

Recognizability of the Idea: the evolutionary process of Argenia

Prof. Celestino Soddu

Director of Generative Design Lab

Department of Scienze del Territorio, Milan Polytechnic, Italy

<http://www.generativedesign.com>

published in the proceedings of AISB99 Edinburgh 6-9 April 1999

Argenia

Argenia is the new word that I have coined for Morphogenetic, Generative and Evolutionary Design. Or, better, for my subjective and operative approach to design. My works are not tools for designers, but design-products realized with a subjective and original software.

My idea is that the generative approach can realize operative meta-projects that are new design products. These are something like idea-products: a product that is able to generate an endless sequence of object-products. The idea-projects creates a new market: an industry can buy a morphogenetic idea-project for lamps, for example, and use the endless sequence of generated 3Dmodels to produce always different lamps (the idea-project can be used as an auto-reprogramming tool for robots). The customer can choose his unique object by activating, in Internet, the generative tool and sending his request to the industry.... or..... a mayor can order the idea-project of evolution (this means an increasing complexity) of his town and use it to control the possible incoming scenarios and the identity in progress of the environment.

The *recognizability of the idea* is the first step to reach the possibility of selling the idea-product, performed as generative project, as artificial DNA.

Recognizability. Identity, Complexity and Artificial Life

We build up our recognizing codes since infancy. This processes are peculiar to art. We learn, since first infancy, to recognize everything in the world, to recognize a chair among other similar objects. We become able to build our peculiar structure of the chair idea. When we are in front of a chair that we have never seen before, notwithstanding that this shape is new and different from any other known chair, we are able to recognize it as a chair. And more. If we are in front of a painting of Van Gogh that we have never seen before, we can recognize it as a painting of Van Gogh.

The recognizability is, therefore, our abstract synthesis of already lived moments for the valuation of the unpredictable incoming events. But the recognizability is not an objective category. We cannot learn to recognize objects if not through our own experience. This synthesis belong to the field of subjectivity, it is a distinguishing mark of our uniqueness and identity of human beings. It is the subjective building of categories, of spe-

cies for the identification of an individual object.

This synthesis is also the first step to approach design processes.

The designing idea is the natural/artificial dynamic system that everyone try to forge upon the reality, by drawing a model of a possible desirable event, shaping it through one's own thoughts and wishes.

The designing evolution is the sequence of logical procedures to increase performances and complexity, and to open this subjective system to intersubjective and social requests.

Generative design is the design of an evolutionary process able to generate a sequence of events. Each event being different but recognizable as belonging to a species. For this reason the control structure of recognizability become necessary in this approach. Or better, it seems as the fundamental structure in building generative projects, in controlling evolutionary processes, in controlling the results (the species). The recognizability of the idea (and of the species is one of the possible representation of the idea) is the peculiar field of Generative Design, and it is the field that defines the design work, the hand of the designer.

In my work these considerations are not, never, only theoretical reflections. Every hypothesis, every possible developing path that I propose, every logical approach to design has been operatively experimented and emulated as evolutionary process designing for a suitable software.

I have performed my generative projects in front of the need to operate, without preclusion, a *direct entrance to the complexity of natural/artificial environment*, to the dynamic of unpredictable alchemy in increasing complexity, in the growing of evolutionary processes in architecture, industrial design and art. The goal is to identify and approach the *creativity as the time clock of evolution*.

Artificial DNA evolutionary codes

The software I have designed is, in fact, a "design of species", and we can use it as an artificial DNA to generate a multiplicity of artificial possible events. My first experimentation was in the field of town environment and of architecture. This software is the representation of my subjective approach to town environment, of my idea of architecture.

My generative software is based on a presumed homology between natural and artificial spheres, and

their belonging to the world of chaotic systems. Following the possible consonances between natural and artificial evolution systems, we can think that, like the DNA in nature, we can assign to the design of morphogenesis, to generative projects "Argenia", the power to control and increase the evolution procedures, defining the complexity of possible meanings/functions, the stratification of multiple orders, the mode of contamination between orders and between different disciplinary fields, and, shortly, the recognizability of every events the system can generate, apart from the subjective identity of the single object.

The human/machine interaction can manipulate the development of this project operating upon the parameters of the evolution code and not only changing the final arrangement.

Two are the most important topics in designing this tool: the complexity and the relationship between species and individual.

To manage the complexity I referred to the concept that the complexity is not generable *ex novo*, but only using a process to stratify sense into a flowing simulation of a temporal irreversible path. We can activate and control this stratification if we design a system with a self-organizing paradigm that can increase its identity and recognizability during the simulated time flowing.

To built this paradigm I referred to the chaotic dynamic systems that are suitable to be controlled by algorithms, even if they never produce the same event.

I have used a fractal but non deterministic logical frame. In other terms, every decision cycle has inside, nidified using a lot of other cycles, other decisions, and so on. The structure of these cycles is, as in fractal objects, always the same. The differences and the unpredictability born from the resonance with other cycles, from the time of activation and from always different flow of information.

Each cycle represents a whole structure in simulating the decision choices. It operates the transformation of the answers into possible shapes. This device is designed by:

1. The use of a paradigm to control the self-organization procedures. This tool represents and controls the gained complexity but, in the meantime, represents the adaptability to the incoming developments. It is the device that allows us to reply to an answer putting one of the possible formal matrixes into the paradigm.

2. The identification and sharing of the random margins between answers and shaping replies. The system uses and represents these margins as "operable fields" for the designing choices to improve the project evolution.

3. The set of possible formal matrixes, that are abstract shapes but usable in the giving body for a set of possible performances. These formal matrixes are not a data base. They are extemporary generated by the bound-up cycles, by a set of simultaneous devices operating

into a series of different fields, like geometry, dimension, materials, technology, complexity, and so on.

