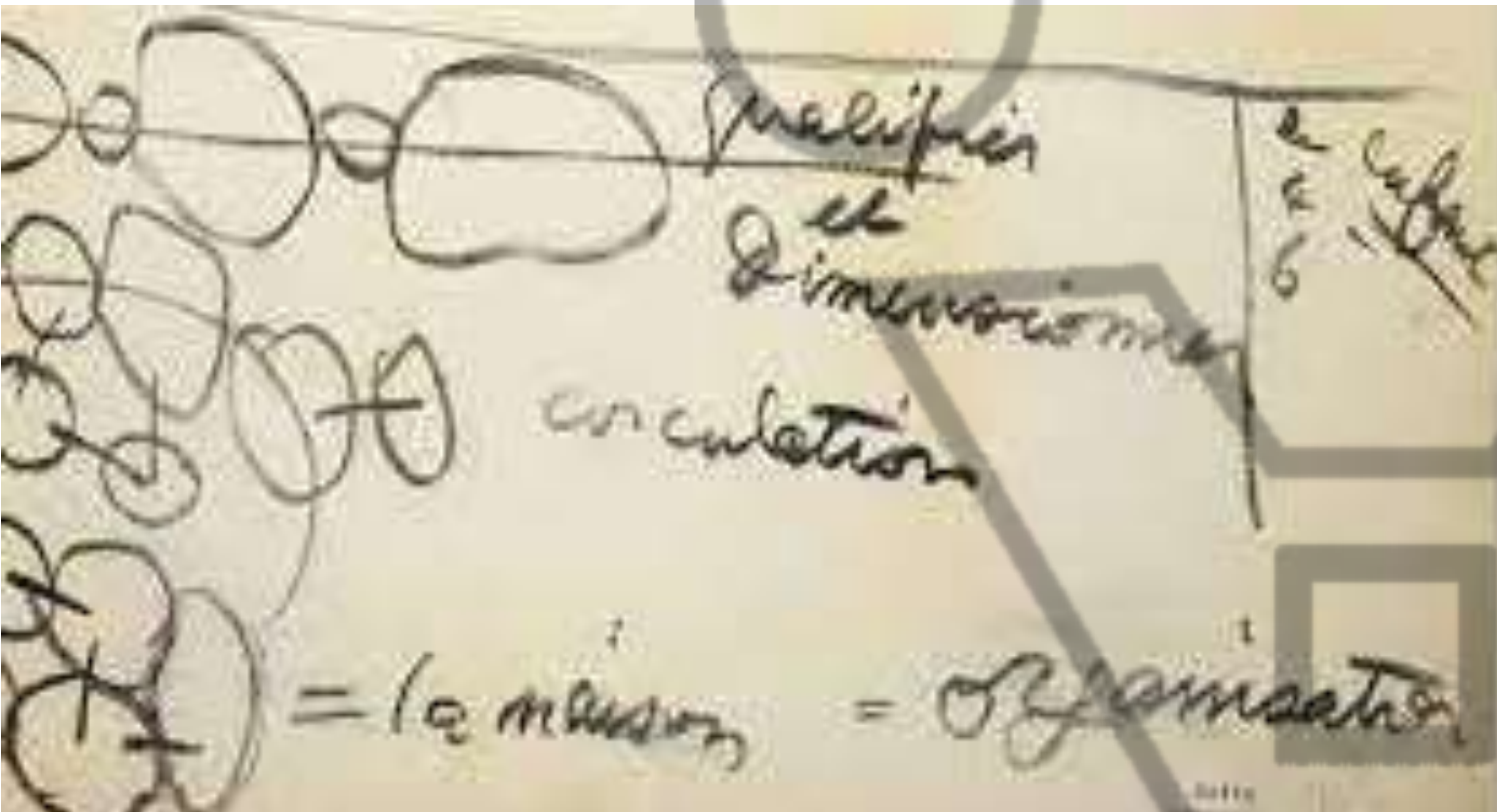


Le Corbousier's diagrammatic studies

UNIVERSITÀ DEGLI STUDI FIRENZE

DIDA
DIPARTIMENTO DI
ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**
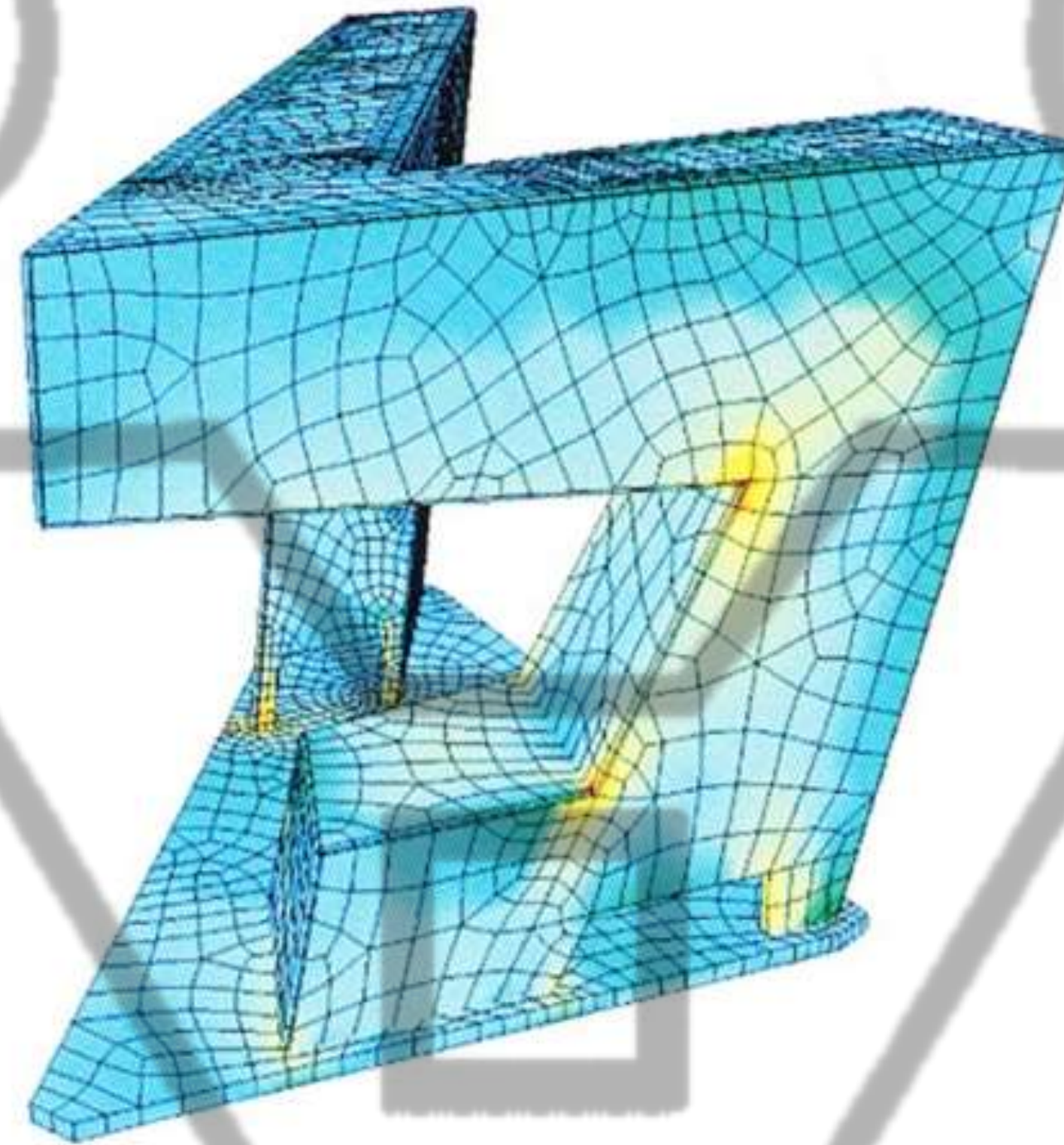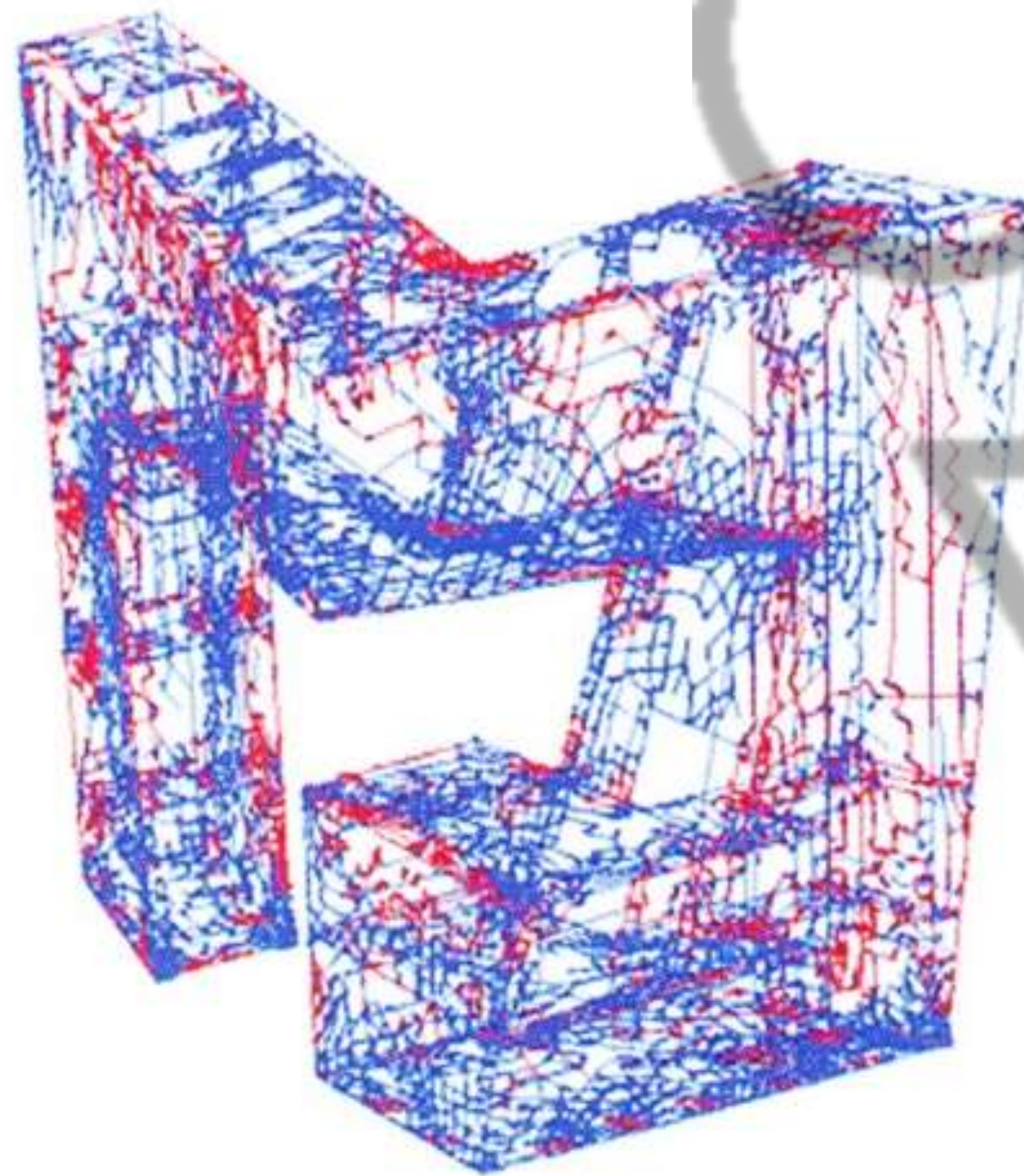
# MODEL



AKT, South Bank Pavilion (Zaha Hadid). Load paths. © Adams Kara Taylor (AKT).

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# ISOMORPHIC MODELS

**Morfological Model or "Depictional" representation**

*Simulation in order to understand how it looks*

Filippo Brunelleschi, Modello ligneo
Cupola del Duomo, 1420-1440 circa,
Firenze, Museo dell'Opera di Santa
Maria del Fiore
Ph. Antonio Quattrone

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design
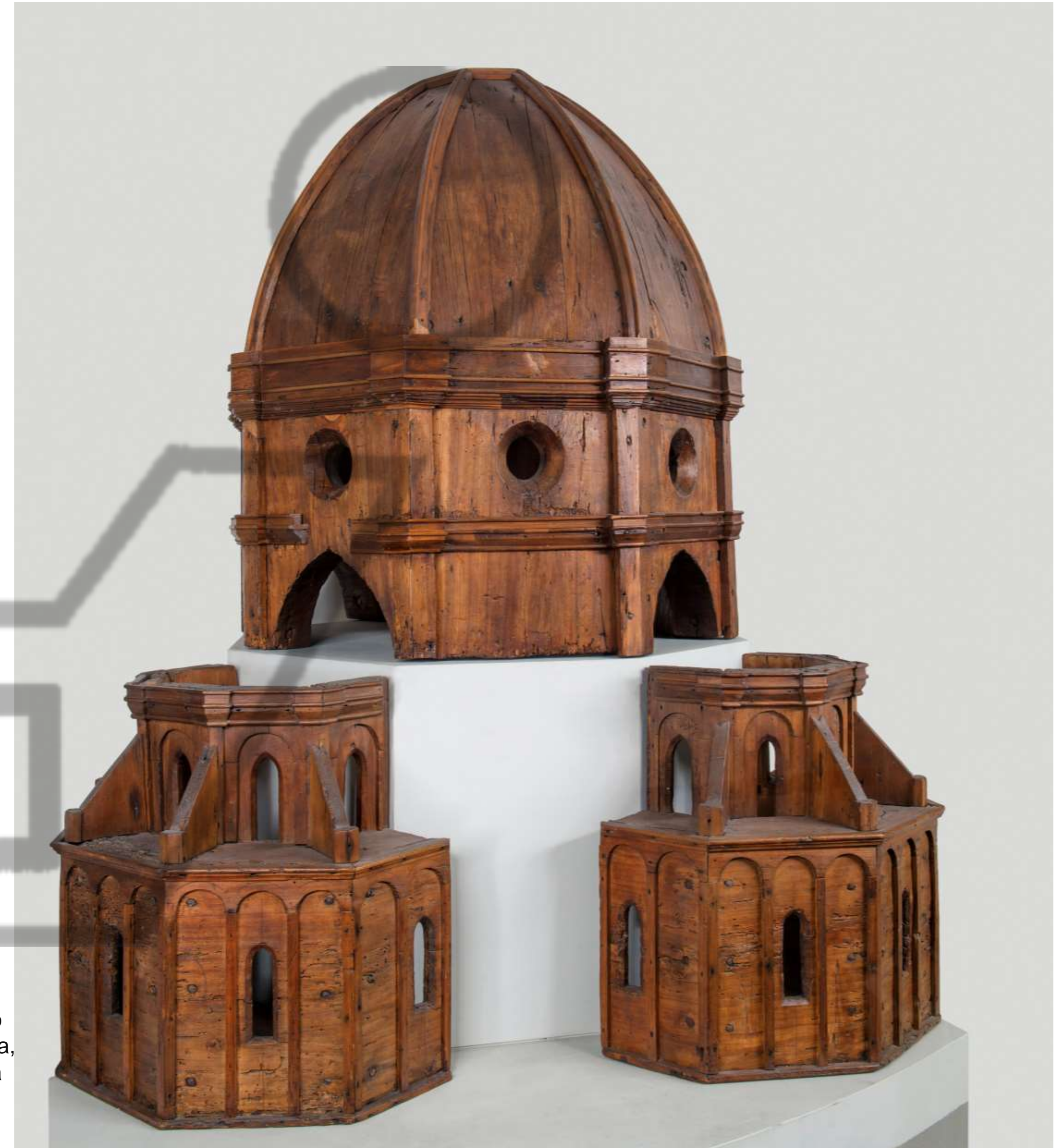
# A SCALED MODEL AS AN EXPERIMENTAL SIMULATION
## to understand how reality behaves



