Reading morphology through diagrams. Exploring methodology

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Abstract. *The relationship between reading and designing can be found in Saverio Muratori's theory. At the same time reading, as a means to understand the contemporary city, meets urban morphology analysis in 1979 in Gianfranco Caniggia e Gian Luigi Maffei "Lettura dell'edilizia di base" in the chapter "Lettura delle strutture edilizie". In this context, reading means understanding urban structures using analytical tools like maps and types to produce different outputs. However, the contemporary city is framed by a co-existence of variable times where past, present and future are linked and overlapped. To explore the complexity of reality it is necessary to define new analytical tools capable of keeping dynamicity. Grounded on the instrument used by the Italian School of Muratori and Caniggia, the following research questions the feasibility of the mapping method as a tool to understand complexity produced by transitional events in contemporary scenarios. Studying the diagrammatic component of the maps reveals its role in understanding urban transition. The diagram as a medium (Gleiter and Gasperoni, 2019) to understand and generate processes can be a functional experimental machine that defines relations between cities' patterns (hidden and formal) and their transformation. Through diagramming the maps of San Bartolomio (Muratori, 1959) and Via Rovelli (Caniggia, 1963), the research explores new methodologies helpful in the transition between the analogical study of urban morphology and data-driven design. The outcome is a method that merges maps and types (diachronic and synchronic) with the help of diagrams, opening the possibilities of multiple representations of urban transition.*

Introduction

The introduction of the time variable in reading the city leads to the interpretation of the continuous evolution of urban elements as a constant relationship between fixity and mutation. In such a way, it offers a specific facet to research in the discipline of architectural and urban design, which must encounter and measure itself with the becoming of the contemporary city (Mei, 2014). The shape of contemporary cities can be described as a changing dynamic system subjected to continuous stresses over time. From this perspective, architecture enters the paradigm of complexity (Obon, 2022), and consequently, cities are associated with the concept of complex systems.

Complexity theory occurred with the revolution of the XX century with the introduction of three theories: cybernetics (Norman Wiener), informational theory (Claude Shannon And Warren Weaver), and system theory (Ludwing von Bertalanffy) (Obon, 2022), and it became relevant with the study of Edgard Morin.

It is possible to describe the attributes of complexity rather than give a definition. In system evolution, complexity is configured as the intermediate situation between equilibrium and chaos. It is a dynamic condition that tends neither towards immutability nor chaos. In this particular condition, a system manifests intelligent behaviour of adaptation to environmental stresses and exhibits specific properties (Padoa Schioppa, 2015). Complexity theory thus deals with systems whose structure is emergent. This property is a hallmark of the city, the economy, and the ecology within which new elements evolve (Batty, 2018). Meanwhile, the city as a complex system is an entity in continuous change in which the transition process from one state to another is the present reality. The city takes place in a time in which past, present and future are overlapped (Mei, 2014). Its transformation deals with an external and internal system of forces through a non-linear dynamic transition (Easterling, 2019). From this assumption, the study's focal point of this research became the transition process between two states, A and B, that are not necessarily in equilibrium. Moreover, the balance between A and B is not defined as an exact moment (Neyant, 2019). Therefore, there can be categories such as instability, contingency, unpredictability and lack of control, which express the indeterminacy of the complex system of predicting changes (Padoa Schioppa, 2015) and can be useful in considering the contemporary city and interpreting its change. Reading the transition process in this never-ending transformation gives the perception of opening up new possibilities to the project in architecture. The term transition within the city study highlights how dynamism and complexity are two fundamental characteristics in the contemporary environment (Wowo, 2015). The following contribution thus emphasises two main points: transition as a phenomenon to be studied and transition as a matter of representation through the map.

The image-based thinking characteristic of architectural practice reasons profoundly through the use of a specific convention: the map. From its historical origin to its current use, the map intertwines the reading of the territory with that of the inscription (Leader, 2011). The mapping systems as a tool for analysis and visualisation are upstream of many urban studies (Muminovic, 2019). The map does not have the only feature of a descriptive tool, moreover is a theoretical model (Palma, 2000) capable of representing reality by defining a specific orientation of space (Muminovic, 2019) both in terms of time and interpretation. The abstraction process characteristic of the map thus provides a possible trajectory for reading space (Leader, 2011). However, the map is an articulated tool that, although it presents characteristics similar to those of a diagram and makes the shape of the built environment explicit, leaves latent the relational information typical of a dynamic system. At the same time, maps show permeances very well but need help to perform for the permutation. Reading as a keyword to understand the structure of the

urban environment is formalised by using the map as a reading tool to unravel urban transformation by looking towards the city's project. From this point of view, the maps can be considered as a diagram that is forgetting to do its job (Hall, 1992).