At the end of every cycle (and of the related and multiple progressive nidifications) the result is:

1. An increasing complexity, and the related passage into a more evolved representation of needs.

2. The production of new needs, for the reason that every event designed was born also in front of a subjective and random approach. The shape used was not necessary before the choice but it began necessary after, as a part of the project, it generates further requests. This also happens if we, later, removed it because we considered this event as an obsolete one. The event is into the project history, the needs generated by this event have been just satisfied, and we can appreciate its contribution as time patina.

A time patina that measures the gained complexity, the growth of the specific identity of the project, shaped by the past research occasions used as training events.

(Reference to C.Soddu, E.Colabella, "Il progetto ambientale di Morfogenesi, Esculapio Publisher, 1992 Italy)

Natural/Artificial Complexity

As clouds, towns evolve with time, expanding, contracting, transforming themselves, their image, their characteristics under economical, cultural, political and technological impulses. It is easy to predict, in short terms, the development of towns, as for any natural system. Everything happens according to precise rules deriving from urban planning, current technology, economical and social influences.

However, predictions are almost impossible in the long term since towns are inhabited by human beings and that each choice, each successive step brings about margins of subjectivity and unpredictability. This subjectivity produces one of the most important characteristics of urban shape: formal diversity of solutions responding to the same necessity.

It must be remembered that the most subjective and casual aspects of decision making have little influence and will disappear in the subsequent transformations of a town. However, some events or marginal aspects will persist and because of concomitant casual circumstances and they will assume more and more a capacity of influencing the course of future development. This influence, once it has been consolidated becomes irreversible and can outgrow the importance of the event that caused it.

Some architectural forms, originating from contingent, casual or subjective choices very often loose their *raison d'etre* and become pure formalization of relations between following events; they often disappear surviving only as a trace, as a testimony of the passage of time leaving a strong characterization of urban shape.

Piazza Navona, in Rome, is a good example of this continuity. The form, the dimension, the sequence of the

various architectural structures of Piazza Navona have been determined by a building no longer existing and little is known about its past function. This building has had an irreversible influence since its form has conditioned the surrounding architecture and has contributed to the formation of one of the most fascinating places of Rome.

Other Roman buildings, from the same period, conceived then to have a greater influence on urban development, as for example Trajan Forum, did not have the same fortune.

Of many fragments breaking off from a glacier, only a few, at random, become avalanche and only a few avalanches can modify the environment and only a few forms in the environment have the capacity of fascination due to the casual contribution of rivers, winds, vegetation and why not architecture.

All this is not predictable since the succession of ever growing changeable events cannot be predicted and above all, because the casual, subjective event that may become incisive on the whole system cannot be imagined and be clearly defined in advance.

The system is not predictable, however, it can be represented through numerous simulations done in order to produce a large variety of possible results.

My research introduces a mechanism/software for the simulation of time in a town system whose instability is due to the complexity of objectives often contradictory. This mechanism should produce an endless series of urban events temporarily parallel and recognizable as different "individuals" from the same "species".

This implies, as it happens in current scientific research, to abandon the idea of the possibility of identifying and defining an order capable of assuring, with time, an urban characteristic, if this order takes form from a static evaluation, from the analysis of one moment of equilibrium leaving out the dynamics of time. The evolution, and also the time, starts from the system unsteadiness.

Urban growth can therefore be more appropriately analyzed if it is represented not as a temporal stratification of successive equilibria but as an unstable system that proceeds through irreversible changes even if it keeps a modus operandi than can be individualized and characterized. This instability, once it has been represented mathematically, is the characteristic of an unpredictable dynamic system.

Towns, in other words, can be considered as complex entities that can be individualized in their uniqueness and above all, as entities in evolution capable of modifying their form in an unpredictable way.

Evolution, the passage through irreversible events and morphogenesis are characteristic of urban shape but also of living beings. Towns are not, in fact, notwithstanding their artificiality, very different, from that point of view, from nature and, according to the trend of current scientific debates, can be considered living entities. This evolution can be emulated using the Artificial Life.

(Reference to C. Soddu, Simulation tools for the dynamic evolution of town shape planning, Oxford Polytechnic, 1991)

Giotto, a medieval idea in evolution

The results of my first generative experiences in town design was impressive, and my generative projects have improved their complexity with the progressive stratification, in ten years, of new ideas performed as evolutionary devices inside the software.

The entry version, realized in 1988, is an evolutionary software that emulates the increasing identity and recognizability of some particular town environment existing in Italy.

I have designed, as a natural species, the DNA of a typical Italian medieval town. I have referred, for this experimentation, to the drawings of Giotto; and I have interpreted these drawings as an evolving idea of a town environment. To obtain an acceptable complexity of the urban image I have simulated and ran the linear and non-linear dynamics of the evolution of this type of urban image. I have proceeded in identifying and discovering, following my subjective interpretation as architect, the

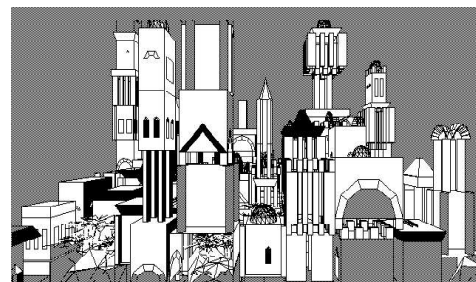
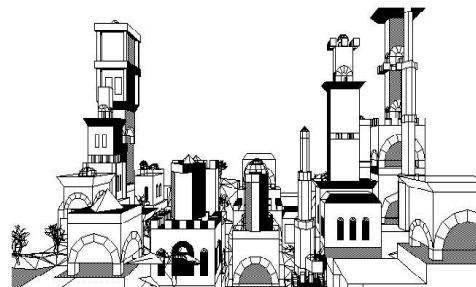


Fig. 1 - Generated environment of Italian medieval towns

rules of the game, the modes of the transition between one order to another, the role of randomness in increasing complexity and the power of the time in shaping the environmental image.

