

# Recreating the city's identity with a morphogenetic urban design.

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The increasing complexity of the urban environment requires that we control and plan the development of any given town without homogenising its internal differences and the peculiarity of its identity. To achieve that, we have designed a software programme based on Artificial Intelligence, capable of controlling the development of the image of the environment as a dynamic mathematical system. This tool enables us to design the morphogenetic code, the DNA of the environment, and, modifying this code and simulating the incoming possible scenarios, we can directly plan the development of the environmental system. This design procedure is obtained by generating a sequence of multiple, completely different, spatially formalised scenarios. Each scenario is characterised by a different virtual development history, yet they all share the same logical approach, the same DNA. The challenge is to design the development of a town by modifying and enriching its peculiar development code rather than merely one of its possible scenarios. Thus, we can increase the complexity of a town environment while at the same time strengthening its particular identity. The case study presented here concerns the evolution of a part of the historical centre of Rome. We have realised this project through the simulation of different possible scenarios. The morphogenetic code that we have used follows our subjective interpretation of the DNA of Rome and of its complexity.

Making cities livable. The city must answer, in a germane way, to the increasing requests and needs of its inhabitants, but above all to the unpredictable subjective needs of each individual, who "lives" the city following his own thoughts and his own desires and his own conceptual paths.

The fields of relevance of these requests are manifold: from the contradictory requests concerning artificial and natural ware, to the needs concerning the recognisability and the preservation of difference; from the needs concerning the adequacy, in real time, of the evolution of human life, to the need to find in our cities the patina of time that tell us we are alive.

But all these needs are not so easily classifiable in optimised data that are legitimate for all. Each of us is unique and unrepeatable, and our needs are, above all, subjective needs. The city, to be a livable one, must know how to respond to the unpredictable subjective requests of each of its citizens.

The city must be adaptable to the multiplicity of subjectivities, but the same time must be recognisable, unique and, more, it must preserve its identity.

A precise relationship exists among the subjectivity of needs and the identity of place. Everyone gets the answer to his main need which is to live in an environment that respects the uniqueness of the individual. This is possible only in a city in which the identity, difference and oneness of the same environment have been saved. An environment homogenised with an approach that follows only optimisation standards gives birth to a want of response in our subjective search of the happiness, and of the sense of our presence and existence.

But what does the "identity" of a city mean, and how is it possible to save this identity from destruction, from the homologation of the image and from the levelling of the performances?

We can follow two different paths, that depart from different and contradictory presuppositions. A way is to save the existing events by freezing them because we read the identity of an environment as belonging to a particular static equilibrium. But this approach runs the risk of transforming each city into a museum

and could not be an approach that brings us very far if applied to the entire city and not only to some exceptional existing events. The city, considered as a structure which identity is part of its contingent equilibrium, doesn't evolve and die, totally losing its identity as a living environment.

The other approach, even if it is more difficult to manage, sees the identity of an environment in developmental procedures, in the modes, consolidated by the time, of controlling the increase of complexity, and that represents the culturally unique and unrepeatably matrix of the site. Like an olive tree that, overworked from the wind and from the rain becomes more and more an olive tree. It enhances its own identity, while, if grown protected in a bell of glass loses its own identity because it has not the occasion to explicate and represent its character. Following the same way, each city explicates its own identity living the perpetual shifts of cultural moments and unpredictable events, living and using the occasions created by the increasing of the complexity of the life of the man, and of his needs, but also created by the changing of each subjective approach.

This way is, however, much more complex than the first, and more difficult.

<font color="#FF0000">The structure of our approach.</font>

The hypothesis that we present in this paper is our response to a challenge: to design and check the identity of a specific urban environment identifying and using the developmental code of that city. This means that we can abandon, if not in exceptional cases, the control of the evolution using the operations of interdiction, that are now the rules that break the increase of complexity of the cities. The objective is to operate by looking at the possible, identifying the fields of evolution, building the codes that will enhance the city's identity. This tool should operate without using the creation of cages, but with the custom of design modes that guarantees the quality of that is proposed through the relevance of the cultural approach that identifies the genius loci, even if the design proposal is new, unpredictable and subject to the cultural identity of the designer.

These modes could be explicated and incorporated into design processes if they become morphogenetical codes, an operative DNA of the city realised like a control software that regulates the modes of increasing complexity of the environment.