Massimo Ricci, Modello in scala della Cupola di
S. Maria del Fiore in Firenze
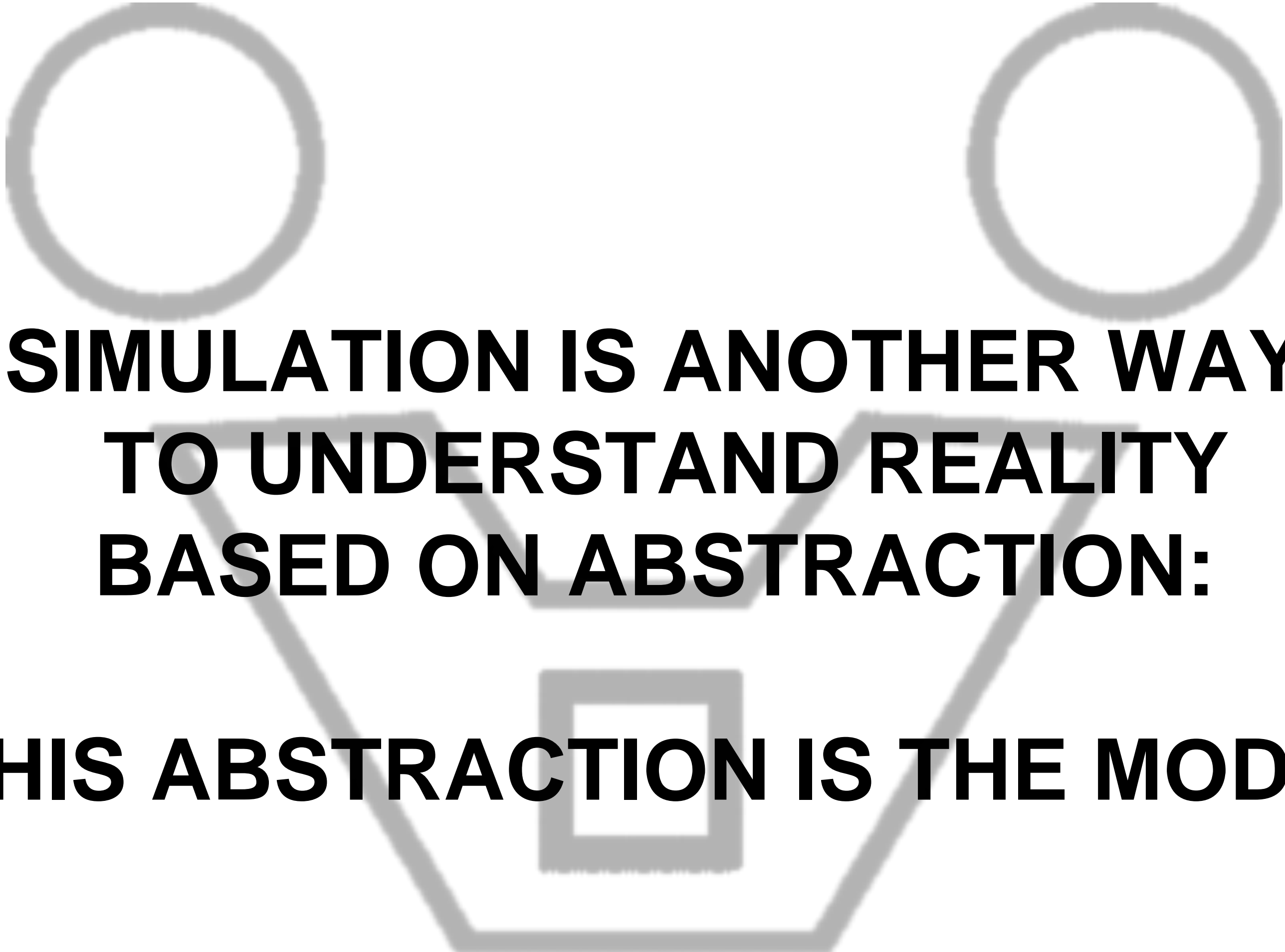
*Normally, simulation differentiate itself from experiment where experiment is conducted on reality itself, using the same matter while simulation operates through the interposition of other and different materials.*

*Traditionally models and simulations are mainly representative, experiments are descriptive.*

MAILAB

Multimedia
Architecture
Interaction

*"Design is not just what it looks like and feels like. Design is how it works."*

**S. Jobs (1955-2011)**

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

**SIMULATION IS ANOTHER WAY
TO UNDERSTAND REALITY
BASED ON ABSTRACTION:**

**THIS ABSTRACTION IS THE MODEL**

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

# Functionality and Performance Design

## MODELS TO VISUALIZE MATTER BEHAVIOURS

**ANALOGIC MODELS**

**VS**
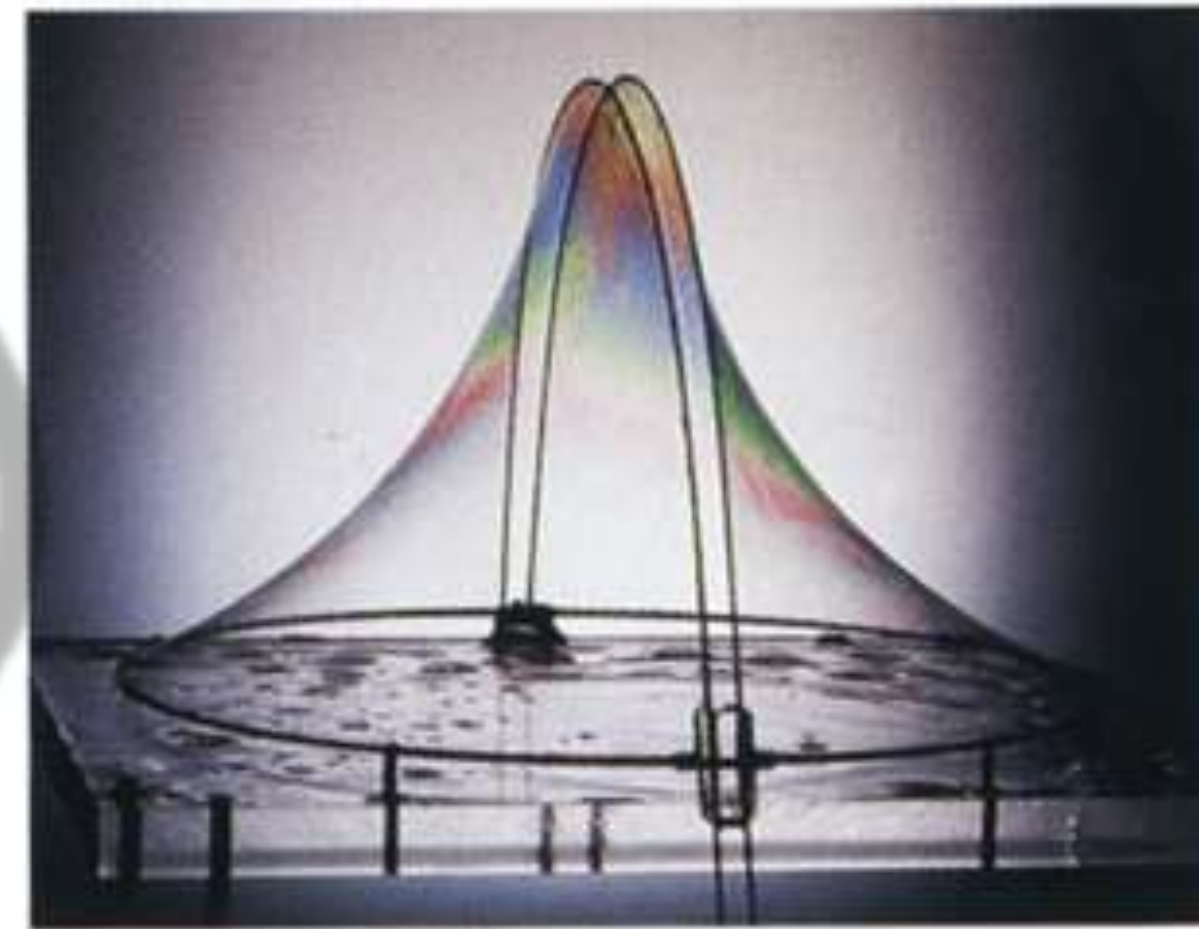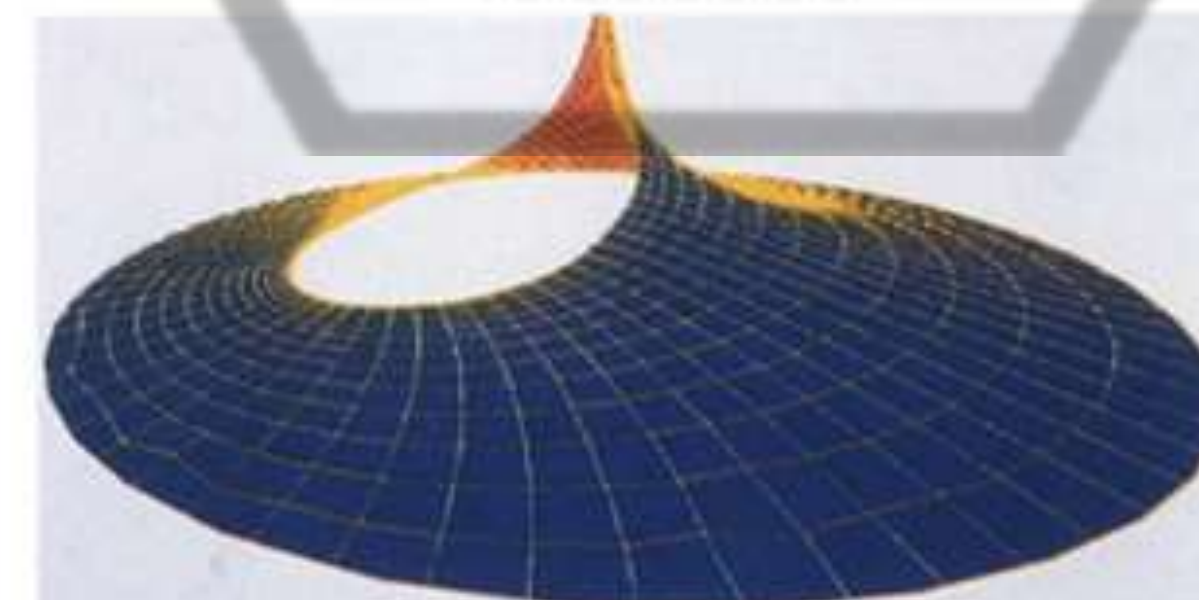
Frey Otto's studies & researches

1  Soap film model of an arch-supported membrane.

2  Soap-film model of a membrane surface with rope loop as its high point.

3  Computer simulation of a minimal surface with rope loop.

**DIGITAL MODEL**

UNIVERSITÀ
DEGLI STUDI
FIRENZE
DIDA
DIPARTIMENTO DI
ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# DYNAMIC MODELS & PARAMETRIC SIMULATION

## Static (informative)   vs   Dynamic (performative) Model



Antique map of the medioeval  Florence

Monopoly Game Board

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

# DYNAMIC MODELS & PARAMETRIC SIMULATION
# The Digital Modeling

**MANY DIFFERENT BEHAVIORS** FROM A PARAMETRIC MODEL



Warehouse 2 / False Colour Rendering
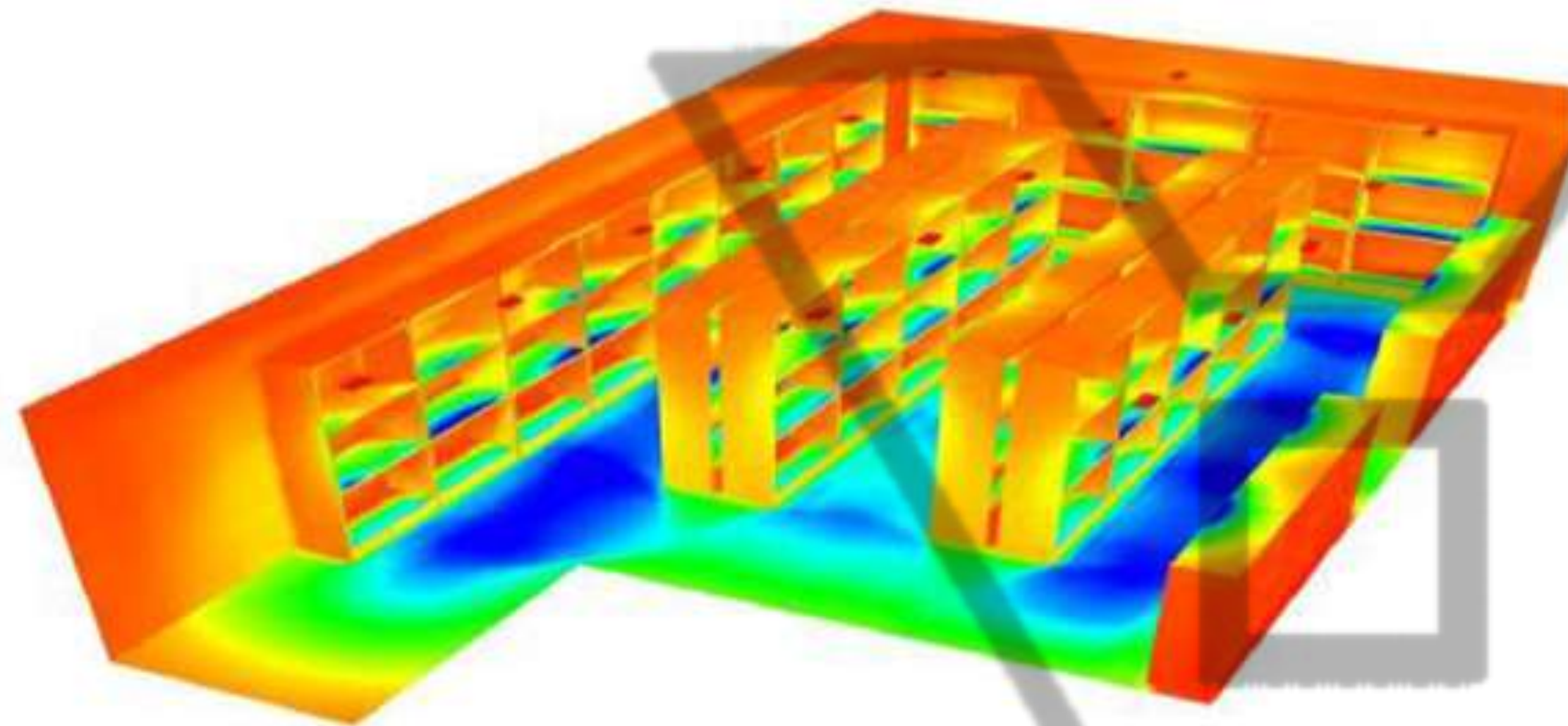
*"... digital tools give us an holistic and visual perception of fenomena in order to have a faster comprehension of a large quantity of aspects"* *G.Ridolfi*

**MAILAB**
Multimedia
Architecture
Interaction
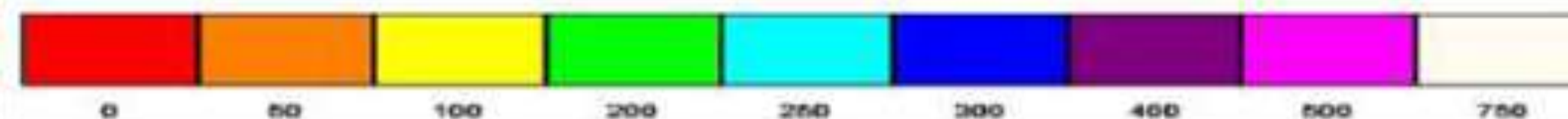
# DYNAMIC MODELS & PARAMETRIC SIMULATION