Transition connecting reading and design activities

The word "reading" is often related to "the project". This relationship is already found in Muratori's method, which considers the city an aesthetic synthesis defined by the formation process (Muratori, 1959). However, reading as a verb to understand the city concretely encountered urban morphological analysis in 1979 when the term appeared in Gianfranco Caniggia and Gian Luigi Maffei's book "Lettura dell'edilizia di base" in the chapter "Reading Building Structures". Both the code and the instrumentation used to read it allow us to understand what the object is made of, but also to understand where it comes from and how it came to be. The highest performance in reading is achieved when the most effective representation of how a building object is made with its stratifications and transformations (Caniggia, 1979). Reading is understood as a compendium to the project. Above all, reading is a fundamental principle to developing a tool in a methodological framework.

The Italian morphological school, in this sense with its studies on Venice (Saverio Muratori) and Como (Gianfranco Caniggia), defines tools and methods, such as typological maps and types variations, capable of showing the invariants of transformation (i.e. its structure) through a synchronic and diachronic process of decomposition. The structure of the present city explains the past and vice versa, within which the project fits as an outcome of the reading process. From both Muratori and Caniggia, the importance of studying the city is not just about trying to understand how the city changed over time but also how to develop a method to show this transition using the maps. Some characteristics of the morphological map give different interpretations of the transition process in terms of time, scale, deviation, structure and point of view. Each map of Muratori and Caniggia highlights the difference in the mapping system in showing a dynamic process. Muratori maps are made from surveys and cadastral documents, it shows the ground floor of the building identifying doors and stairs but without information on windows. With his students' help, he reconstructs the different phases in which the development of the neighbourhood, St. Bartolomeo, can be described. Each map is made separately with the same level of information but without a clear link or willingness to the overlapping phases. Caniggia, instead, is working differently to show the transition between the roman settlement of Como and the city as it is in the nineteenth century. The maps overlap the nineteenth-century street pattern with the roman transformation over a different time. Each map compares the survey with the conjectural reconstruction of Roman Castrum. It is clear the intersection between the elements of the maps because of the static element of the Roman Castrum repetend in each comparison.

Comparing the characteristic of the maps that show the transition (time, scale, deviation, structure and point of view) with the diagram logic, it is possible to define the diagrammatic components of the maps: abstraction, relation and reaction, sign and symbol, synchronicity, diachronicity, subjectivity, multiscalarity and multimediality. In this sense, the map is similar to a diagram. This vision leads the map as an analogical statical tool to a diagram as a form of technology that can keep the city's dynamicity alive.

Methodology

From focusing on definitions of methods, analysis and project tend to be separate practices; instead, links need to be defined. The perspective of the project changes: analysis does not

aim to establish what already exists, and the project does not express itself as a desire for invention. Between the two, a mechanism of mutual exchange is established within which there is the recognition of pre-existing models that are not taken as prior judgement but are re-formed (Rispoli, 2016). For this reason, in developing a new tool able to keep the complexity of the dynamicity alive, it is necessary to consider the need to question the tool continuously while designing (Fig. 1).

The research experiment focuses on transforming Muratori and Caniggia's map into a diagram that can stress the critical component of the representation. Therefore, the objective is not a graphical rework of maps but defines a critical view of a tool that can read the city and simultaneously provide a lens for the development of multiple future scenarios. It transforms an analytical tool into a generative one capable of unveiling processes, relationships, actions and reactions. Its generative feature is the peculiarity of the diagram as a medium (Gleiter & Gasperoni, 2019) helpful in representing transition. The transformation of drawing as a representative medium into a generative one marks its use in the generative design process. Drawings can be diagrammatic if used diagrammatically (Gasperoni, 2022), and maps can be if the diagrammatical component is stressed out in the formation process.

The research method is identified in the diagrammatic experiment in which the dynamic components in the map are stressed. The process of transforming the map into a diagram is divided into two parts. The first is to comprehend the representation of the transition event on the map, and the second developing the critical instrument of the diagram.

The case study used comes from two methodological books on the analysis of the form of the city. The maps of St. Bartolomeo (from the book "Studi per una storia operante di Venezia" by Saverio Muratori) and the maps of Como and Rovelli street (from the book "Studi per una città. Como" by Gianfranco Caniggia) are the two emblematic example of the Italian morphological study. The method developed by the two scholars represented transition and urban change in time, comparing different layers of the evolution of the urban pattern. The emphasis on the map is instrumental for studying the city from a perspective of understanding and acting on urban environments.