Because 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 recognisability of an urban environment is removed by simplification. And the typological optimisation it is a simplification. The complexity involves the adaptivity to 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 answers, can make our cities livable.

The projects we have done are structured and represented as Morphogenetical Codes of specific towns or of a species of town, like Medieval Towns in Italy, or towns with a waterfront like Montecarlo, and so on. These projects can generate an unpredictable sequence of incoming virtual scenarios that represent the "idea", the identity of these cities, and allows us to control this identity in managing, following and increasing this unique identity, the evolution of these environments.

<font color="#FF0000">Structure of the town design based on the Morphogenetical Code.</font>

We have developed a design tool which offers the possibility of computer simulation of the formal dynamics of a town system, identifying its particularities starting from the instability of the system and simulating the transformations of urban shape through time.

This original software is designed to produce computerised three-dimensional models of possible urban patterns. These models, although they are produced with the same series of algorithms, are always different and unpredictable.

The capacity for irreversible events to modify the structure of urban growth systems is represented by the plurality of formal potentials, of scenarios that the system can produce.

The software tool we have developed is, therefore, an instrument capable of generating dynamic sequences of urban shapes through time. It offers an almost infinite variety of possible shapes, thus realising a pertinent representation. The objective is, in fact, to illustrate the dynamics of development of urban shapes, not to concentrate on one single ephemeral moment of equilibrium.

The incoming urban scenarios are obtained from the previous scenario using a time simulation, with the artificial life of a virtual history. So, let us first analyse this process, in its overall structure, and then, step by step.

The scenarios we use to initiate the virtual evolution are not a representation of moments of equilibrium of the system but of moments of disequilibrium. We read the city as a dynamic system in dynamic evolution.

What does this assumption mean for the urban system we want to represent? The algorithms we have used for the initial urban scenario are not only

different and autonomous but can also be contradictory. And not only each single algorithm but also the series of algorithms, that are not reciprocally integrable. For example, the series representing the logic of urban growth can contradict the series for architectural formalisation.

The simultaneous or cyclical utilisation of these series (whose tends toward disequilibrium) gives rise to the virtual beginning of time.

Each new architectural form modifies the urban shape, each new urban development influences the style to come, contributing irreversibly to a town's history.

Although the process occurs within the same logic, each simulation starting from a scenario produces different possible incoming scenarios. The fact that each scenario derives from the previous one renders all incoming scenarios recognisable as "species", and the urban image produced is always recognisable as belonging to a particular town. We can work with the identity of each town, with its uniqueness.

Let's look, in more detail, how morphogenic simulation is carried on with the passage of time in the history of a town. To simulate the passage of time, it is necessary to define an initial situation of disequilibrium when initiating a series of transformations. The initial situation of disequilibrium is determined through a series of disconnected algorithms representing different development sequences, often contradictory but that must operate simultaneously. The increasing complexity in the tracing of urban shape simulates the series of irreversible events in the history of a town.

Let's follow this cycle starting from any point - for example, a new architectural form:

1. The urban context generated until this moment is compared with a series of algorithms in progress operating to represent the possible/desired delineation of a new level of complexity.
2. The result is a series of growth requests corresponding to the expectations of incoming scenarios with respect to the previous one.
3. These growth requests are directed to a series of algorithms representing one of the logical pathways adopted for the formalisation of the architectural object. The programme is designed to make an evaluation of functional interstices and margins of feasibility within the framework. These margins are defined as design opportunities to increase shape complexity that goes beyond the programme requests. The formalisation is made by the software not using a database of elements, because this kind of answer is predictable, and thus, not suitable for dynamic processes. The process occurs activating simultaneously many different devices (formal, geometrical, dimensional, integrators of complexity, etc.) that are autonomous, not necessarily congruent. The unpredictability of the outcoming scenario is due to the use of resonances between the linear flowing of each device's activity. This resonance generates a non-linear output.
4. The result of this operation is an architectural event more or less exceptional, depending on the randomness of the generating instruments. This event is then compared with requests and its acceptability is evaluated "a posteriori". If the event is normal, it is accepted and if it is exceptional it can be accepted or

not according to the availability to the exceptions registered in the program/morphogenetical code. If it is not accepted, we go back to point 3.