## PERMUTATIONAL OUTPUTS FROM A PARAMETRIC MODEL
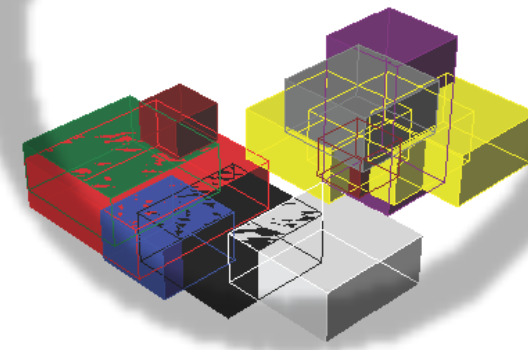


PERMUTATION 1
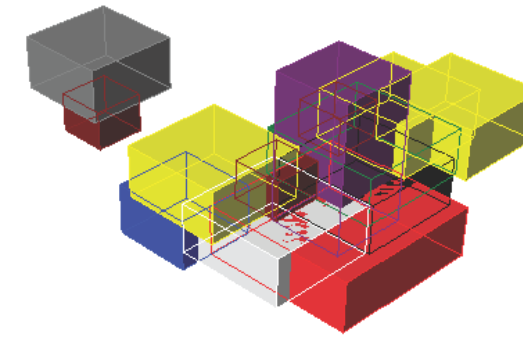
PERMUTATION 5
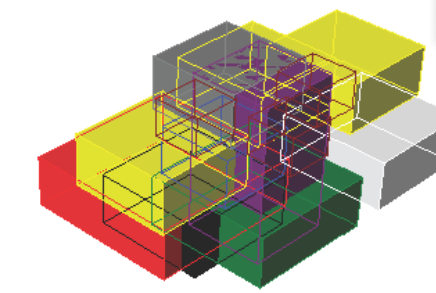
PERMUTATION 9
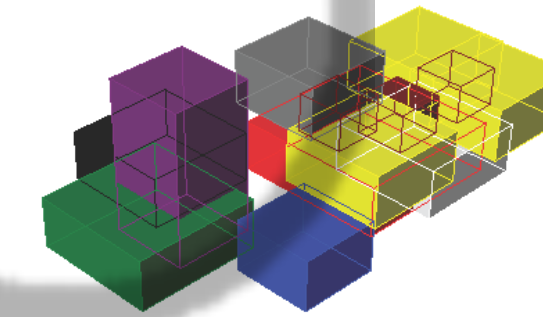
PERMUTATION 13
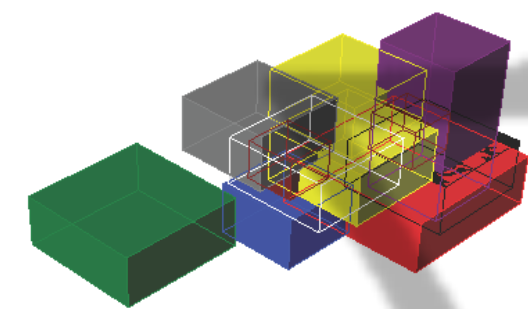
PERMUTATION 2
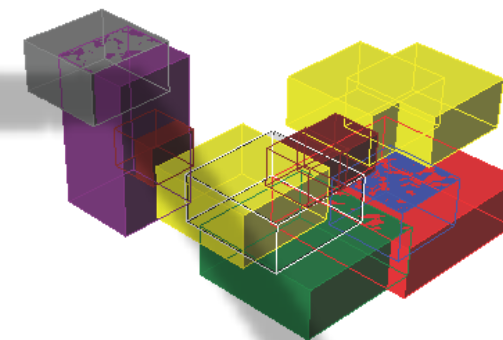
PERMUTATION 6
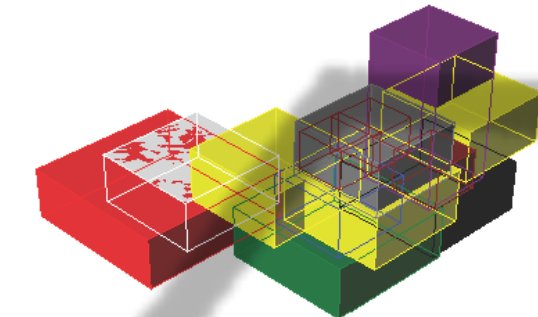
PERMUTATION 10
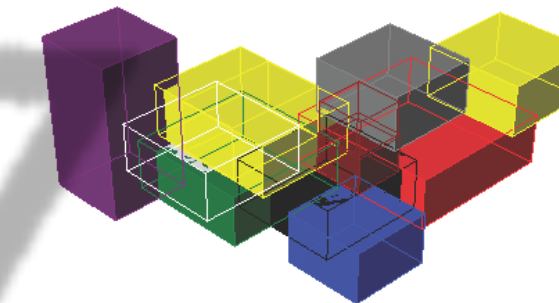
PERMUTATION 14
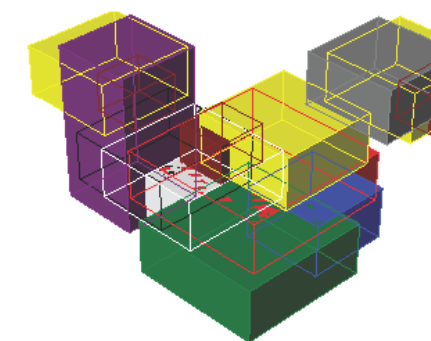
PERMUTATION 3
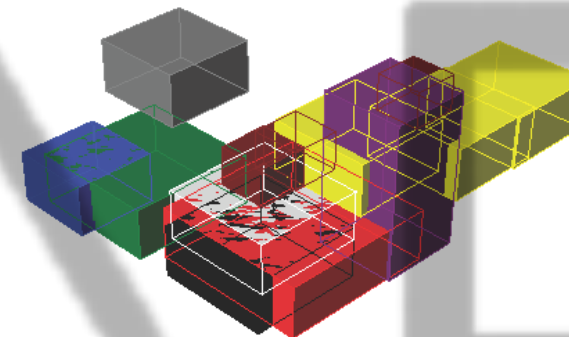
PERMUTATION 7
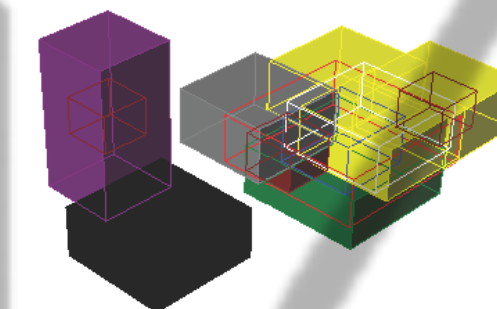
PERMUTATION 11
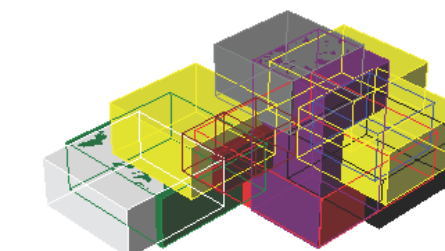
PERMUTATION 15
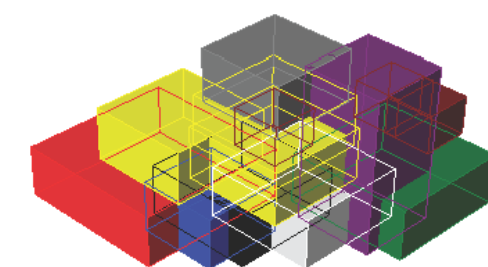
PERMUTATION 4
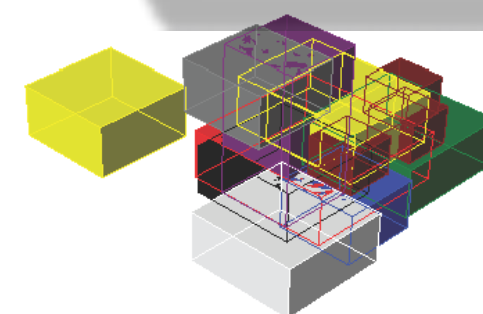
PERMUTATION 8
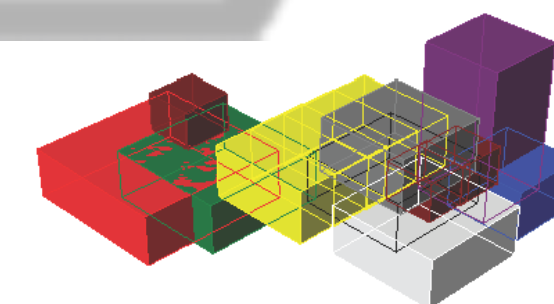
PERMUTATION 12

PERMUTATION 16

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**
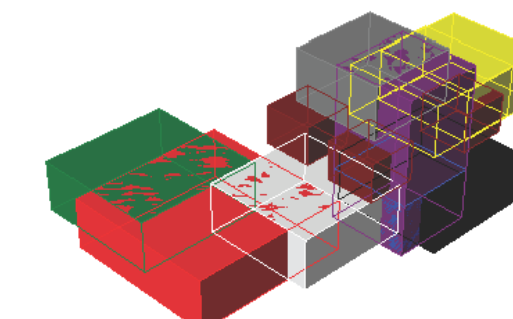
# DYNAMIC MODELS & PARAMETRIC SIMULATION

DIGITAL DATA EVIDENCE BASED DESIGN

# Designing as a scientific process
(*Decision making testing – through  different simulations – variable conditions*)

# What if ?

MAILAB

Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

# Testing the trade-off in order to be aware of how configurations and elements can affect behaviors and produce different results

MAILAB

Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

# INFORMATIVE BIM
## VS
# PERFORMATIVE BIM
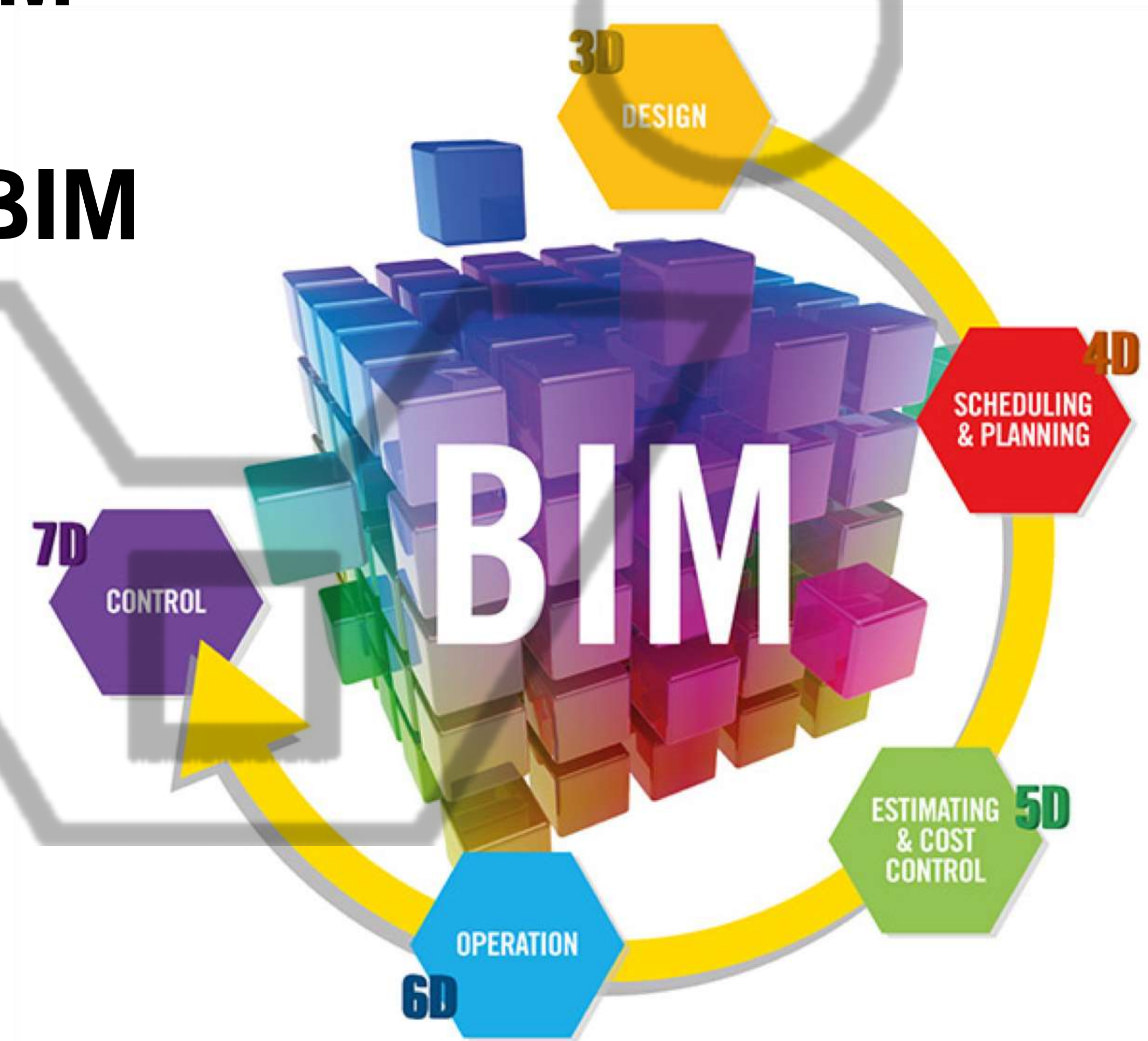
**BIM** DIGITAL OBJECTS PARAMETRICALLY INTERRELATED FOR AUTOMATION, COLLABORATION AND DECISION MAKING
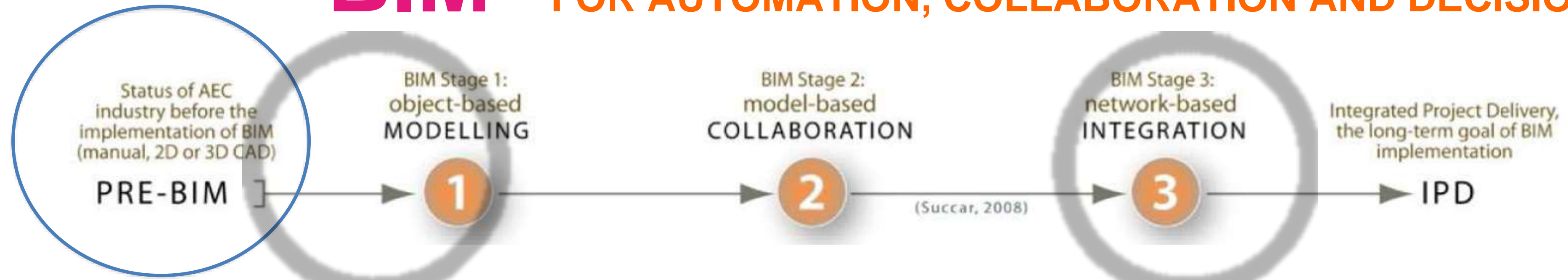
ELEMENTS / LIBRARIES

DATASET OF FACTS & PERFORMANCES
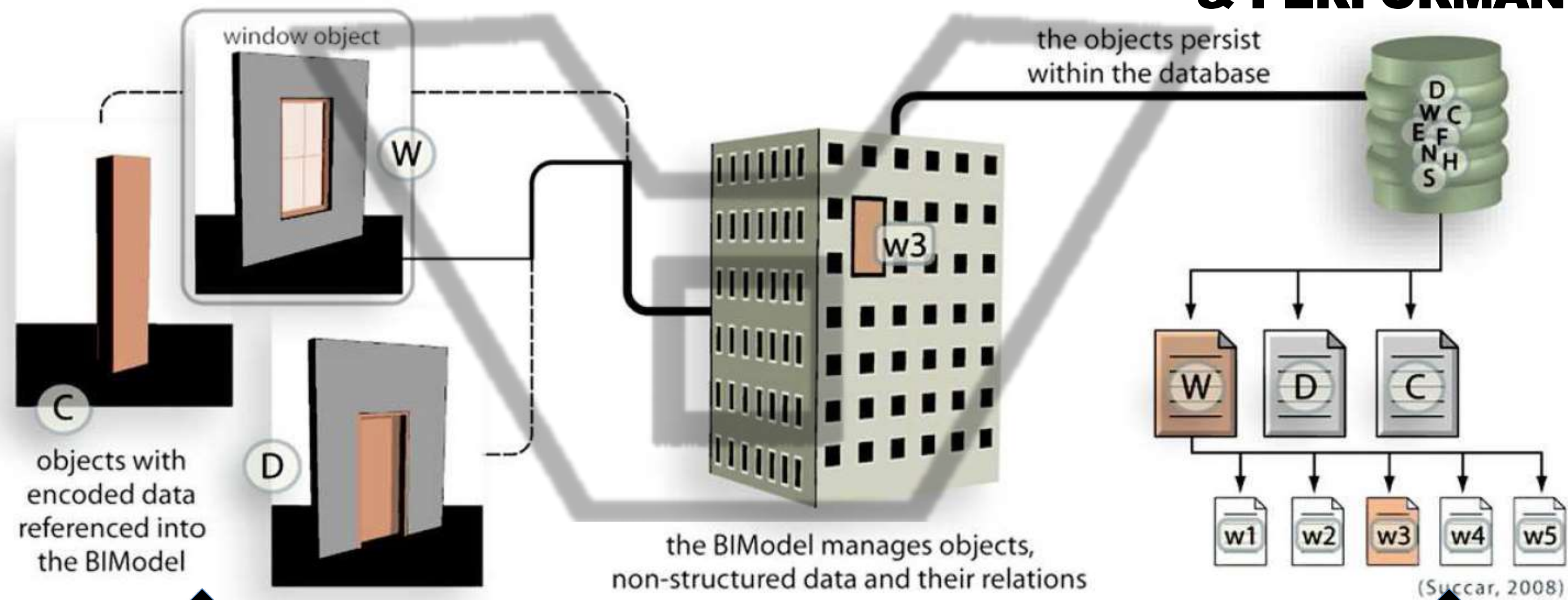
THE WHOLE MODEL AS A SYSTEM WHERE THE INTERACTION TAKES PLACE

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# INFORMATIVE BIM
## Modeling to increases productivity & reliability

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# PERFORMATIVE BIM
## Modeling to run explorative simulations



Develop evacuation, contingency- and mobility plans

54.47
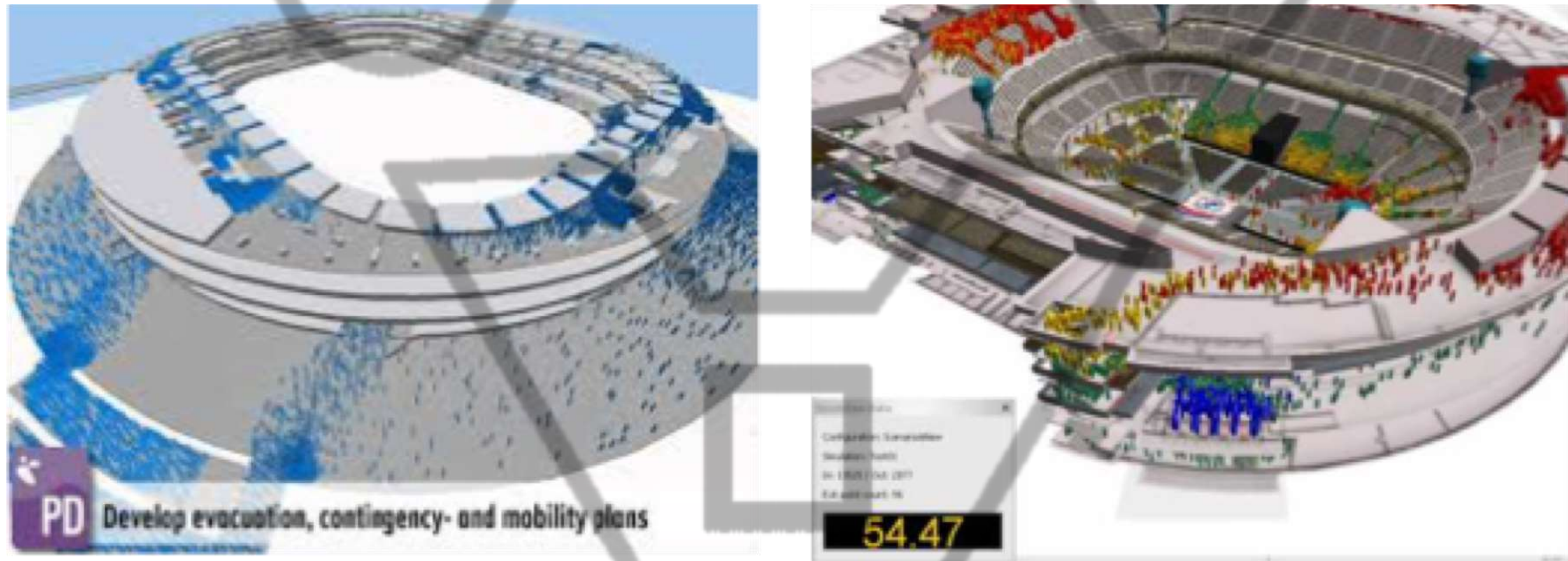
**Evacuation Planning Tool (EPT) for Emergency, Event**

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# "Don't fight forces, use them".