So I have realized (crafting it as an original software, built like a DNA code) a first experimental generative project, designed following and representing the dynamic evolution of urban image and identity. Every time this project is used, a lot of always different 3D models of virtual medieval towns can be generated.

Every model is one of the possible parallel histories of "my" medieval town evolution. The difference between one and another virtual model is like the difference between one and another individual belonging to the same species. A difference shaped by the random components of the evolution. But every town images is characterized, in front of the differences, by the morphogenetic nature that identifies this particular design approach to the evolutionary code: my designing idea of the medieval towns came from my interpretation of

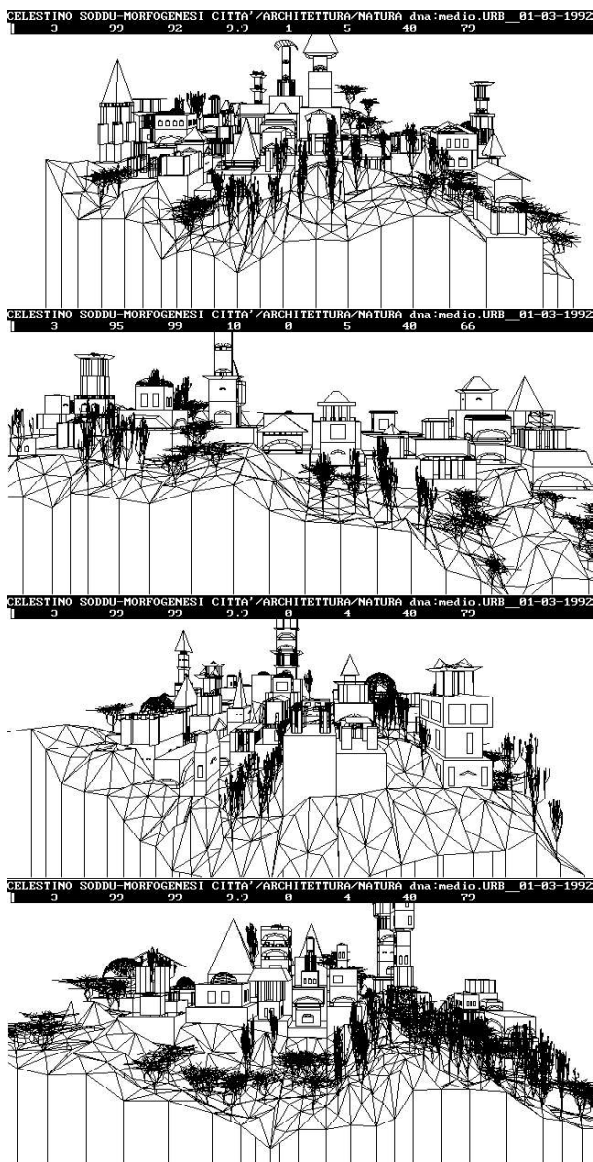


Fig. 2 - generated scenarios of italian medieval natural/artificial environment

Giotto's frescoes

I mean that every time we use this software, we run through one of the possible town histories. And every history is always different but it is also parallel to the others.

Like in every fable, the structure is always the same but every time we tell it, we run one of the possible subjective paths. (C.Soddu, The design of morphogenesis. To design the genetic code of artificial environment, Museum of Design, Zurich, 26 Jan. 1992)

And the possibility of identifying the character of these towns is linked to the management of the increasing complexity, because the complexity is the representation of the laws of evolution.

The real problem is the management of this complexity. The complexity derives from the evolution, from having crossed a "history" that has enchanted the identity of the system. Most of the time, the credibility and recognizability of an urban environment is removed by simplification. And the typological optimization is a simplification.

The complexity involves the adaptability for each possible consumer, the progressional stratification of significant structures that, reacting with the subjectivity of each individual, shows unexpected performances, but relevant in front of the needs. And these answers, unexpected and subjective, can make our cities livable. (Reference to C.Soddu, E.Colabella, Recreating the city's identity with a morphogenetic urban design. 17th Interna-

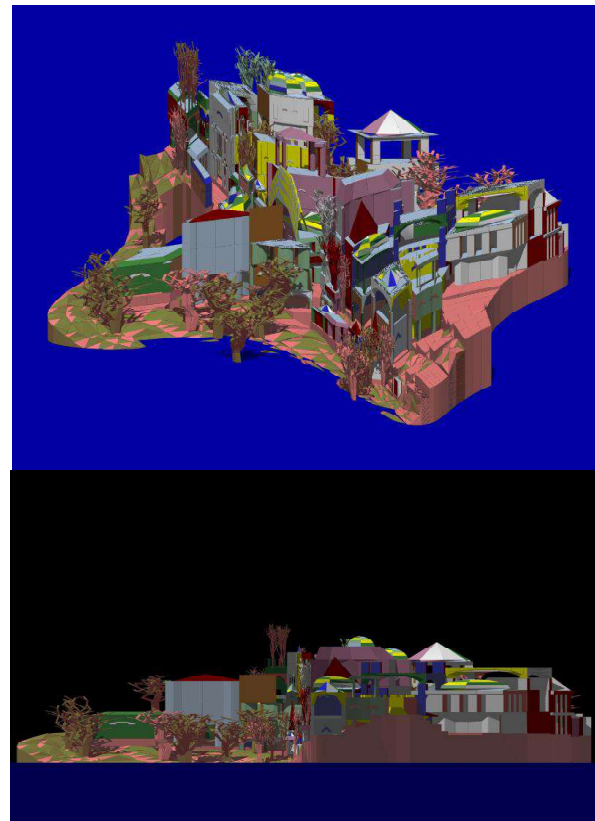


Fig. 3 - generated natural/artificial isle

tional Conference on Making Cities Livable, Freiburg-im-Breisgau, Germany, Sept. 5-9 1995)