The first part of this analysis focuses on redrawing and understanding the map of St. Bartolomeo (Saverio Muratori) and Rovelli Street (Gianfranco Caniggia) as a starting point for the analysis. For each case are defined the macro-phases of the area of transformation (Fig. 2). For St. Bartolomeo, Saverio Muratori defined four phases of transformation from the 11th century to the 19th century. In the same way, Canniggia conducted the study on Como on five phases of expansion of the roman settlement compared with the city of the 19th century and a specific analysis on the case of Rovelli street. The maps are read and ultimately interpreted to understand the tool's logic and the information carried out by Muratori and Caniggia. Within the individual phases, several expansions are therefore identified in extended timeframes. The macro phases of transformation are understood by fragmenting into areas of interest in which variations and changes in the shape of the built environment can be recognised (Fig. 3). The zones of interest have been identified in the map and the written text that recounts the transformation phases of the St. Bartolomeo district and Rovelli street. Therefore, some direct information can be deduced by interpretation and further identified in the construction of the diagram. The macro-phases are subdivided into micro-phases of transformation analysis, in detail, the transition from one state to another of the single area. In the representation, each of the microphases is divided by its time phase decomposing the maps in a different part of scale and entity of the transformation (Fig. 4). Each piece builds the gussets to be introduced into the diagram. Therefore, the map's transformation is assembled, defining relationships of scale, time,

perspectives and dynamics and identifying signs and symbols.
The second part of the reading highlights the generative rather than the descriptive character of the method, seeing the diagram and its functioning as the protagonist. Reading, in this case, means defining a critical instrument that has as its basis the functioning of the transition maps analysed by stressing the diagrammatic components of the map itself composed of temporal, spatial and dynamic variables. Place and time are discriminating factors in reading the urban fabric through the map. Above all, time is the structure of the dynamic component that has the task of showing the transitions of urban form. In morphological studies, the mutations that occur within the city can be broken down through cultural and temporal lenses. The variable "time" in the reading of the city leads to interpreting the continuous evolution of "urban facts" and the continuous relationship between permanence and permutations (Caniggia, 1973). In such a way offers a new research tool to the discipline of architectural and urban design, which must confront and measure itself with the becoming of the contemporary city and its transition. The time variable is used to relate the plurality of times of the contemporary city that moves between past, present and future to define a new character. The mutations that can be found can therefore be defined as diachronic if they occur in the same cultural area in the same period (Caniggia, 1973); if, on the other hand, the mutations occur in a specific and instant time, taken as an abstraction, they are identified as synchronic (Caniggia, 1973). Time and scale built the principal axes of the diagrammatic tool (Fig. 5). The x-axis contains the diachronic variation and, therefore, the succession by phases of changes within the city (diachrony represented by the invariants). The y-axis contains the scale of the urban tissue from the territorial level to the building. Another axes, the z-axis, contains synchronic variations shown in the diagram as a section in a specific time of interest; it shows the typological variation and the permutation of the transition process. The reconstruction of the diachronic variations takes place in successive changes of scale, identifying the phases of the transitional map as the first component, represented by icons in the first row at the territorial scale (the scale in which the two cases of St. Bartolomeo and Rovelli street are less represented but described in the specific methodological text by Muratori and Caniggia). The second part of the analysis is on the city scale, going into detail with the urban tissue analysis. So for each micro-phase previously defined, there is a subdivision in different scales of analysis constructing the tool's transcalarity. As described in the premises, to define the city as a complex system is necessary to reconnect the different scales of transition of the urban environment (Padoa Scioppa, 2015). Finally, at the architectural level, the relationship between buildings can be defined, and it is possible to understand the typological change within the city. Once the transformations are defined on each scale, relationships can link the micro-phases. The links are defined through a relationship of strength between them, identifying strong relationships between areas of homogeneous fabric and weak relationships in the case of neighbouring fabrics where there are indirect influences between transformations. Moreover, the relationships connect all the time into the diachronic period.
Synchronic variations are identified differently from diachronic ones. These define a mutation concerning a primary element, which is the type. For this reason, representing diachronic variations identifies the process, while synchronic variations represent the exceptions and are easily identifiable through a section. The change of a basic form is identified by cultural, historical, social, territorial and morphological variables (Caniggia, 1979).
The final output relates the diagram's components to each other to identify the permanences and permutations. The outcome, therefore, concerns the identification of permanences that are directly legible on the map and permutations that are difficult to interpret from the map

are instead identifiable from the synchronic sections. Within diachronic development, it is possible to define fixed elements that constitute the structure of the transformations, which cannot be replicated because it is composed of unique and specific rules. Meanwhile, from the synchronic section, the permutation can be defined, although invisible on the map (Fig. 6).