R. Buckminster Fuller



LOW TRAFFIC          HIGH TRAFFIC
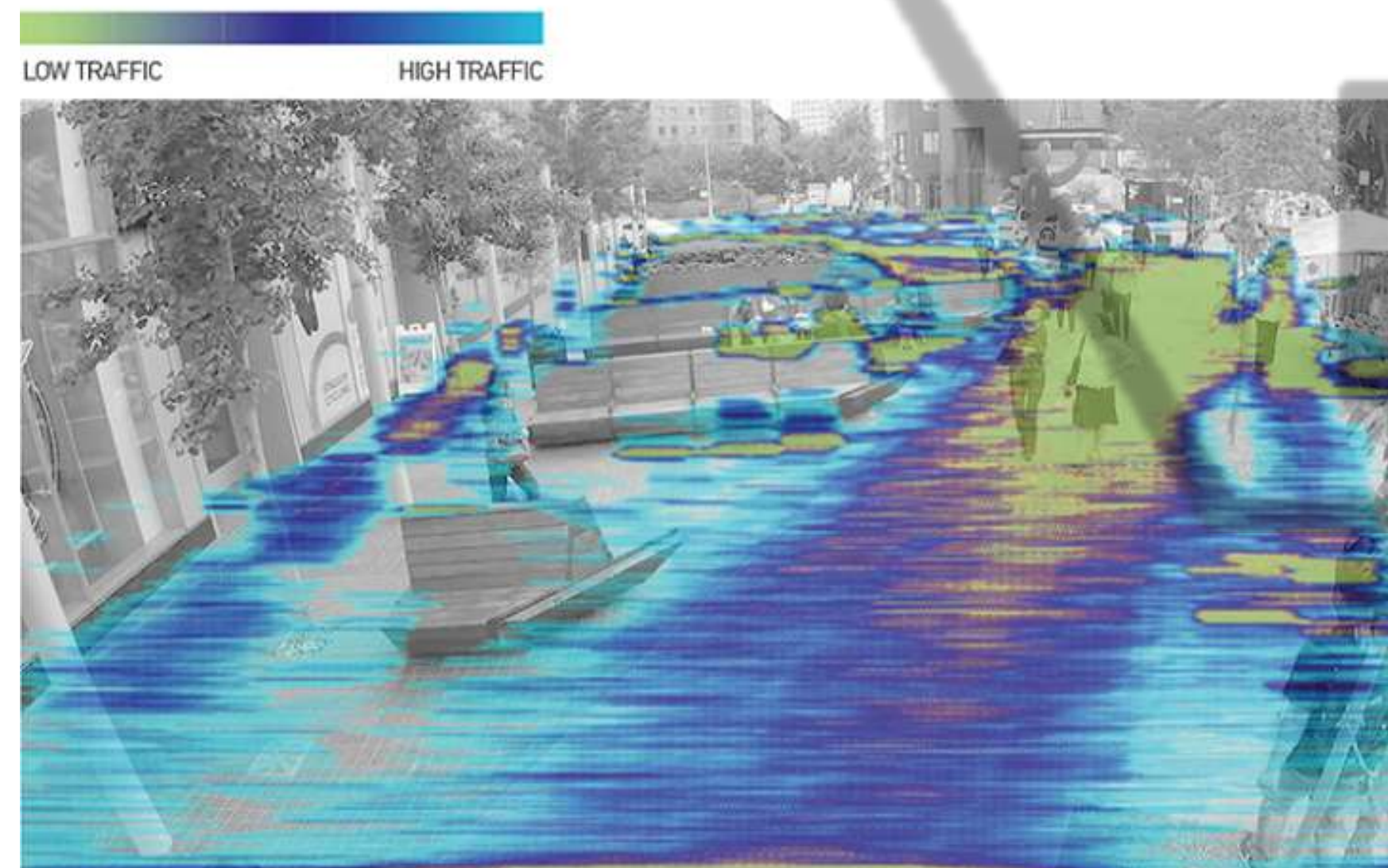


*"Modeling reality will no longer be entrusted to wax, gypsum or wood, but to mathematics of algorithms"*

Parametric computation, generative algorithms and artificial intelligence are the products that open up promising trajectories for Design since they are able to conduct exploration of solutions beyond the already known, the rule of art, and norms.

**MAILAB**
Multimedia
Architecture
Interaction



Asymptote H. Rashid & L. A. Coture, *New York Virtual Stock Exchange*, 2001
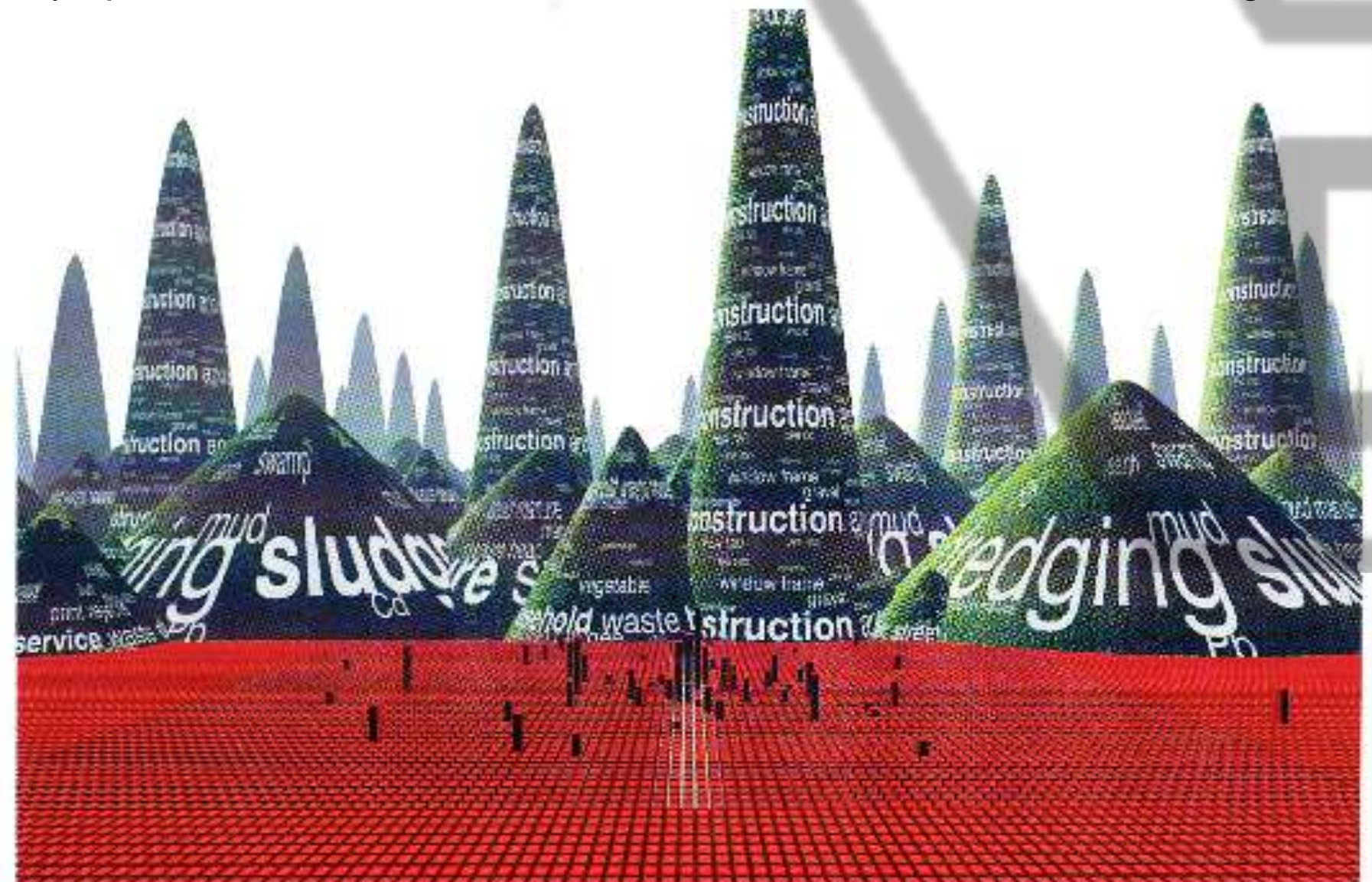


MVRDV, Metacity Datatown -Sector Waste, 1999

## DIGITALIZATION / DATATIZATION:
### *DATA DRIVEN DESIGN /*

**Parametric Modeling and Performance-Based Design,** emerging in the linguistic-architectural phenomenologies of Parametricism (Schumacher, 2008),

**A new Co-evolutionist organicism** «in the sense that each and every part is interacting with each other» (Lynn, 2004, p. 12).

In an open criticism of modernist reductionism, Parametricism is the manifestation of an **a-hierarchical and cooperative vision** of architectural elements that allow the overcoming of modularity and series opening up to unexpected differentiations.

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

# VISUAL SCRIPTING for DIGITAL MODELING
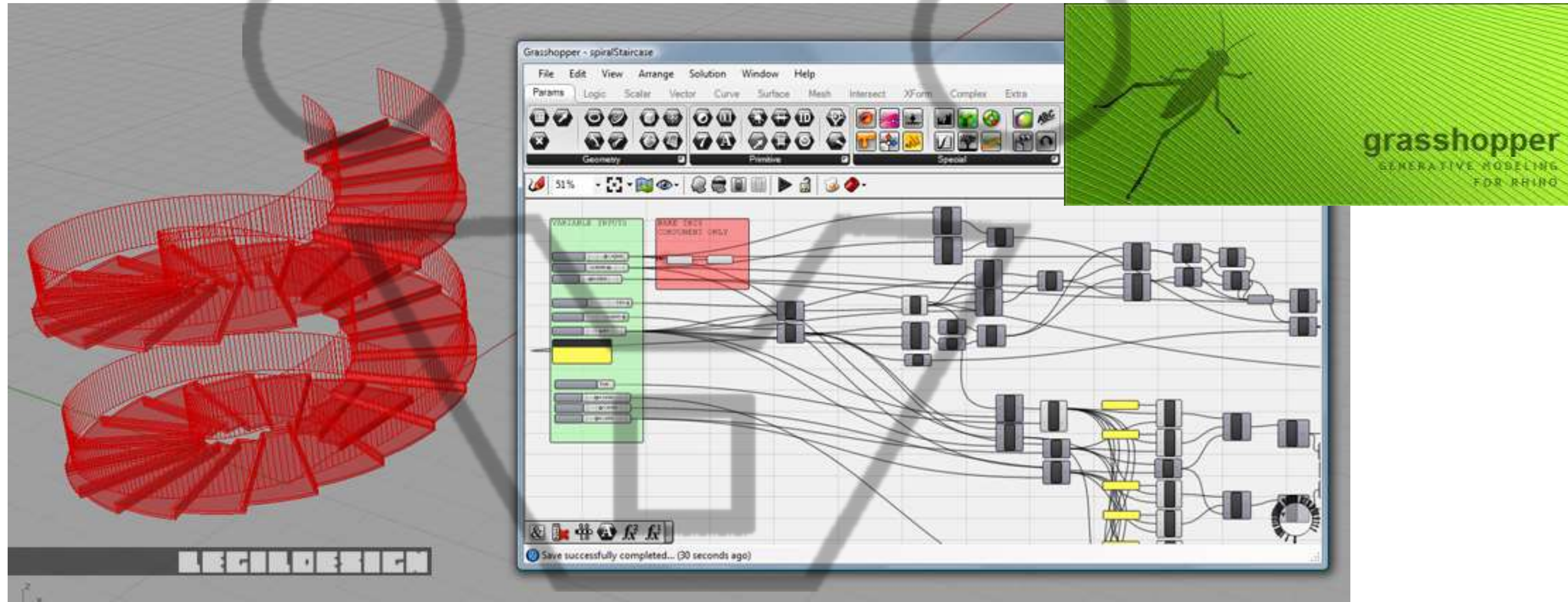


The increased availability of cheap calculations and user-friendly simplification of tools have amplified this power by offering a vast plethora of users interested in the generation of virtual models on which to conduct explorations of the new.

A significant role in this democratization in access to Computational Design is thanks to the introduction of fistr introduced by Grasshopper (2007), later emulated by Autodesk with the launch of Dynamo in 2011 and lately by Nemetschek with Marionette for Vectorworks (2015)

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

The post environmental age and the agent based computational design

part 3

Examples of Agent Based Design

in the Post Environmental Age

UNIVERSITÀ
DEGLI STUDI
FIRENZE
DIDA
DIPARTIMENTO DI
ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

SANSEPOLCRO

MAILAB
Multimedia
Architecture
Interaction

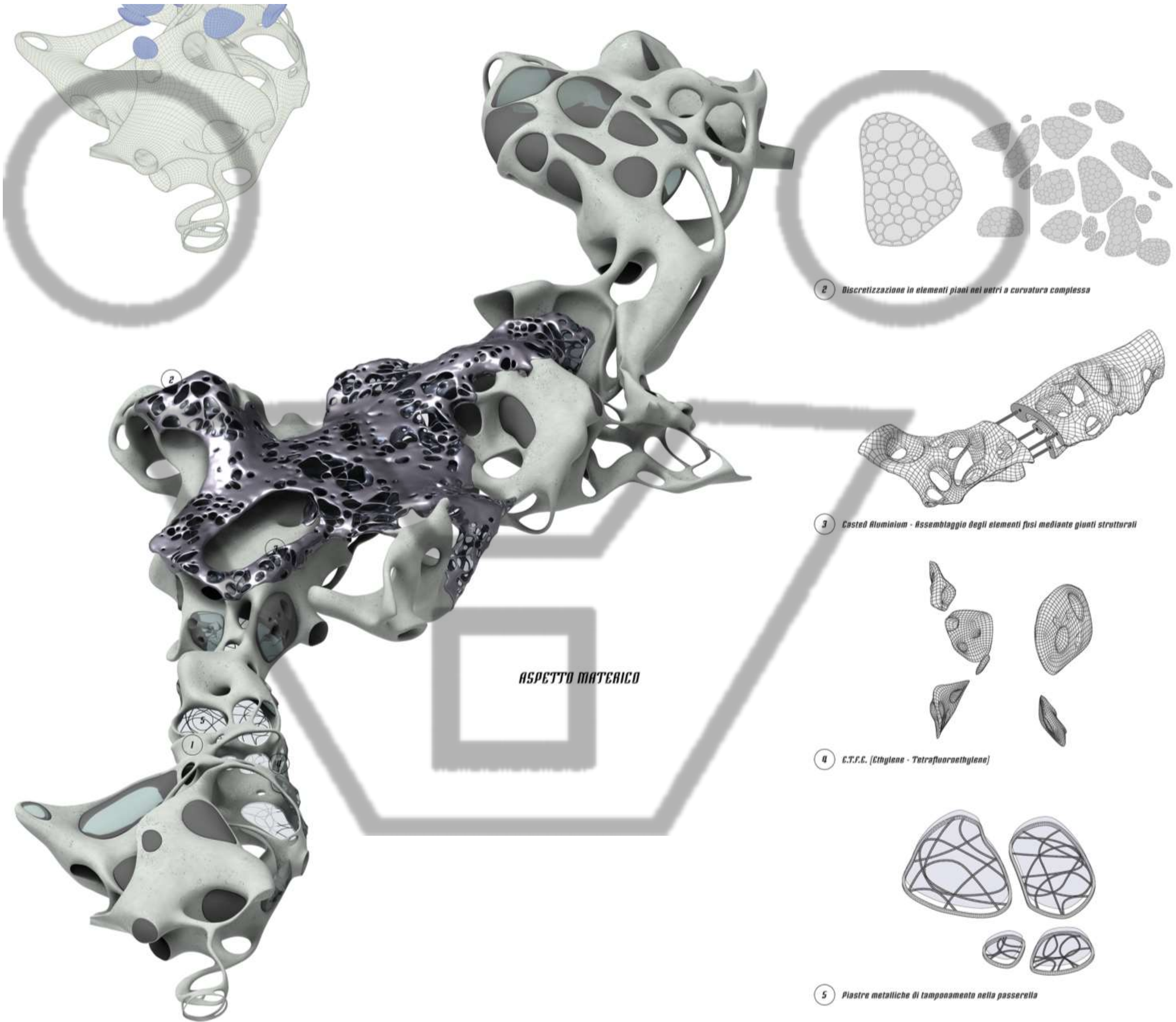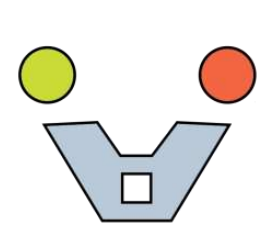G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**The post environmental age and the agent based computational design**