Rome, future scenarios

An example of the professional use of this environment generative software was the project of the evolution of Borghetto Flaminio in Rome. (fig. 4)

The evolutionary code of this environment was defined and a sequence of possible scenarios was generated. In the images, two different scenarios generated

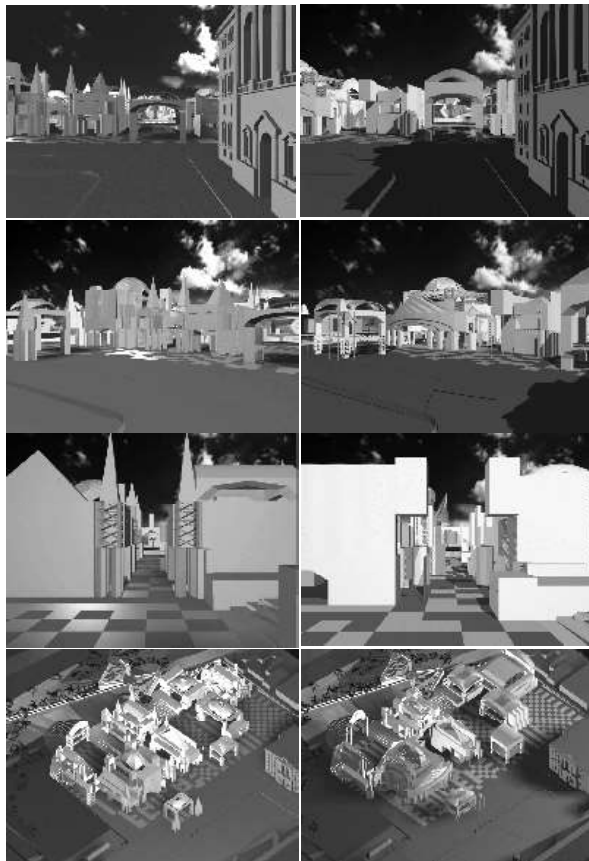


Fig. 4 - Generated roman environment (Two steps)



by my evolutionary software, (the last one is on the right), presented using the same point of view.

Basilica, a generative software to design the complexity

Basilica, first version in 1990, is a project able to generate an endless sequence of architecture, all different but all belonging to the same idea. A work in progress to gain an increasing recognizability of my idea of architecture, starting from classic and renaissance paradigm and controlling the evolutionary process through an artificial life. It may also be a tool to manage the increasing quality of architectural projects, working in the field of possible different path of formalisation.

In the design process every choice is, in effect, a moment of formalization. The options are formal options, and the choice of a formal option is conducted through the preview of some virtual environments. And so these virtual worlds grow up.

When the choice of a design is made, the formalized event is put inside the designing paradigm and the global environment is evaluated in front of the reference possible worlds that, in the meantime, could have been improved. In other terms, as the project develops gaining new shapes and new events, the reference virtual worlds, the thinkable worlds, gain in evolution structuring and lead to desirable possible scenarios.

Managing this evolution, this dynamic accumulation of significance, we can get the tool to measure the correspondence between the subjective posture and the inter-subjective imaginary, that is the imaginary shared by a lot of different individuals in order to give dimension to the quality as the value achievable to generate acceptance.

To manage this procedure we need:

1. The possible worlds, the virtual environment we use getting a dynamic evolution in affinity with the process of sliding between subjective and inter-subjective spheres.

It means that the dynamic evolution allows an increasing complexity, an increase of the possible use/signification, a complex answer/scenario nearest to an objective excellence defined as the capacity of pertinent reply to ever possible and random subjective approaches. To gain the objective spheres is to gain a universe of possible subjective spheres.

2. Every formalization choice we operate in a cycle needs/answer must be proposed again in the next cycle as a new need. With this procedure we can, in time of design, gain two targets:

- A. To close the functional plurality and the accumulation of possible subjective signification, and at the same time to purify our project from the categorical events, from events that cannot escape from a hard subjective point of view.

- B. To build a logic structure to approach the formalization that allows also exceptional events. The exception, in fact, is necessary to operate the jump of the

paradigm to construct the multiplicity of virtual possible scenarios. But every exception, to do that, must be used as a new question in the next step of the design procedure.

3. The sequence of formalization cycles must draw a dynamic evolution of possible shapes, of possible architectural scenarios. This evolution is directly connected with the information and complexity. The number of possible alternatives, of possible scenarios is, in fact, the measure of the resources of the designed environment to reply to the possible needs. It is not the measure of the quality, but it is certainly a good key for evaluating such quality.

The generative software Basilica that I have designed and realized was born to operate inside the difference real/virtual environment, the difference designed event/desirable worlds. Basilica can show the multiplicity of possible scenarios that every design choice can light. It is a device that can generate always different possible scenarios in front of every single composition idea, even single design choice. This results allow us to evaluate the quality of the design process in act.

Basilica gives us a concrete representation of the evolution dynamics of designing idea through the continuous increasing complexity of virtual environments. In other terms, the operative contribution of Basilica is in the explicitness of the dynamic evolution of the project from the subjective spheres to the inter-subjective ones, allowing the evaluation of the increasing quality during the design process.