5. The event is inserted in the context. The scenario increase its complexity. The event becomes irreversible. In fact, even if it is eliminated afterwards, the fact that it has existed has conditioned the urban shape evolution. 6. The code used till this moment must be adjusted after this irreversible modification. It can be a matter of simple adjustment if the architectural event is to be considered normal; however, in the case of an exceptional event it may be necessary to modify substantially some proposals of the code: This requires the passage from one form to another one and can be represented using Rene' Thom's catastrophe theory, regarding discontinuous changing processes. This variation can be described as the passage from one attractor to another, recognising the attractor as a model capable of representing the formal characteristics of an event in a dynamic sequence.

7. The new context is then used starting again from point 1 and continuing until time has been entirely simulated and the initial shape transformed into that of the possible incoming one.

### **Case Study: Rome**

The identity and uniqueness of Rome is due to its specific way of living

history, time, contingent events. An operational hypothesis to design a subsequent growth of this city must be based on the identification of a developmental code that reflects the developmental tendencies, the modus operandi of this city, the DNA of Rome.

Our design is the proposal of a morphogenetical code that represents Rome and his developmental way. In operational terms, this project is a meta project/software realised to be a tool to hypothesise and generate a set of possible incoming scenarios. These scenarios must have, in their difference and unpredictability, the character and the identity of the Roman urban environment.

This design approach doesn't operate on the city as a static system, but directly on the urban dynamic system that, in the meantime, is evolving, describing the manifoldness of its possible evolutions in real time.

Our designing idea identifies a possible developmental code able to simulate the modes that characterise the evolution of Rome. This code is based on considerations extracted from an imaginary of Rome, from Stendhal to Piranesi, from Michelangelo to Borromini, but also and above all from the subjective fascination that the vital structure of this city operates on us.

This developmental code that we have represented and transformed into an operational tool, a software/meta project, woos the challenge of representing the idea and the identity of Rome not proposing again the same events that look like the existent ones, but enhancing the uniqueness and identity of this city like it have always revealed: giving birth to unique and unrepeatable sites that widen in time and that stratify the texture of the Roman paths of discovery. The unsuspected presence of unpredictable architectural events explicates the immanence of the possible. And this presence, in their differences, sometimes casual, enhances and fix the identity and uniqueness of this city.

This uniqueness and unrepeatability emerges at every level, and appears, like a fractal sequence, in the spaces, in the varied plazas of which Rome is composed. The same plazas are, in the proposed developmental code, the bearing structure of the simulated evolution of the city. The objective of this virtual evolution is to save and increase an environmental identity that, until the last architectural event, till the unpredictable detail, each time that we pass, would be able to unexpectedly discover or rediscover following one of our contingent moods, one of our subjective new codes of reading.

By designing a code, a DNA that represents the immanence of the possible of this city, we can operate on the structure of the exemplary complexity of Rome, and give birth to urban environments that allow to find again the unpredictable infinity of possible subjective paths of discovery.

It is not possible in fact to think that we can describe the urban complexity with a unique gesture, with a design that bears from the idea of building a situation of equilibrium. We cannot propose, especially in Rome, a static situation, an architectural event based only on the contingency of a functional application related to a specific temporal moment. This approach means the annihilation of the idea of Rome, of its complexity, of its adaptivity to the possible and of its ability of be, however, a germane and essential response to the manifoldness of the possible subjective applications.

Our challenge is build the complexity, like the design of a Roman site requires, by triggering the developmental "modus" of Rome, operating with the simulation of subsequent stratifications of complexity, also if we adopt a virtual time simulated with an operational paradigm able to stratify different moments, and which find again in the "felicitous randomness", as Simmel wrote about Rome, the occasion to increase the identity of the place, its uniqueness.

The design of a developmental code, of a morphogenetical code, it is an architectural and urban complete and recognisable design. A design that is different from a traditional design, which doesn't seek a unique and final solution. It generates a universe of possible scenarios representing and identifying, in their plurality and difference, the same "genius loci", the same structure of environmental complexity.

Each scenario is unique in its difference, in its being an individual belonging to a species. It has gone through a contingent and bumpy temporal path, increasing its complexity and uniqueness.

Even if, to realise our project, we opt for one of these scenarios, having checked its quality directly in the genetic code that has given birth to it, guarantees us of adaptivity to the possible, of its strong belonging to Rome identity and uniqueness. And we can presuppose that these characteristics will grow with time, and they won't be only an ephemeral season of flowering.

<font color="#FF0000">Procedures used in the construction of the developmental code of Rome.</font>

We have considered that the character and the acknowledgment keys of an urban environment belongs more to the developmental procedures consolidated in local cultural tradition than to the individual architectural events.