UNIVERSITÀ
DEGLI STUDI
FIRENZE
**DIDA**
DIPARTIMENTO DI
ARCHITETTURA
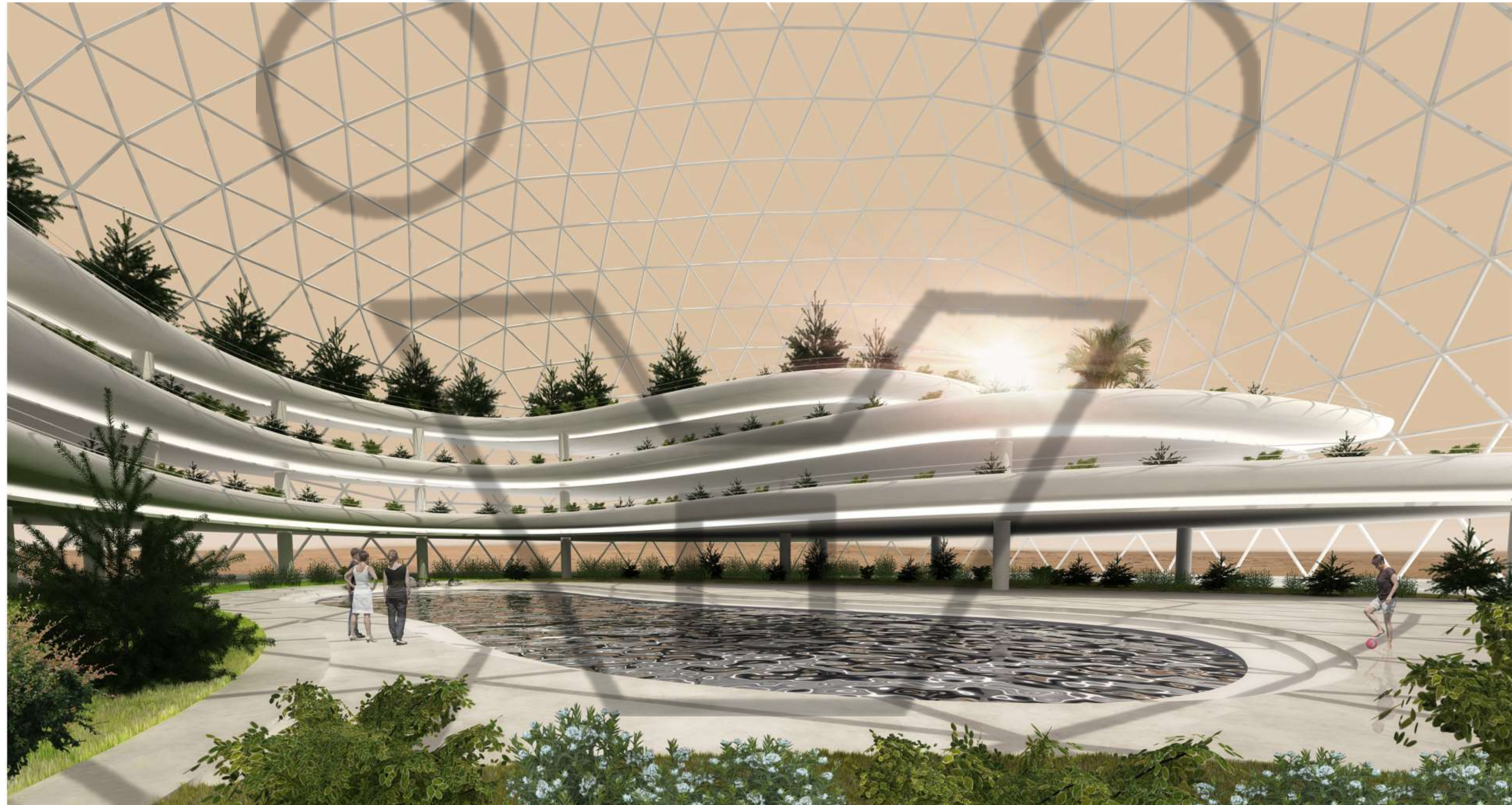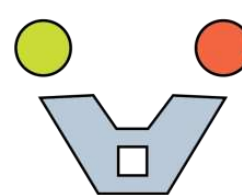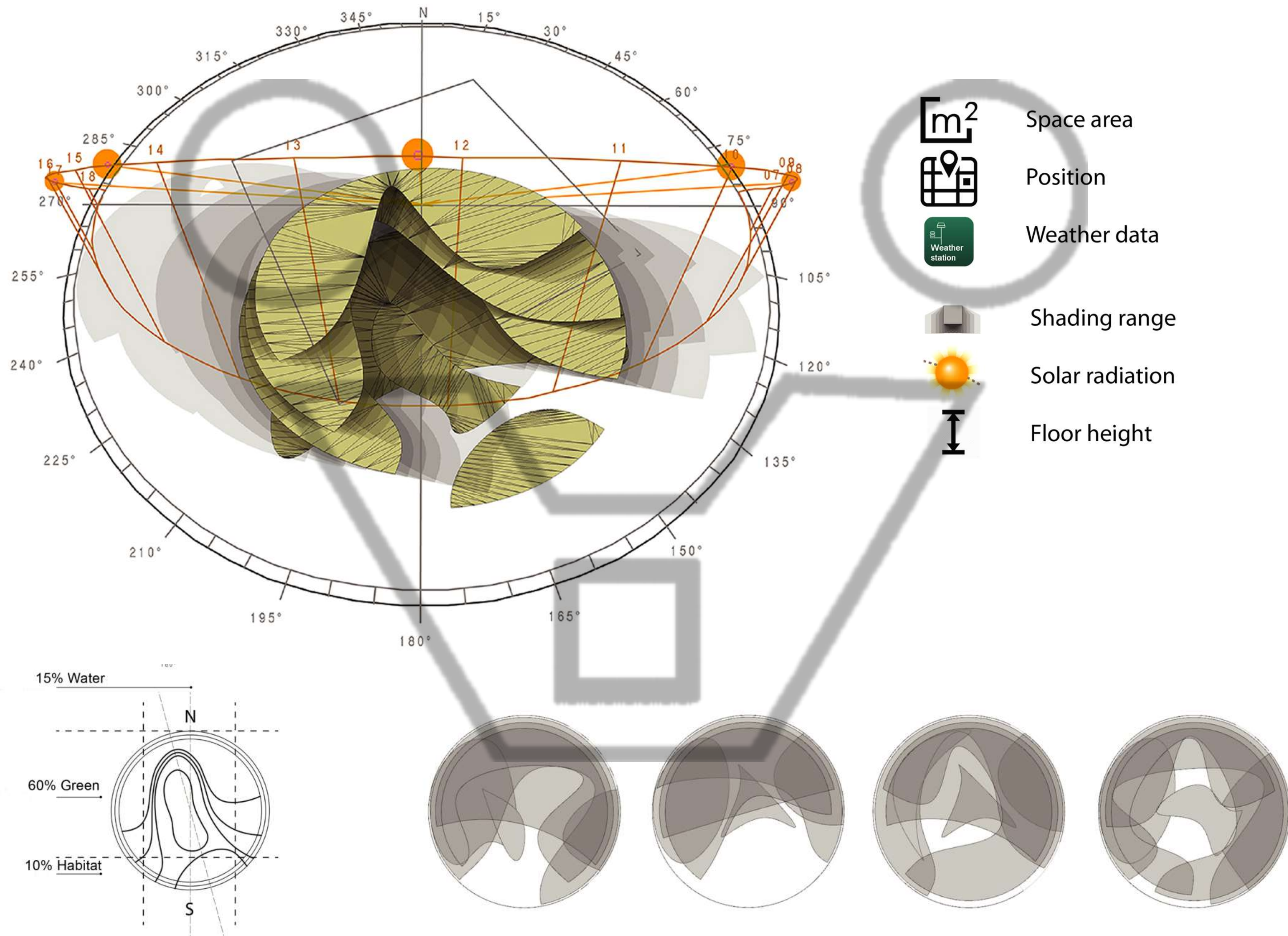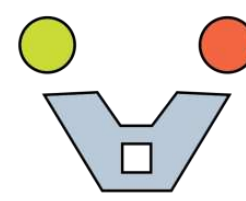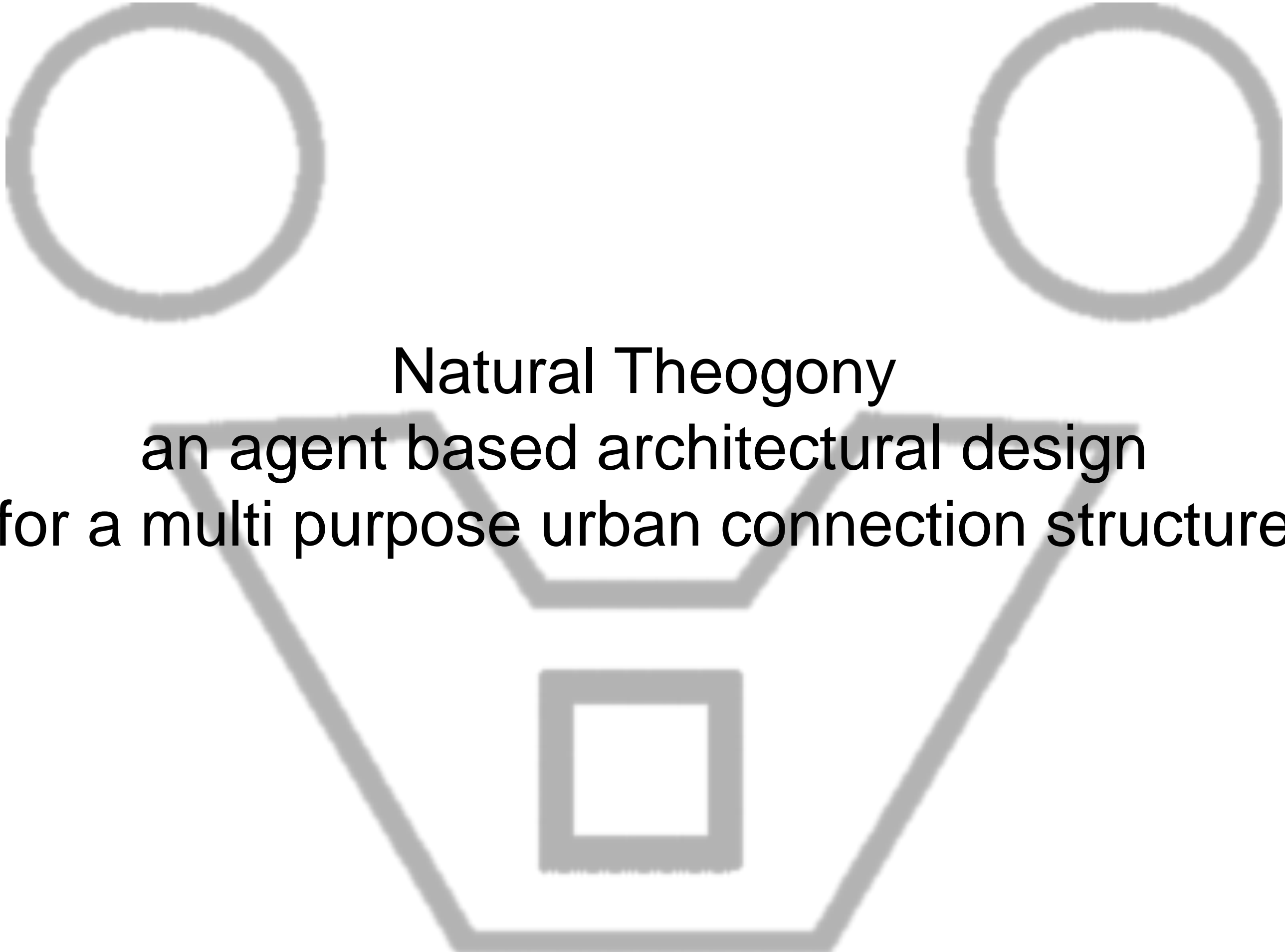
# Natural Theogony
## an agent based architectural design
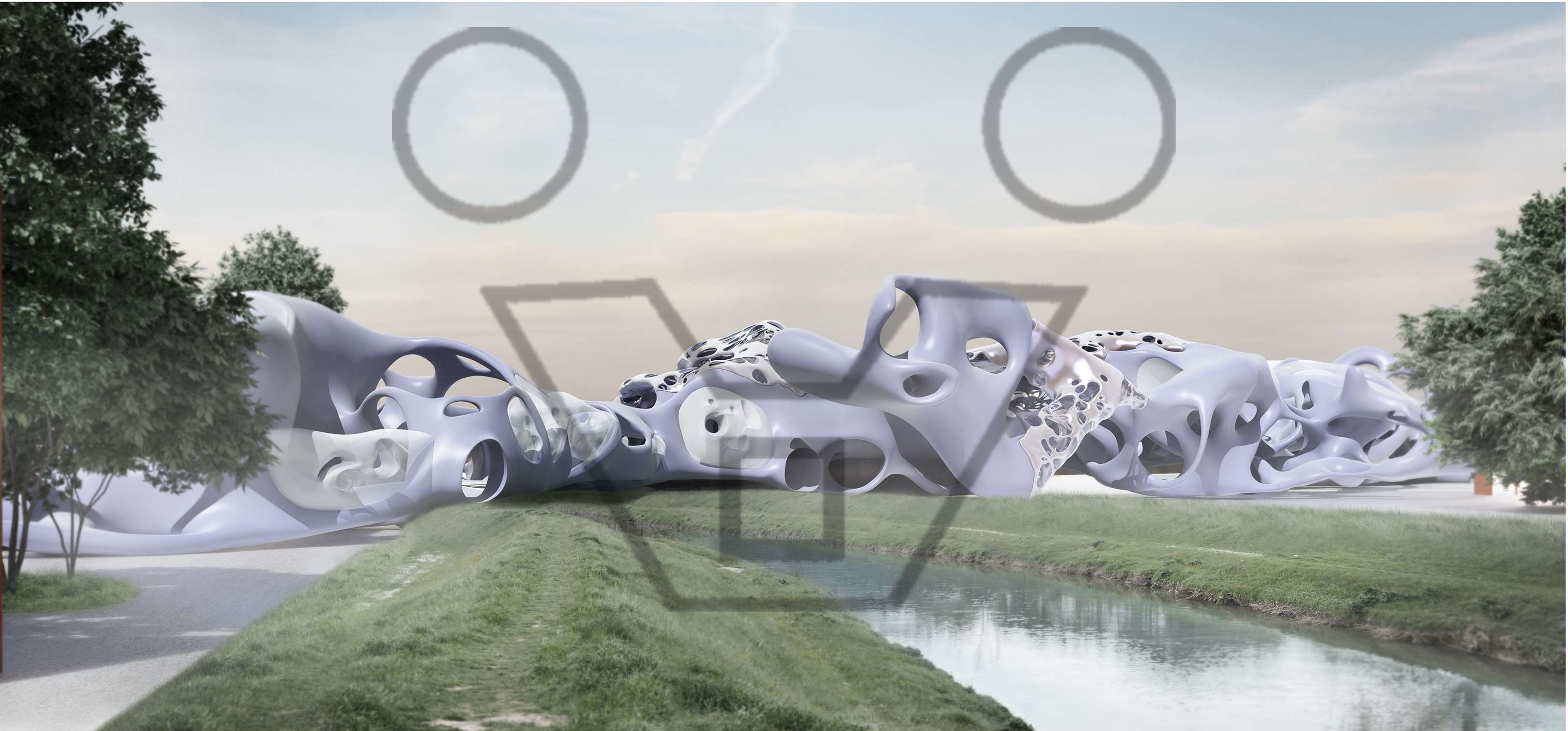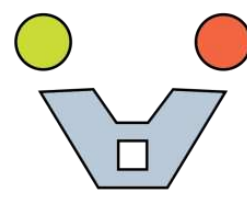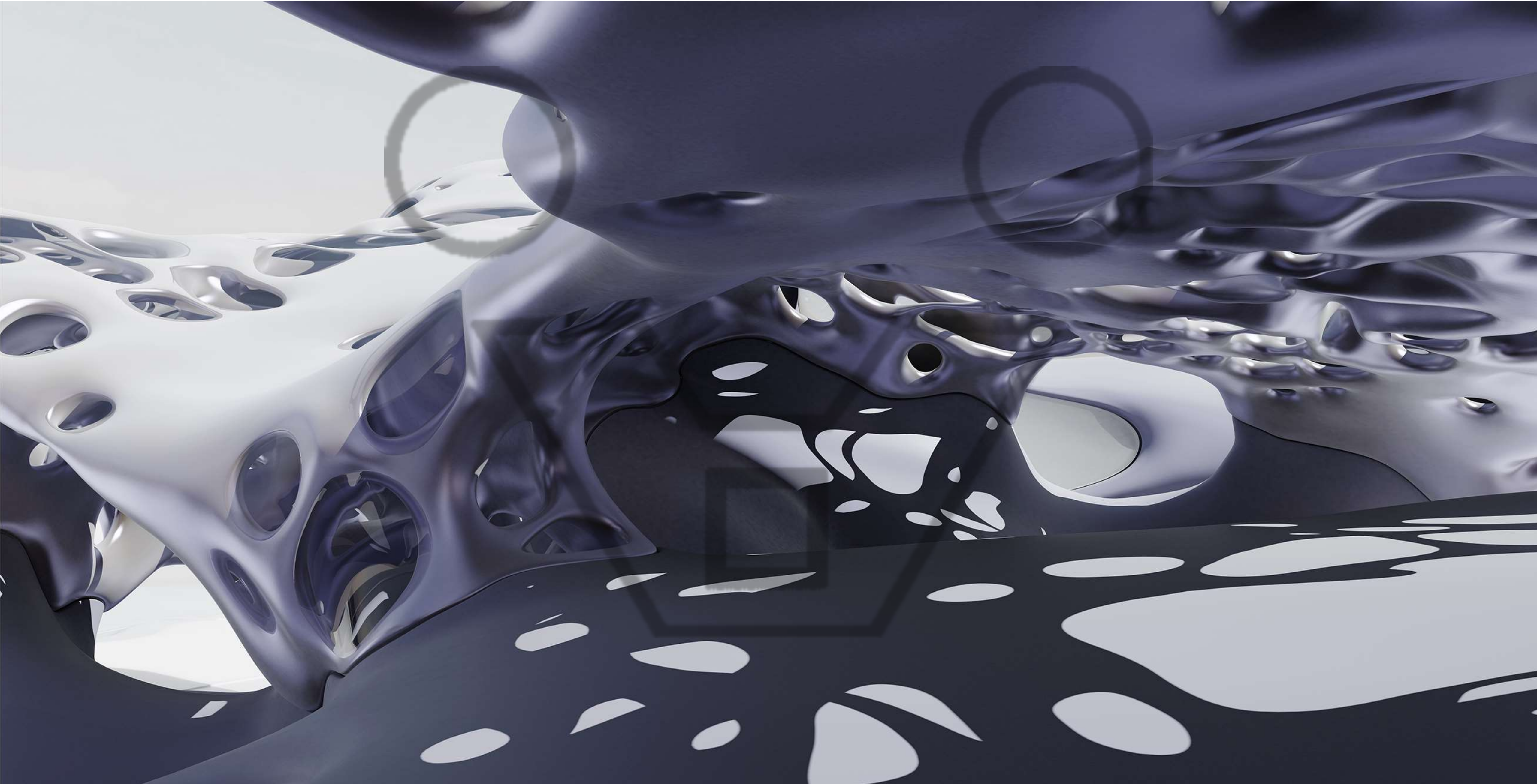## for a multi purpose urban connection structure