Using Basilica I have drawn some considerations. Following the possibility offered by this evolutionary project, to generate many different 3D scenarios as a projection of single composition idea, we can considerate that the multiplicity of possible shapes is not concurring with creativity. It is only a possible representation of the idea, as a logic/formal DNA, a post-metaphysical structure of the same idea. This reflection give any working priority to any choice operated inside the evolution logic, to the tools that allow these choices and, so, to the evaluation and control of the idea before its infinite possible realisations inside a shape. (Reference to C.Soddu, "The morphogenetic design as AI system to support the management of the design processes through the total quality of the built-environment". The management of Information Technology for Construction. First International Conference. Singapore 17/20 Aug. 1993)

Madrid and Milan, generated architecture

An example of the professional use of Basilica is the project of enlargement of Prado Museum in Madrid (fig. 5), performed as an evolutionary process of a micro town environment. It was realized with an original software representing our design idea of evolutionary codes of Madrid. The multimedia urban stand (fig. 6) and the multimedia square in Milan (fig. 7) are architectural projects completely generated using Basilica, and its in-

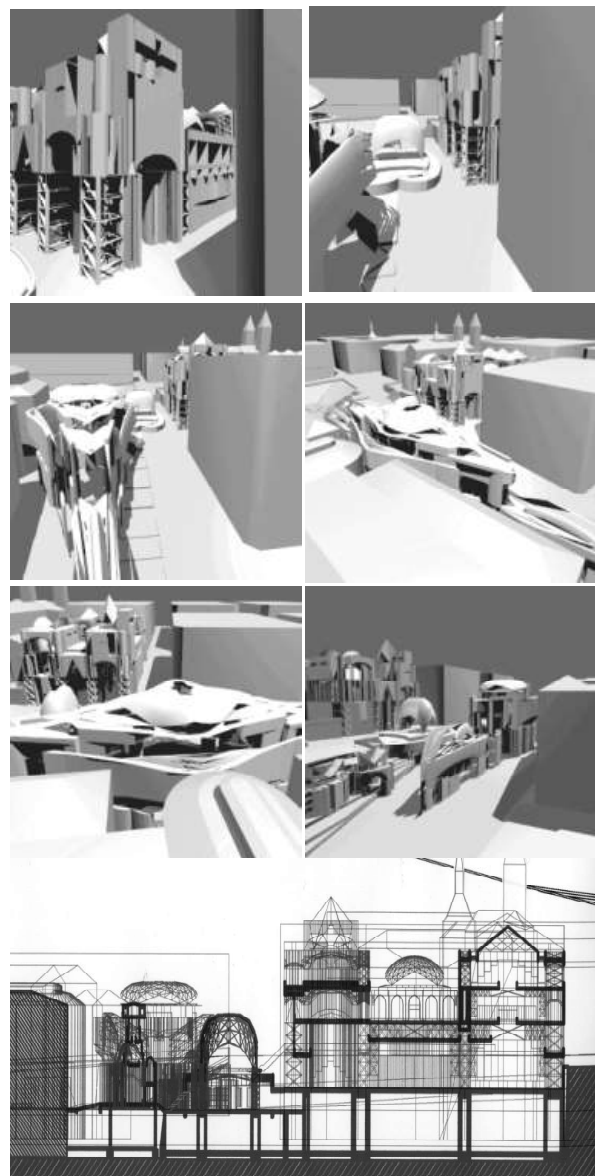


Fig. 5 - Enlargement of Prado Museum

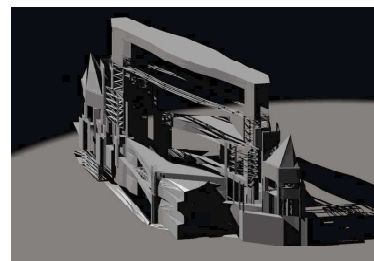
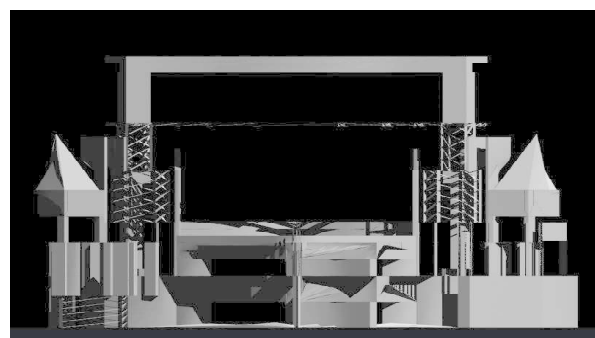