We have identified some characteristics, some developmental procedures that, according to our subjective criteria, characterise this urban environment.

1. The "piazze". The evolution of the urban system is based on the empty sites, the squares. The building system evolves all around these sites that flag the identity of each place. This developmental paradigm, that we have transferred in our proposal, is characterised by the ability to increase the recognizability of each individual "piazza", increasing its peculiarity and, at the same time, its recognisability as Rome, just as it is legible in the historical evolution of Rome.

2. The uniqueness of architectural events and urban recognisability. The developmental structure of Rome is so recognisable that it allows, without fear of contamination, the structure of differences and the presence of exceptional events. Better, Rome owes its recognisability to the presence of a stratification of complexity and not, as in other cases, to the presence of particular formal and/or technological matrixes exemplary of a specific cultural and historical moment. Rome is the city that, more than any other, has enhanced its own identity and recognizability by passing through extremely different historical moments, living and transforming extremely aloof and contradictory cultural contributions, preserving, and at the same time evolving, a Roman way to go on and to look at the future. Each site, each ward, each plaza has increased, over time, its own recognisability and uniqueness. At the same time, it has contributed to increasing the uniqueness and recognisability of Rome, in its global image. If this evolution stops, if we think only for a moment that we can stop time by building an equilibrium, we deny this identity, we would remove the recognisability and uniqueness of Rome. The organisational paradigm that we have built into our design, and that allows us to check the developmental modes toward complexity, bears from the idea of using the contingent and the casual for "training" each urban event, increasing its complexity like a germane response to the need for uniqueness of each place, of each event, of each detail, but also as an unpredictable response to the need of be, however, Rome.

3. The basilica. The developmental structure of Rome is constituted not only by the urban void, by the plazas, but also by the basilicas, the big covered plazas, of the "thermae" considered like the fractal symmetry of the overall urban structure based on the plazas. Like a city's calidarium, Piazza Navona is the shelter from the north wind. The playful component is essential in this sequence and, also, in the recognisability of the form of the plazas and of the fountains. The organisational paradigm that we have built to operate the subsequent evolutions in the historic centre from Rome, reflects this type of performance, this way of describing the complexity of the spaces. The bearing elements are the empty spaces that, in the specifics of the contextual site of the project, enhance their own identity in the progressional difference of their rapport with the green lawn, using the green as a playful response to the field of human needs concerning naturality.

4. The design of the natural sites. A consolidated tradition is, in Rome, the use of natural elements in the developing city system. The natural environment, as is common in Italy, but in a more accented and unique way, it is a characteristic of the environment performed to the measure of a man, to measure his necessity but also his pleasure. The natural events reflect and answer to the human need of naturality. It has been carefully designed to answer to this human need. The natural event is, in other words, an artificial ware of the best quality. Often it is, like in the parks, realised with trees and meadows, but also, it is often a right response to our need of natural complexity. In the Roman fountains, particularly in the Trevi Fountain, we could read this aspect of the "genius loci" of Rome, this awake and intentional way to report to the form of nature. This approach to natural events belongs to the logical modes adopted in the construction of the urban complexity. An approach that tries to get a recognisable response to the demands, also the playful demands, of Roman people. But not only of the Roman people, also of whoever because the responses of Rome must be, in the first place, strongly adaptive to difference, because Rome does a boast of preserving differences and uniqueness.

5. The relation between artificial and natural environment. A way of growing that belongs to the identity of Rome is identifiable in the sequence of progressional approach to each natural site. If we want to characterise a serviceable developmental code of the centre of Rome, we can look to the sites where this rapport between the natural and artificial environment has already been expressed, always in different ways but respect to the comparable situation: the stairway of Trinita' dei Monti and at the Pincio. These natural/artificial sequences marked by the construction of architectural events have amplified and redefined, over time, the morphological structure of the seven hills that has been one of the "starting data" at the base of Rome's evolution.

The morphogenetic code we have designed, as we can see in the sequence of the possible incoming scenarios generated by our tool, is in tune with the Roman idea of the presence of multiple paths of discovery among the artificial and natural.

References:

[www.generativedesign.com](http://www.generativedesign.com)

Images:

Sequence of views of two of the possible scenarios that we have generated, with our morphogenetic code, to simulate the evolution of a part of the centre of Rome. The scenarios are represented using the same sequence of points of view and show two parallel histories of the same virtual time of development.