UNIVERSITÀ DEGLI STUDI FIRENZE
DIDA DIPARTIMENTO DI ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

# The post environmental age and the agent based computational design
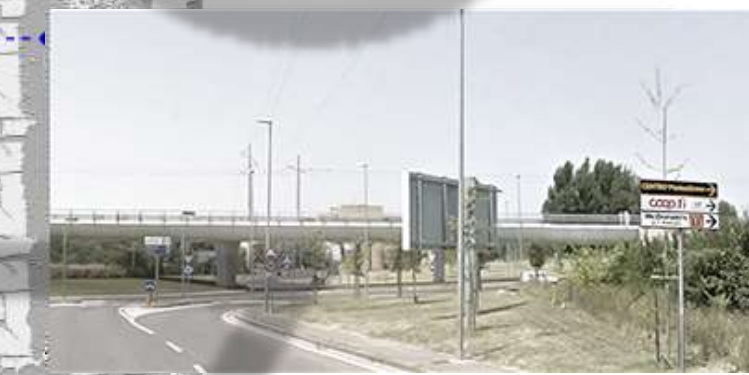


Parco Ecologico

Aree soggette a trasformazione (R.U.)

Aree soggette a riqualificazione (R.U.)

Previsioni di delocalizzazione (R.U.)

Previsioni viabilistiche (R.U.)

Confini comunali

# The post environmental age and the agent based computational design

UNIVERSITÀ DEGLI STUDI FIRENZE

DIDA
DIPARTIMENTO DI
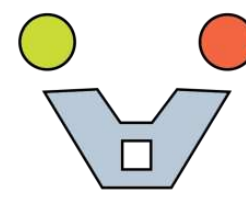ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction



NUOVO VERDE

AREA INTERESSATA DALL'INTERVENTO

PARCO ECOLOGICO [ROGERS

FERMATA TRAMVIA

VERDE ESISTENTE

ACCESSI ALL' AREA E PISTE CICLABILI
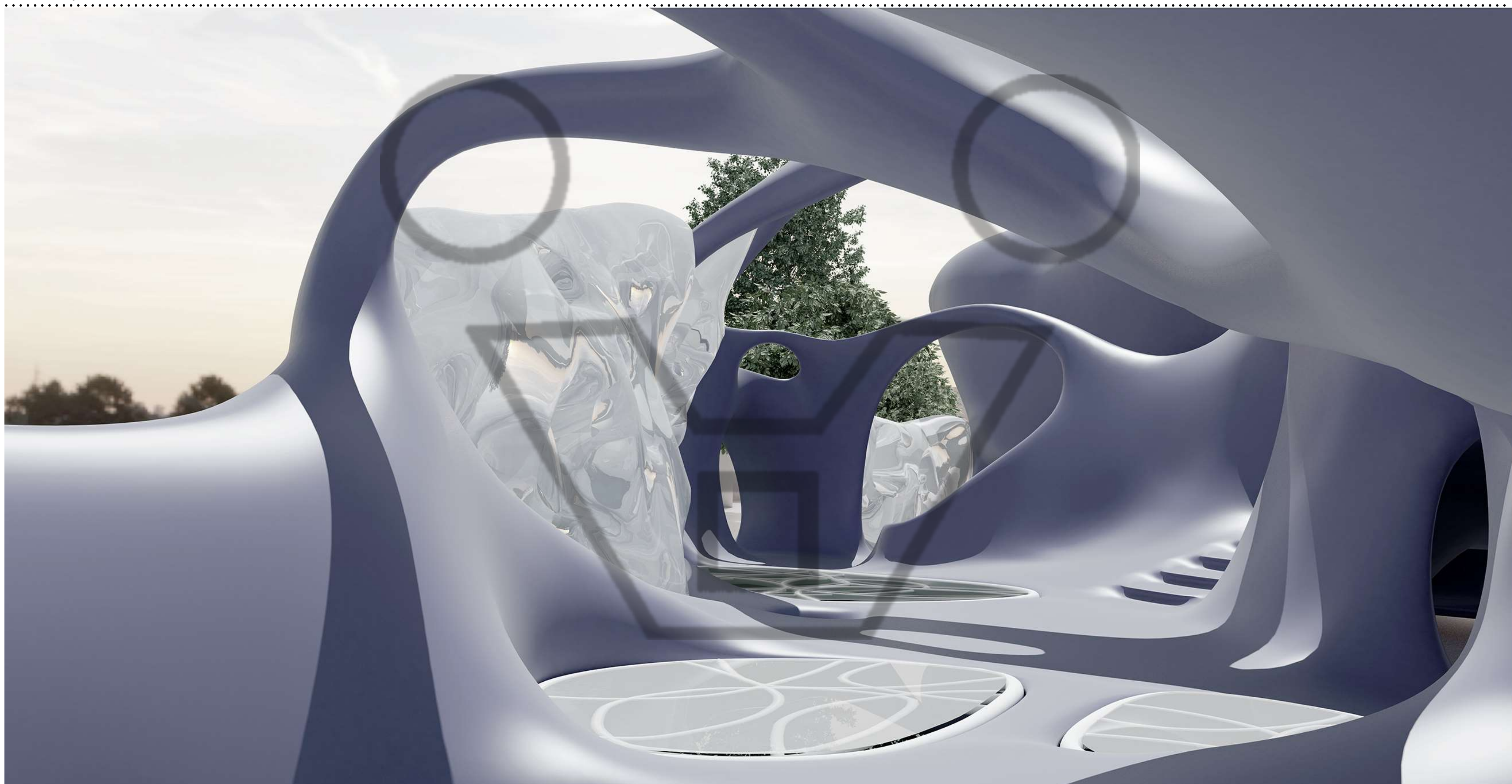
NUOVE STRADE [FIRENZE]

CONFINI AMMINISTRATIVI

UNIVERSITÀ DEGLI STUDI FIRENZE
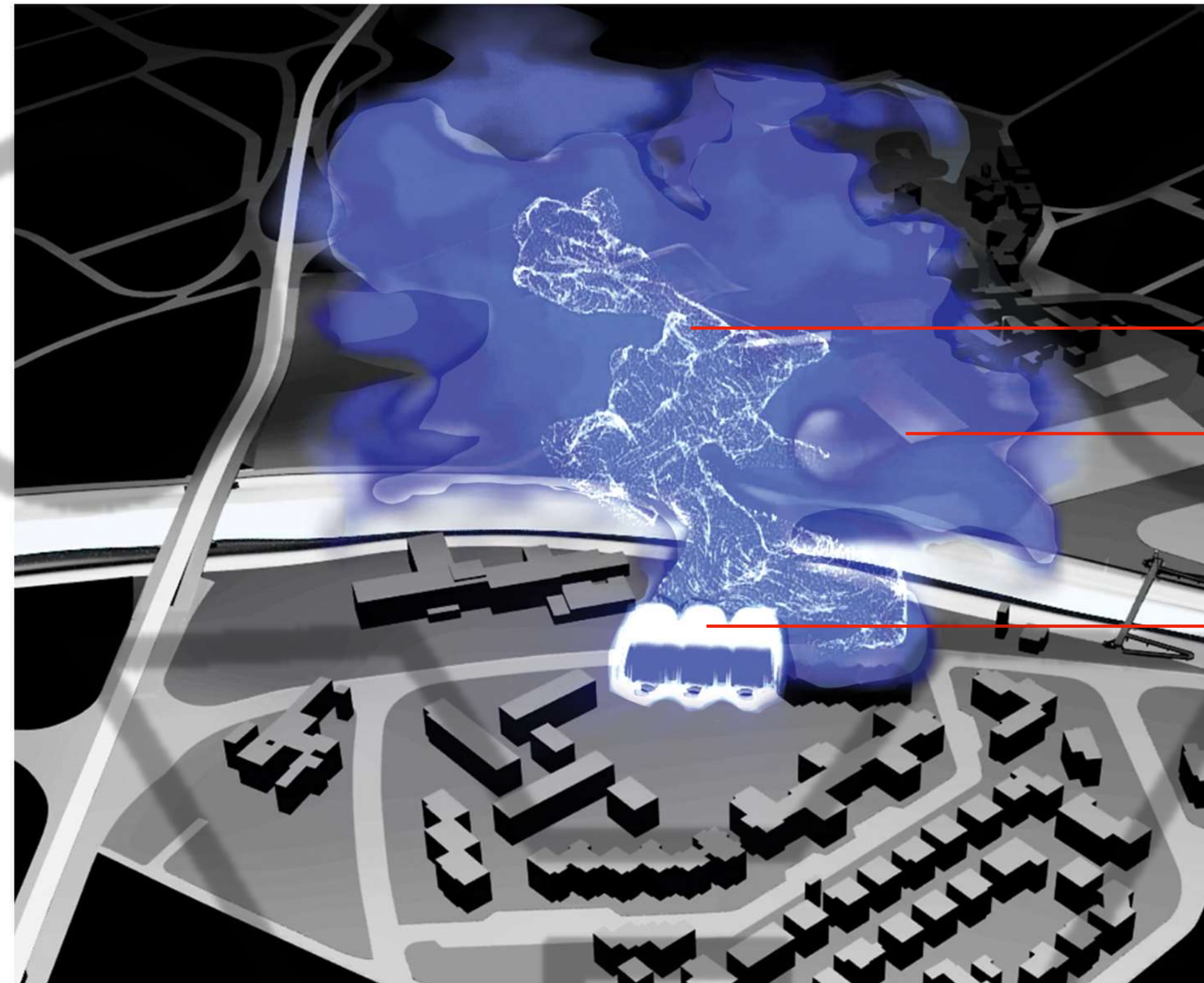DIDA
DIPARTIMENTO DI ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

# The post environmental age and the agent based computational design



NUOVO VERDE
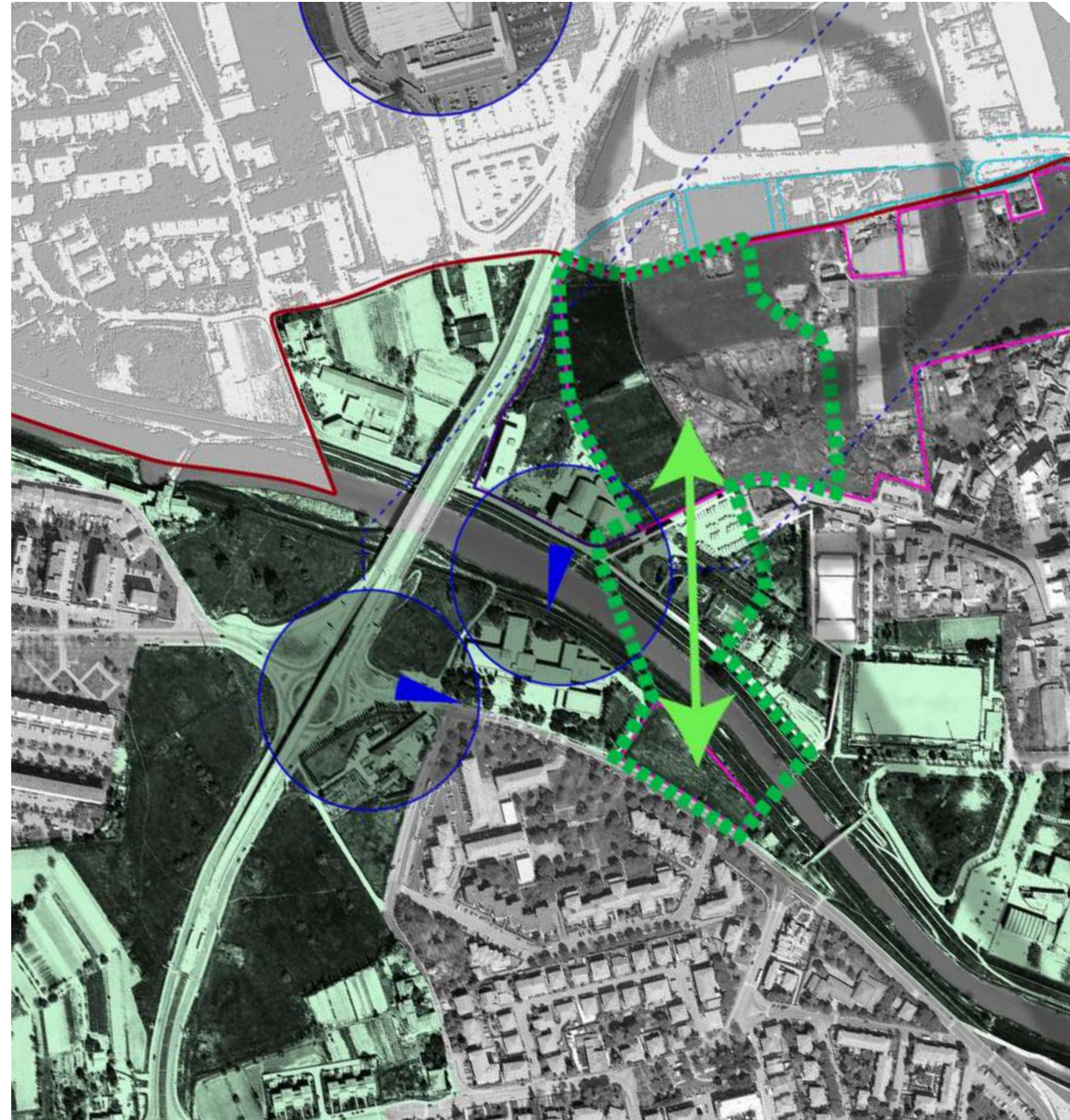
AREA INTERESSATA DALL'INTERVENTO