Fig. 6 - Multimedia Urban Stage in Milan

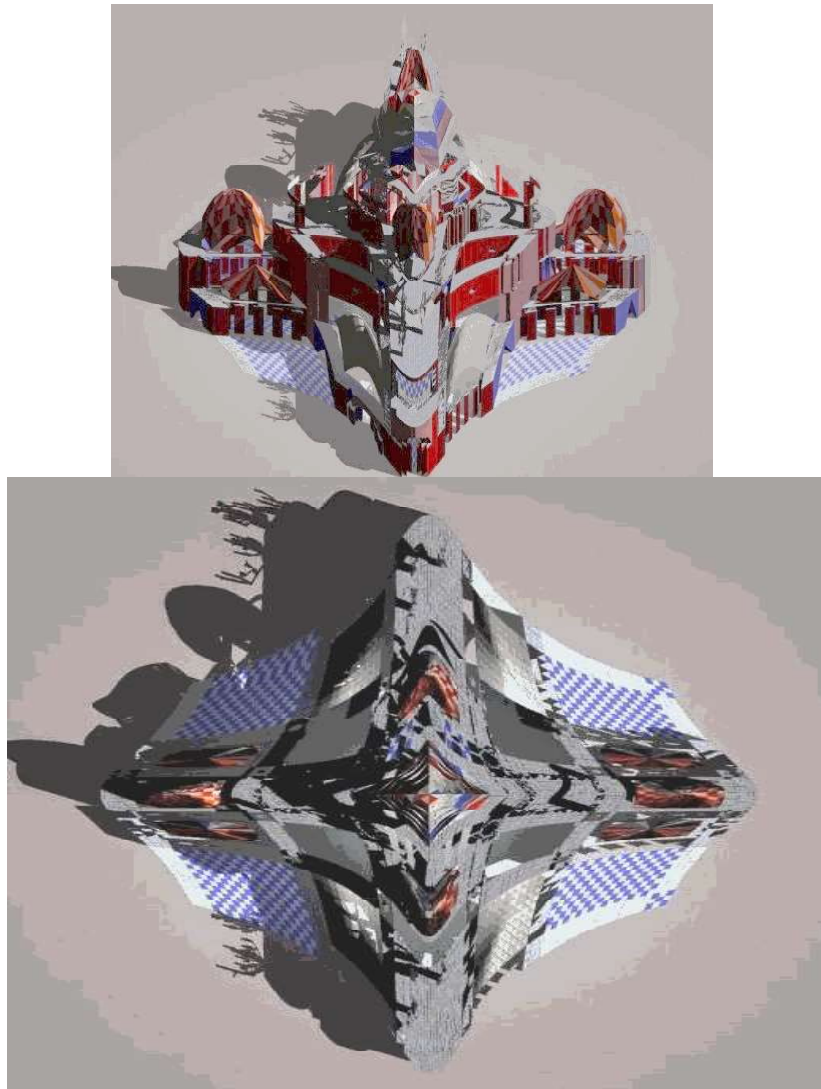


Fig. 7 - New Urban Complexity. Multimedia Square in Milan

terface to control the paradigm of evolution in front of the particular requests for each project.

Argenia, the natural industrial object. The artificial uniqueness of species.

Argenia as generative design of industrial objects is the operative approach to build the DNA of artificial articles and to produce, with the present industrial devices, unique objects, each one different but recognizable by the Idea, as natural articles are recognizable by the species.

Before the industrial era each object was unique, unrepeatable and strongly connected to the identity of a person. This bond, together with the uniqueness and unrepeatable property of the object, determined one of the qualities of artificial objects, a value which went over the intrinsic value, quantified by the materials and by the execution.

The result was, for the object, an extremely slow obsolescence related to the functions (also aesthetic functions) and not to related to the incoming "ultimate

model."

During the two centuries of the Industrial Era, now over, the objects were mass produced. From the assembly line identical products were obtained, and this uniformity was celebrated overestimating the processes of optimization and building an aesthetics of repetition.

But this approach was based on some presuppositions that today have lost their force of axiom, and could be disproved easily for the reason that they are no more respondent to the potentiality and expectations of human beings:

1. The objects realized in series cost less than objects that are different and unique.
2. The optimization of the functions rendered necessary the identification of a "unique" designing result.
3. The quality of the designer, the quality of a particular design idea is the final result, the crystallized scenario of the last action. This is the only possible result respect to the designing idea, it is the unique possible realization.

1. About the first point: the production using digital control can realize, with the same operational costs, unique things or repeated things.

A printer, for example, costs the same whether it prints ten different pages or ten times the same page. The differential of cost belongs to the commands (in our example the text file), to the reprogramming actions in the robot, in definitive to the design.

If the design is an operative metaproject, it will be able to emulate the process to generate the possible results. And to generate these results as they are in reality, as always different scenarios. An operative metaproject can realize these scenarios formalizing them like reprogramming actions, in real time, of the digital control machines, of the robots. In this case, the additional cost, if it exists, is due only to the design operations.

2. The legend of the optimization of a product is over. We cannot identify the result of a design like the only one "necessary", once that we have discovered, or rediscovered the role and the irreplaceable importance of the subjectivity of the designer.

The design is not an inferential process. An identification between function optimization and the design of a single object is not thinkable. Margins of variability of the formal matrixes, of the technological matrixes and of materials will always exist inside of a full satisfaction about the functions. The mass production of identical objects is, on the contrary, an impoverishment, without benefits, of one of the final qualities of the object. The mass production cannot reach the possibility of linking the objects to different human beings, and to their diversified requests. In synthesis the mass production reduces a fundamental function that qualifies the object: the capability to increase the identity and the uniqueness of each human being.

3. The quality of a project cannot be reduced to

the final single result. In order to show and evaluate the quality of a project, it is no more acceptable the action to rebuild the project, a posteriori, in terms of inductive/inferential sequence. It is no more acceptable starting from the result in order to demonstrate that the same result is the only possible result if a determined quality was wanted. If we want to clarify the relation among design, ideation and creativeness we must identify, inside the designing processes, what is possible to emulate using computers and what is, instead, the exclusive dominion of the human mind, the field that is not and it could not be emulable using machines. The idea, as subjective construction of a hierarchy of possible relations and interferences inside an incoming object, is not emulable using a computer, for the reason that an idea is not the fruit of inductive or inferential processes, but of processes of adduction, that is of interpretative processes that strongly belongs to the subjective approach. Once conceived, the idea could be explicated and communicated in two ways: with a series of projects or with a subjective metaproject.

But a series of projects is not exhaustive of the idea, it carries out only some of its possible scenarios. And the process of building a scenario is a process which could be emulated by a computer for the reason that it uses processes of inferential synthesis, as the consolidate procedures of Artificial Intelligence.

If instead of explicating the idea through some results, that however are only some of the possible scenarios, we carry out a subjective operative metaproject, we have carried out a total communication of the same idea.