PARCO ECOLOGICO (ROGERS
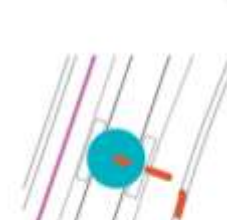
FERMATA TRAMVIA

# The post environmental age and the agent based computational design



ASPETTO MATERICO

2  Discretizzazione in elementi piani nei vetri a curvatura complessa

3  Casted Aluminium - Assemblaggio degli elementi fusi mediante giunti strutturali

4  E.T.F.E. (Ethylene - Tetrafluoroethylene)

5  Piastre metalliche di tamponamento nella passerella

# The post environmental age and the agent based computational design

G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE

**MAILAB**
Multimedia
Architecture
Interaction

**The post environmental age and the agent based computational design**

**MAILAB**
Multimedia
Architecture
Interaction

# The post environmental age and the agent based computational design



selected NURBS

gas particles

emitters

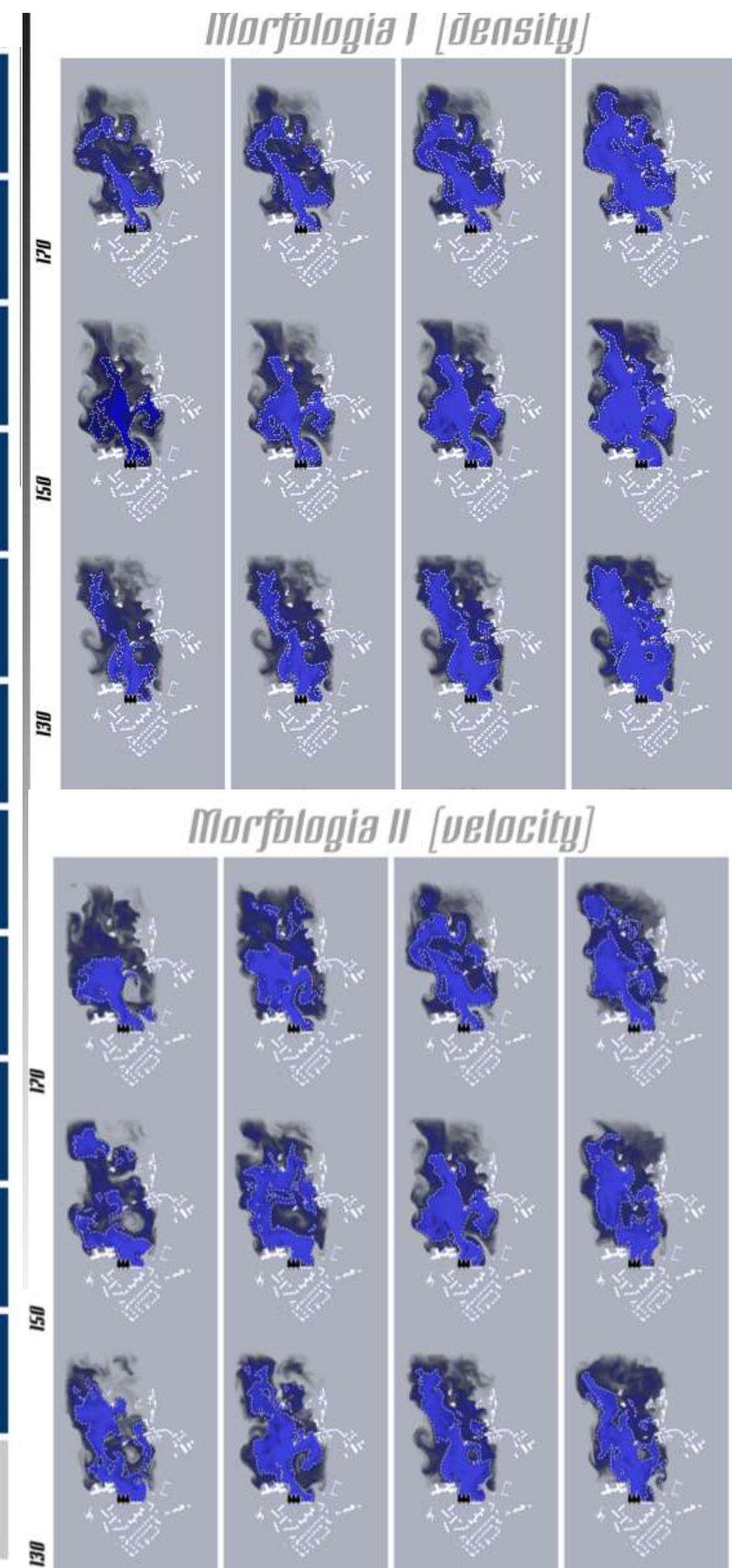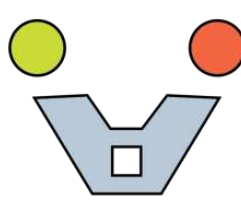**fluid state**      **condensation**      **discretisation**

**MAILAB**
Multimedia
Architecture
Interaction
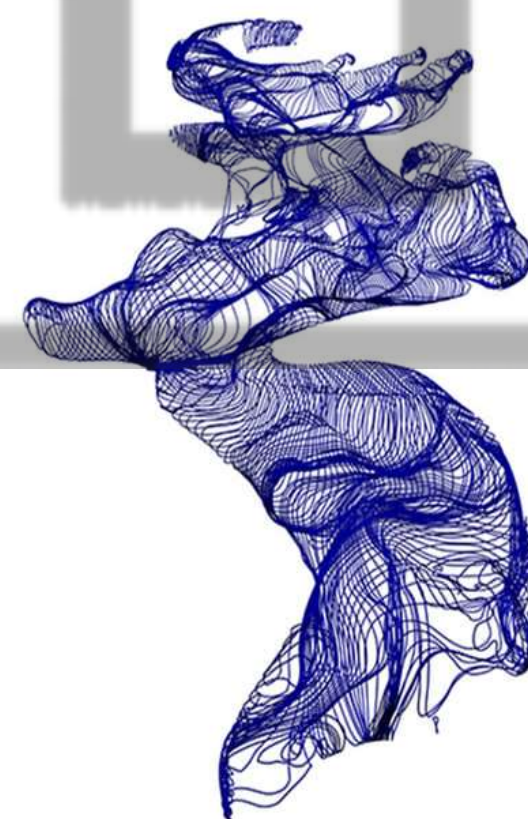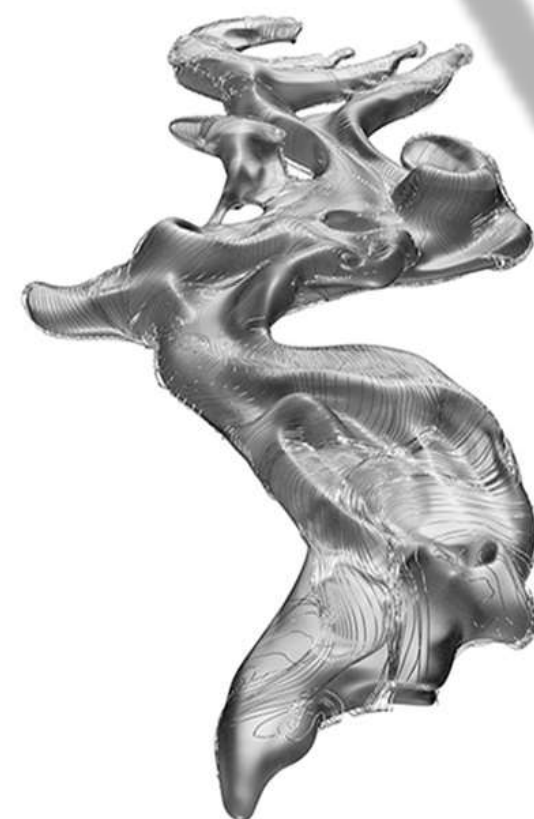
# RANDOM MORPHOGENESIS *frames 61-174*
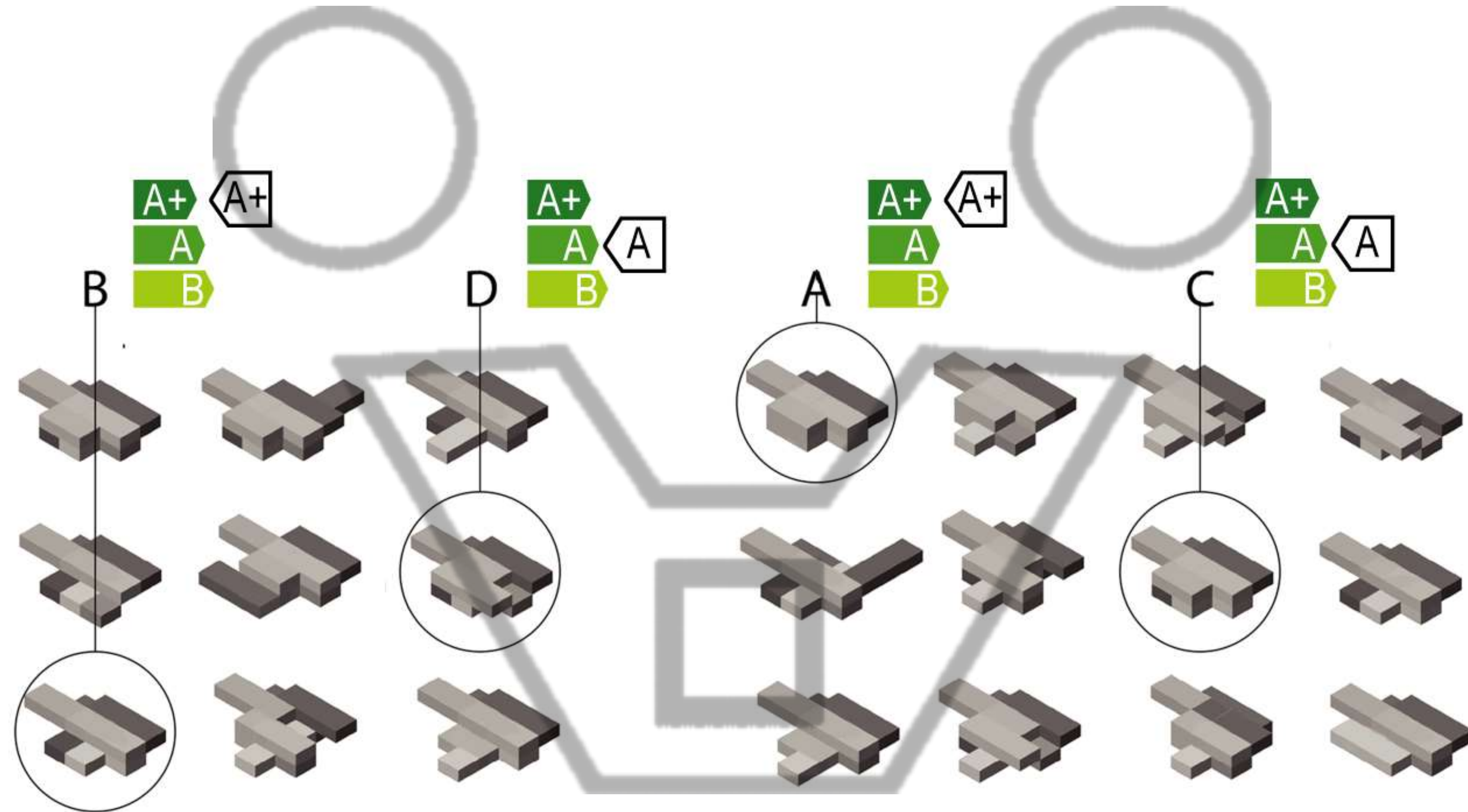


*Morfologia I [density]*

*Morfologia II [velocity]*

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

**MAILAB**

**Multimedia
Architecture
Interaction**

# The post environmental age and the agent based computational design



area di studio

individuazione aree libere
(altezza edificato < 1 m)

processo evolutivo

fenotipi selezionati

UNIVERSITÀ DEGLI STUDI FIRENZE
DIDA DIPARTIMENTO DI ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction
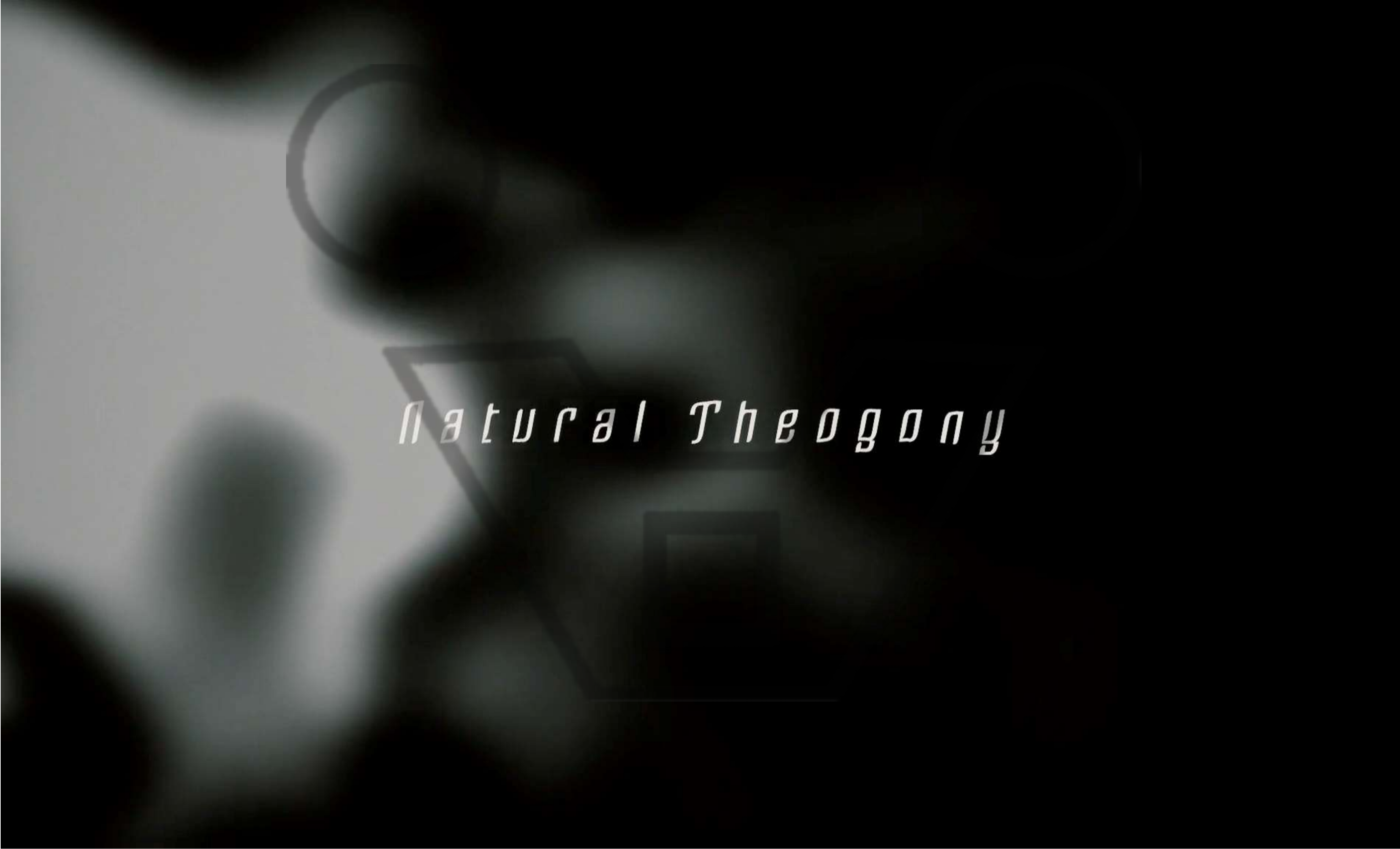
G. RIDOLFI | COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE
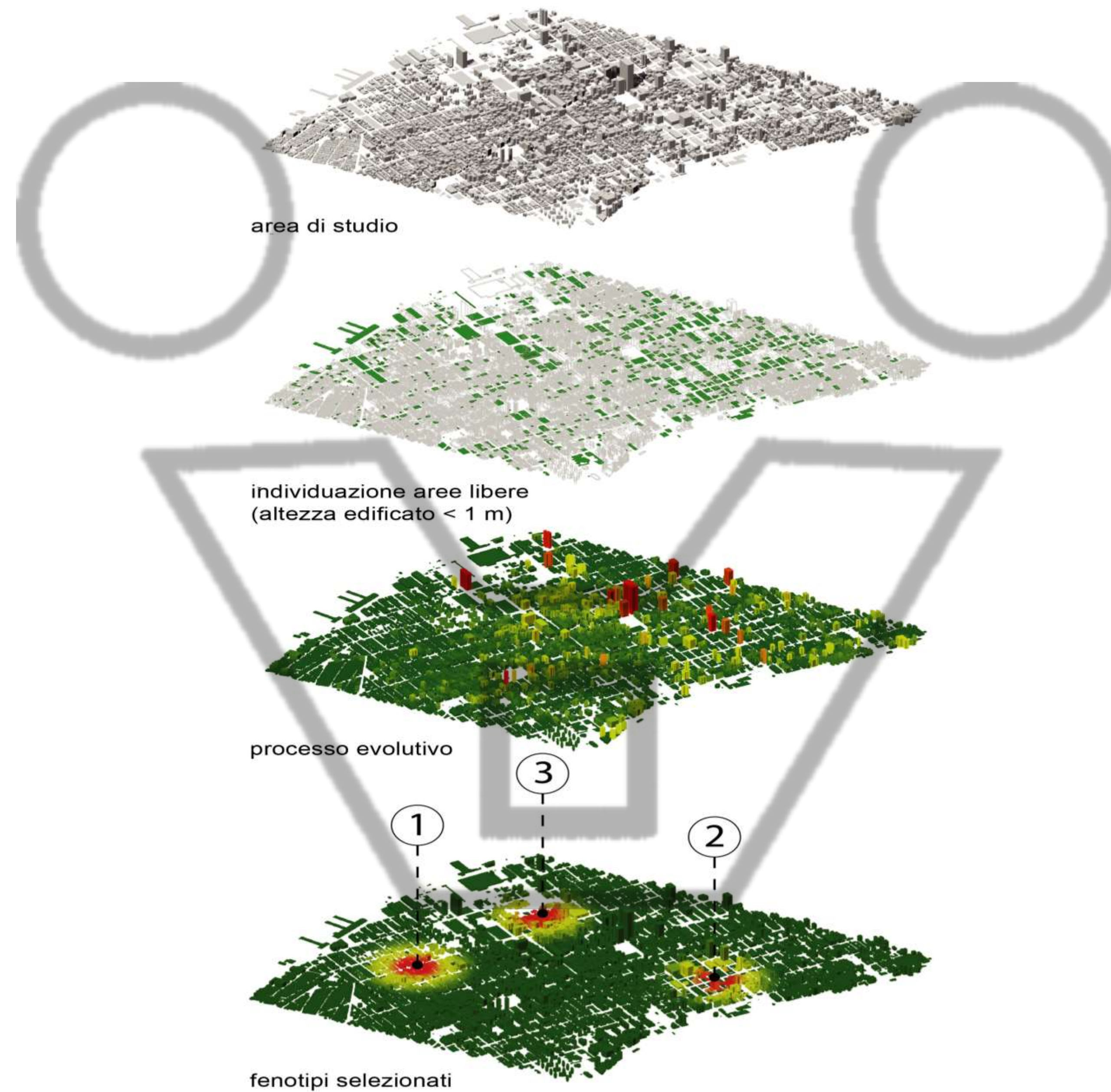
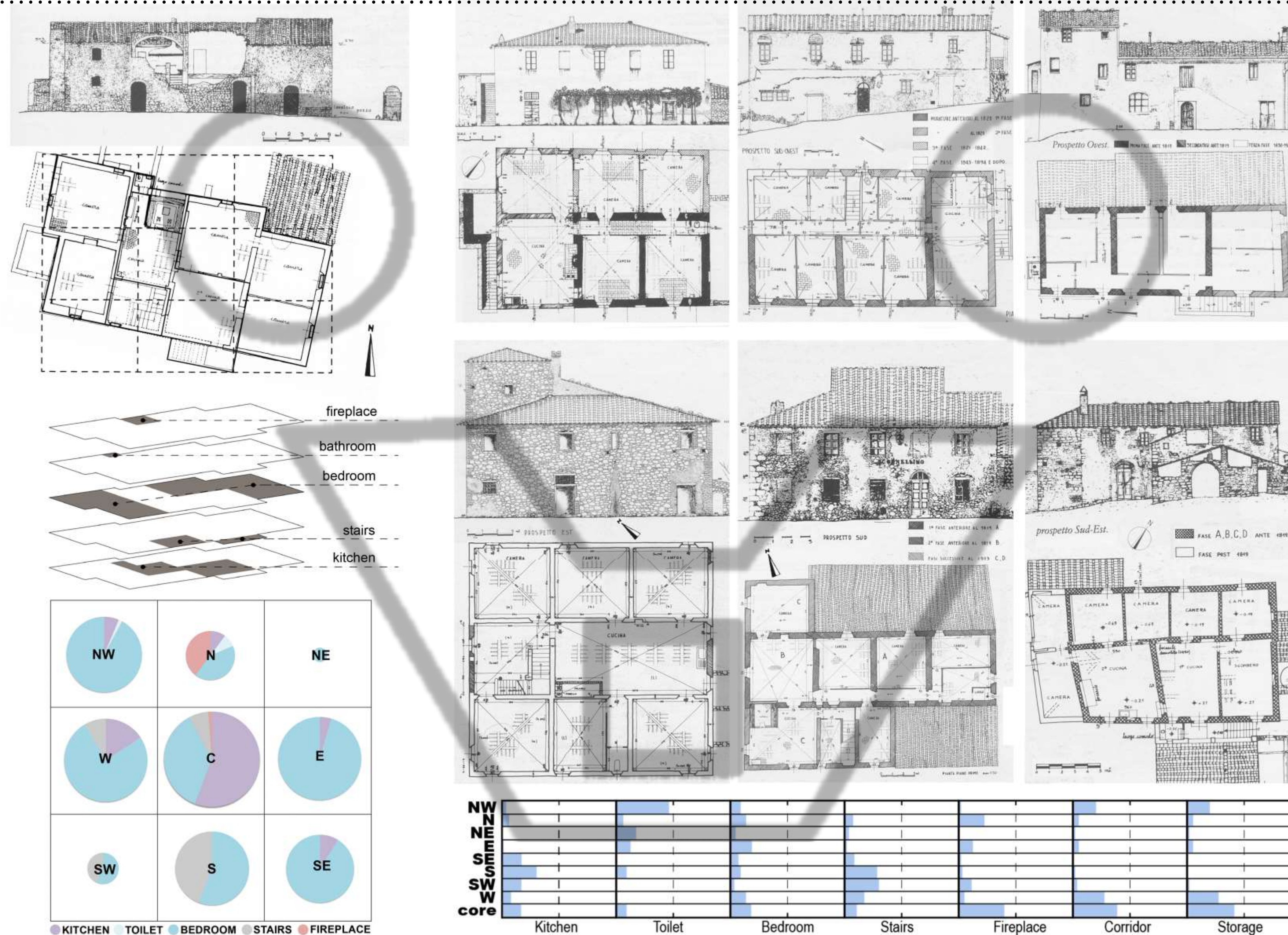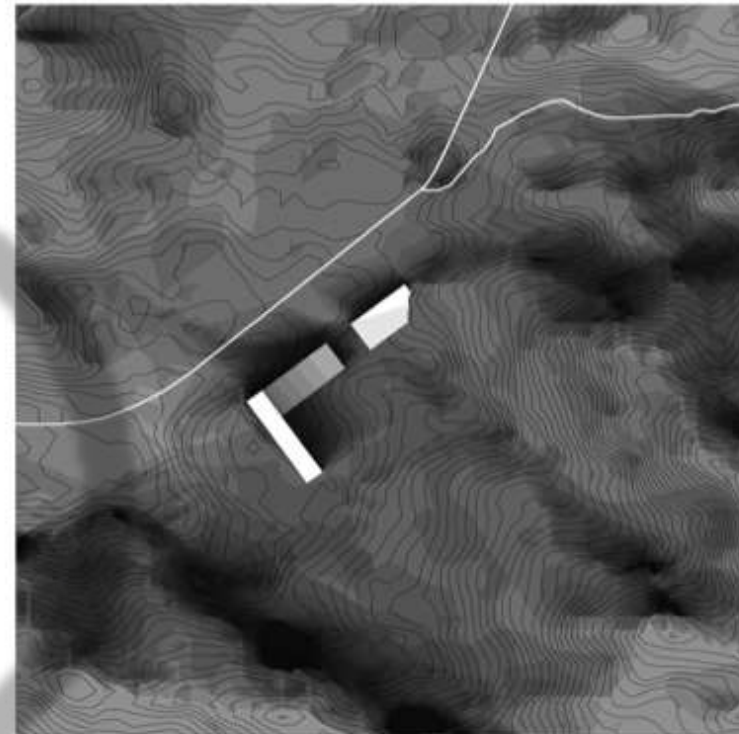The post environmental age and the agent based computational design

figg.21, 22, 23, 24, 25, 26 - Strumento per la conoscenza statistica dell'orientamento dei vani. Prospetto casa colonica impiegata per illustrare il funzionamento dello strumento; applicazione della griglia di scansione sulla pianta dell'alloggio; layer per l'assegnazione delle funzioni; output di distribuzione dei vani generato automaticamente; alcuni esemplari di coloniche storiche del paeseggio agrario nel Volterraneo; output della distribuzione statistica dei vani.

**MAILAB**
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL DESIGN IN THE POST-ENVIRONMENTAL AGE**

**The post environmental age and the agent based computational design**

Testing the trade-off in order to be aware of how configurations and elements can affect behaviours and produce differente results
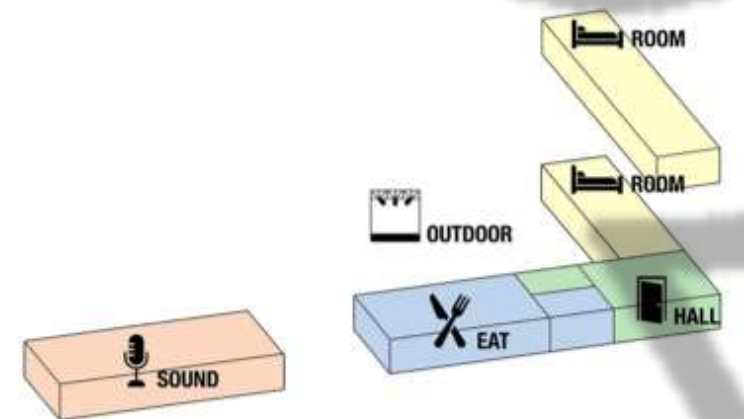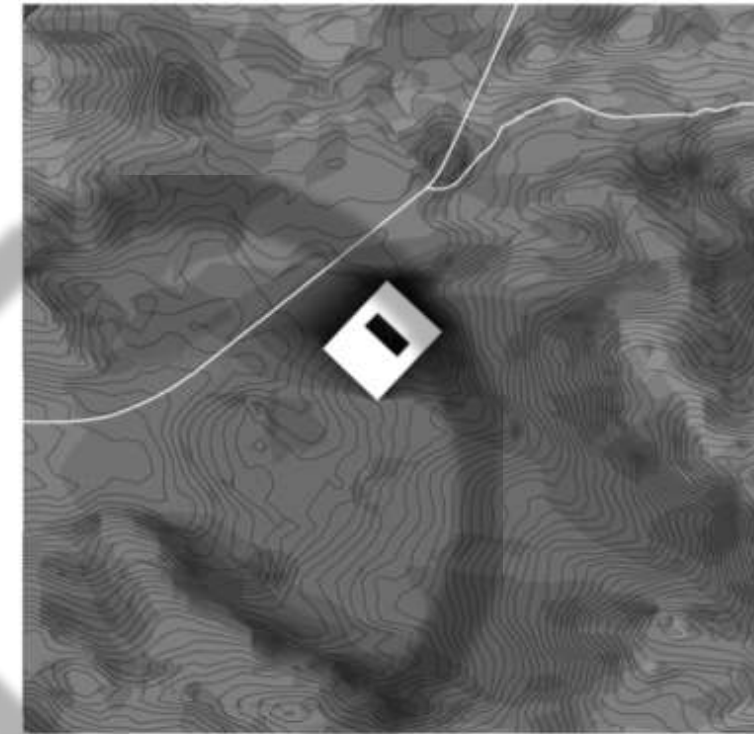
# Digital Modeling give us ethical responsabilities of our choices based on evidence of proof

UNIVERSITÀ DEGLI STUDI FIRENZE

DIDA DIPARTIMENTO DI ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

G. RIDOLFI | **COMPUTATIONAL INTELLIGENCES IN THE POST-ENVIRONMENTAL DESIGN**

# Modellare il clima e conoscere il luogo per il progetto di architettura.

Ipotesi 01



283

ROOM
ROOM
OUTDOOR
EAT
HALL
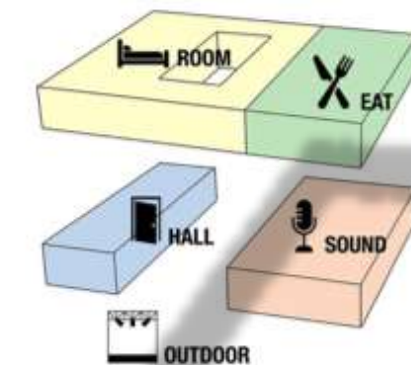SOUND
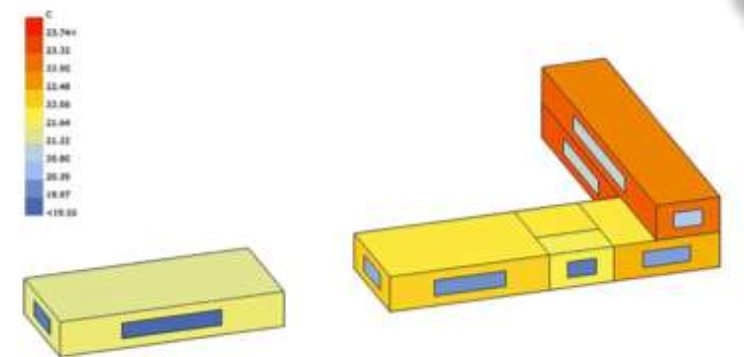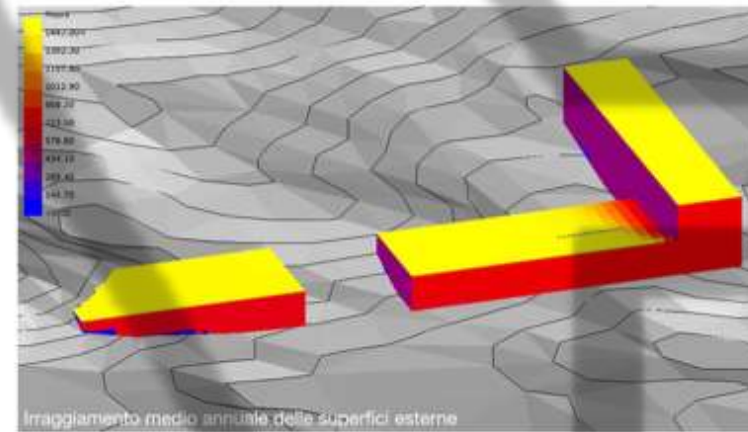
L'ipotesi progettuale si ispira alla tipologia del motel americano, con la zona d'ingresso e di servizio lungo la strada e la zona delle camere, spesso a due piani, collegata alla prima ma inserita nella parte retrostante che delimitano lo spazio esterno.

L'edificio ha forma di L ha, nel braccio più lungo con altezza di un solo piano, la zona "HALL " e "EAT" lungo la strada mentre la zona "ROOM" posta perpendicolarmente al primo blocco è alto due livelli e delimita la zona esterna sulla quale affacciano il bar e il ristorante. La zona "SOUND" posta lungo la strada ma separata dal resto è inserita nella collina per richiamare le tipiche strutture costruite dai minatori.

Il blocco delle camere funziona da schermo per i venti caldi estivi e l'irraggiamento, visto che è posto a sud, ma grazie alle pareti massive accumula calore che viene rilasciato nelle ore notturne quando è più freddo.

Temperatura media annuale delle superfici interne

Irraggiamento medio annuale delle superfici esterne

Emissioni di carbonio annuali

Costo e utilizzo energetico annuale

Carburante

Elettricità

Carico di riscaldamento mensile

Carico di raffreddamento mensile

Ipotesi 02
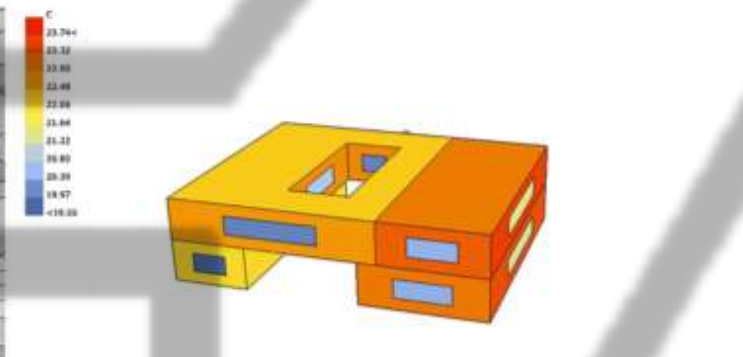


278

ROOM
EAT
HALL
SOUND
OUTDOOR

L'ipotesi progettuale è costituita da un edificio che si articola su due livelli e che richiama la tipologia dell'edificio a corte. Sebbene presenti una corte, i due lati paralleli alla strada risultano assenti, in modo da creare una zona interna, riparata dal forte sole e dove il vento si possa incanalare attraverso il principio dell'effetto Venturi, creando così ventilazione all'interno dell'edificio. Al piano terra troviamo dal lato della strada, la "HALL", e al piano superiore la zona "ROOM", tipologia che richiama il tipico motel statunitense. Questa disposizione permette, attraverso una muratura massiva nella zona camere, di accumulare calore durante il giorno, e farlo rilasciare nel periodo notturno, ovvero quando vi è la necessità di scaldare le camere. Nell'altro blocco troviamo al piano terra la zona "SOUND", lontano dalla zona camere e con la possibilità di aprirne una sezione e trasformare il chiostro in una piccola platea. La zona "SOUND", si troverebbe inserito in parte nel terreno, richiamando le numerose miniere presenti nella zona. Sopra ad essa, troviamo la zona "EAT", collegata direttamente con le stanze.
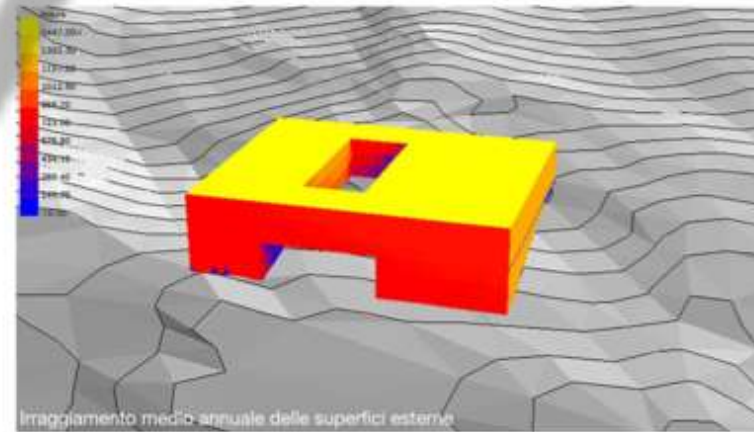
Temperatura media annuale delle superfici interne

Irraggiamento medio annuale delle superfici esterne

Emissioni di carbonio annuali

Costo e utilizzo energetico annuale

Carburante

Elettricità

Carico di riscaldamento mensile

Carico di raffreddamento mensile