A subjective operative metaproject is a computer program of Artificial Intelligence that explicates the idea, since it is able to emulate at the computer the processes of building scenarios, and manage these scenarios in

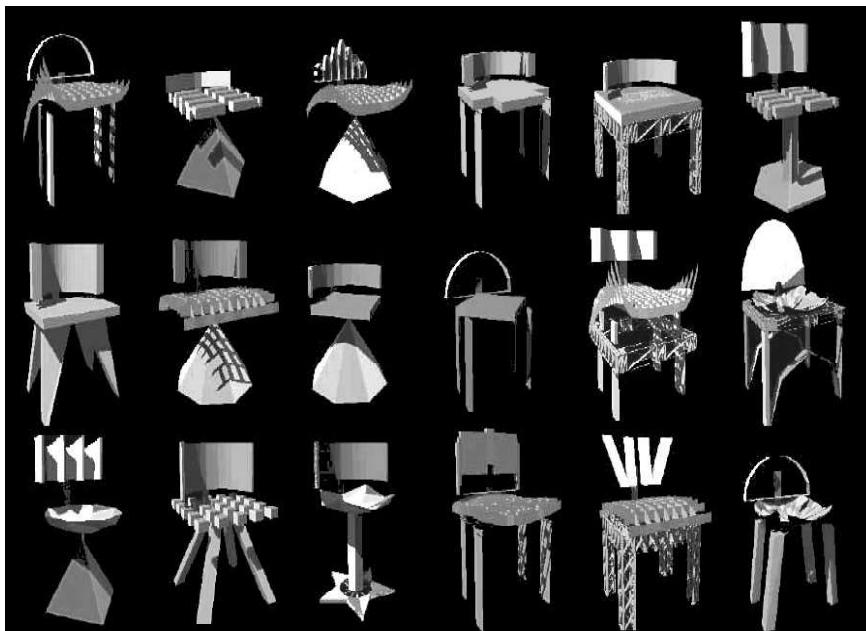


Fig. 8 - Sequence of "unique" chairs generated with Argenia.

the manufacturing sequence.

This design is the Argenic Design.

At this point, if we exclude the relative preconceptions about the cost, about the function optimization and about the recognizability of the design, the Argenic Design is set as a conceptual and operative innovation in order to the realization of the products of the Third Millennium (fig. 8). Unique and unrepeatable products, like the objects the human beings have always made, but realized by the industries. These objects are made in measure of man because they fit to a strong subjective approach of the user. These products are good for the environment, not only because they may be recyclable, but because they have a slow obsolescence. (Reference to C.Soddu, E.Colabella, "Argenic Design", The European Academy of Design, Contextual Design / Design in Context Conference Stockholm 23-25 April 1997)

Picasso, an argenic art

Argenias from Picasso, (fig. 9) an experimentation done using evolutionary devices to increase and control the recognizability of the Picasso's woman portraits. As Picasso has repainted Velasquez, I try to repaint Picasso with a generative art project capable of generating a sequence of Picasso's Woman Portraits each one different but recognizable as Picasso but also as belonging to my interpretation of these portraits. As happens in all cultural activities, different identities are stratified in the

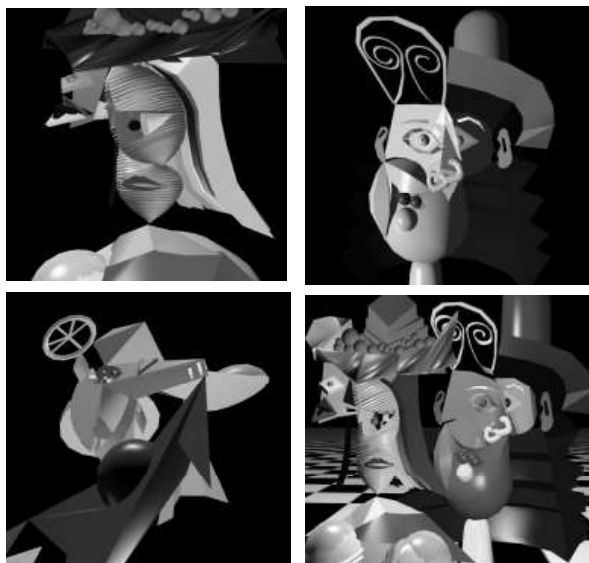


Fig 9 - Argenic from Picasso

same object.

Achieved concept goals

Building and reading the recognizability in evolutionary processes need a *subjective approach*. The possibility to recognize an object belongs to the systematic explication of one's own subjectivity and identity in front of unpredictable events. The identity of each designer is the operative key to synthesize the structure of recognizability. *The subjective sphere is the operative field that can reach an universal communication, because it is the main way to complexity.*

The recognizability occurs as unexpected coincidence between real and possible. In other words, as much the symbolic structure is strong and complex, as much the contingent meaning is ambiguous (the endless sense of Nietzsche), as the event is recognizable. Even if it is related strongly to the idea of the designer, the project is adaptive to the unpredictable incoming meaning that the unpredictable end-users try to found.

The recognizability of the idea. *The idea is a hypothesis of process, not a preview of the result.* It may be a preview of the character of the plurality of possible events. The recognizability is strongly connected with the idea, and may be controlled through the laws of evolution. These laws are subjective hypothesis of "how" the system evolves, and may be represented using a paradigm that defines the progressive modality of auto-organization and reciprocal contamination among events. These laws, and the related algorithms, for the reason that they are operative hypothesis, cannot be interpreted using an analytical approach, but they can only verified a posteriori. Once performed, the Paradigm is an operative meta-project that can generate an endless sequence of different scenarios all belonging to the Idea.

And, finally, a question:

Can we use the beauty of the generated events as measure of the quality?

We all think that natural events are, normally, beautiful.

Referring to Leon Battista Alberti, beauty is the harmony, the proportion and the logic among all the parts of the event. We can identify this proportion and logic with the representation of its evolution through time. Can this complexity, gained with the artificial life of an evolutionary process, answer to the aesthetic unpredictable requests of the user?

The dynamics of beauty is the possible infinite, the abstraction from contingency together with the ability to obtain pertinent answers to possible and unpredictable incoming requests, and ambiguity as multiplicity of possible points of view are the characteristics of beauty.

In a generative project, that is the project of evolutionary laws to gain the recognizability of each generated and different events, we can found in the beauty the last and the more important test.

The beauty of an unpredictable event that is generated by our evolutionary project and is, at the same time, unequivocally recognizable as a pertinent representation of our design idea, may be the confirmation of a well performed and complex evolutionary system.

And it may also be the confirmation that *identity and subjectivity are strongly connected to the evolutionary structure of design*. Identity and subjectivity define the developing field of quality and explain why we cannot think of a work inside the evolutionary processes in design preferring analytical/objective paths and not the developing path that began with subjective hypothesis, as the scientific research does.

Book references:

Celestino Soddu, "L'artificiale progettato", (the designed artificial ware), Casa del Libro Publisher, 1979

Celestino Soddu, "L'immagine non euclidea" (The not euclidean image), Gangemi Publisher, 1987

Celestino Soddu, "Citta' Aleatorie", (random towns), Masson Publisher 1989

Celestino Soddu, Enrica Colabella, "Il progetto ambientale di morfogenesi: il DNA dell'artificiale" (the morphogenetic environmental design: The DNA of artificial ware), Esculapio Publisher 1992.

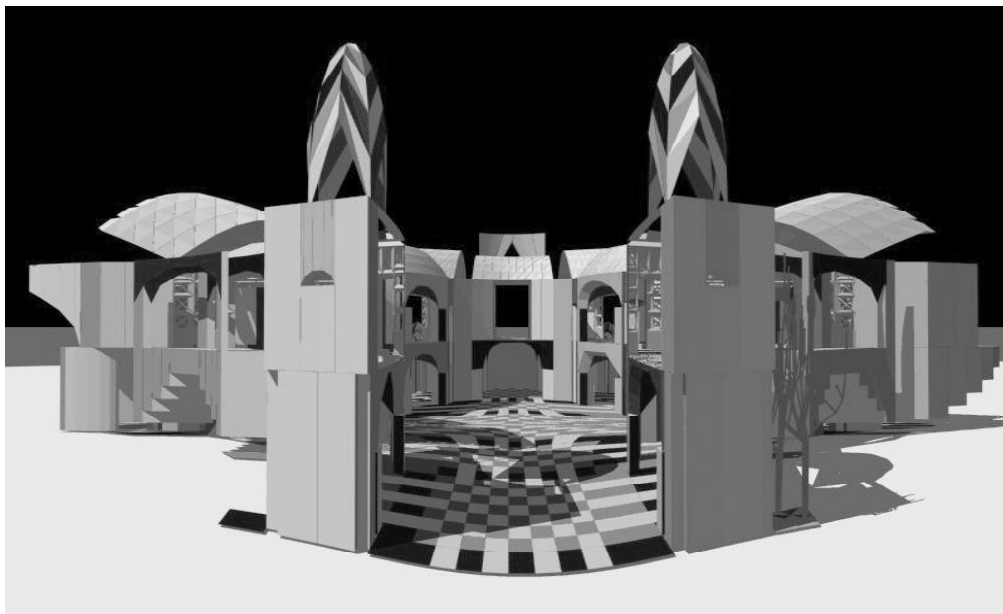
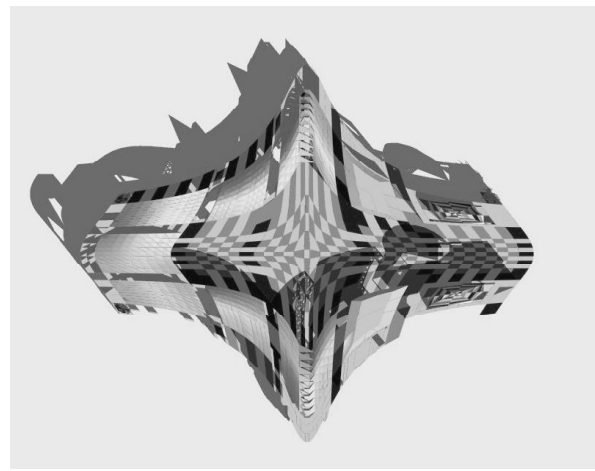
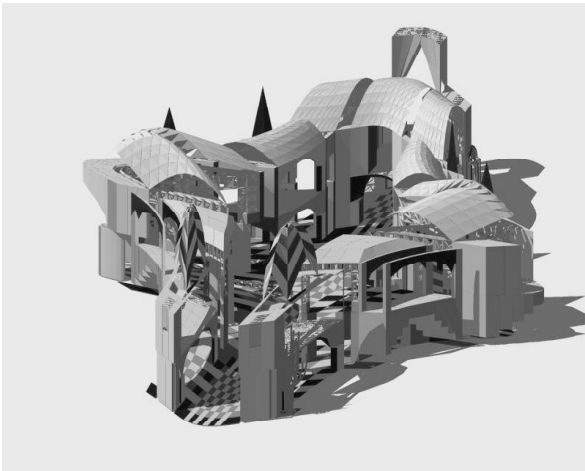


Fig. 10 - Generated architecture. A new urban space in Milan, the "caravanserraglio"