The diagram of transition

The experiment has been conducted on both St. Bartolomeo and Rovelli Street, and the result is transforming the typological map into a diagram of transition.

From the two re-elaborations of the map of Venice and Como, it is possible to draw considerations on the concept of permanence, which is the core of urban morphological analysis, and permutation that is a brand new direction in the dynamic study (Trisciuoglio et al., 2021). The ultimate aim of the analysis of method and instrument is to subvert the duality between permanence and permutation. As mentioned before, the typological map aimed to recognise the permanence inside the city. Starting from their epistemological frame, the maps of Venice and Como, are aimed at the study of transition, a phenomenon that is based on behalf of the methodology within which the maps are inserted, on the static concept of permanence. Both the Venice and Como maps suggest, through the use of layers of succession and overlapping crating dynamicity, the use of the transitional paradigm as an unveiler of changing urban elements.

In the case of Como and Venice, the map as abstraction takes on a precise role. The maps do not serve to represent a state of affairs but highlights how behind a permanent sign within the urban fabric, it is possible to reconstruct a diachronic and synchronic evolution (even conjectural) that explains the transformation phenomenon. The maps should, therefore, not merely overlap but be interpreted to illustrate, even schematically, possible correlations between different periods of expansion. Therefore, understanding permanence correctly is a process based on the construction of the map and its informative character by choosing to represent successions. At the same time, reading the permutation with maps is not immediate, but it comes from external consideration not directly readable on the map.

Permutations, unlike permanence, can be represented by symbols. This is because the concept of permanence and its narration within the map and transition narrative is not fixed but depends on several variables. The significant output from the analysis of these two case studies is not so much the definition of the specific permanence occurring in Venice or Como as it is to identify what kind of changes and how they are regulated, but above all, how they can be understood within the urban fabric. Thus understood as an exception within a presumed rule, the permutation is composed of the event that generates it and the combinatorial variables that influence its formal definition. Permutations like permanences are the result of comparing different scales in different city times. This leads to the reasoning that the whole idea of permanence is an illusion. However, the term architecture is often associated with the belief of a profound structure not prone to change, every object and every architecture when it enters into relation with time changes. Instead, the possibility of variation opens up precisely because the replication mechanisms are imperfect (Ingold, 2019).

Similarly, considering permutations for the construction of a new tool capable of reading the transition allows the dynamic component of the design to be included already within the analysis. The dynamic concept linked to the permutation thus makes it possible to define an investigation tool that can be interrogated throughout the entire design process. Moreover, the final output is not predictive of the project but provides multiple scenarios that can expand the regenerative horizons of the city.

Conclusion

According to Stewart Brand, architecture focuses on permanence (Brand, 1994). The term architecture is often associated with the belief in a profound structure that is not prone to change; however, every object and every piece of architecture, when it comes into contact with time, changes. Architecture, and with it, the city, modifies and adapts even without any particular predisposition to change. In fact, buildings are part of the world, a world that unfolds in its innumerable paths of growth, decomposition and regeneration, leading to ever and continual deviations. Completion is an idealisation (Ingold, 2019) and permanences is as well.
Multiple visions of the map and diagram lead to different understandings of the urban fact. The research proposed here has no imposition methodological purpose. However, it aims to make a methodological critique of the morphological school by exploring new and multiple scenarios for representing, reading and visualising urban transitions. In this sense, the diagram can be understood as a critical instrument in urban morphology analysis, grounding a base for technological study on urban form and strongly linking the project with the city's reading.
Although the research results are still in development, some issues can be considered for future engagement of the tool in the design thought reading. The overexposed research aims to improve map components that can help visualise the qualitative method, working on the diagrammatic component of the tool. Maps are undoubtedly a good candidate to study the diagrammatic approach to the city's transition. Despite the risk in the transformation from maps to diagrams to become an exercise of style on drawing, some considerations corroborate the use of the diagram in method exploration. Furthermore, the diagrammatic process has entered architectural design as a moment of transformation and generation of new forms of the imaginary. For this reason, the diagram can be considered a medium that allows the translation of perfect shapes into thought and vice versa (Gasperoni & Gretsch, 2022).

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Illustrations and tables

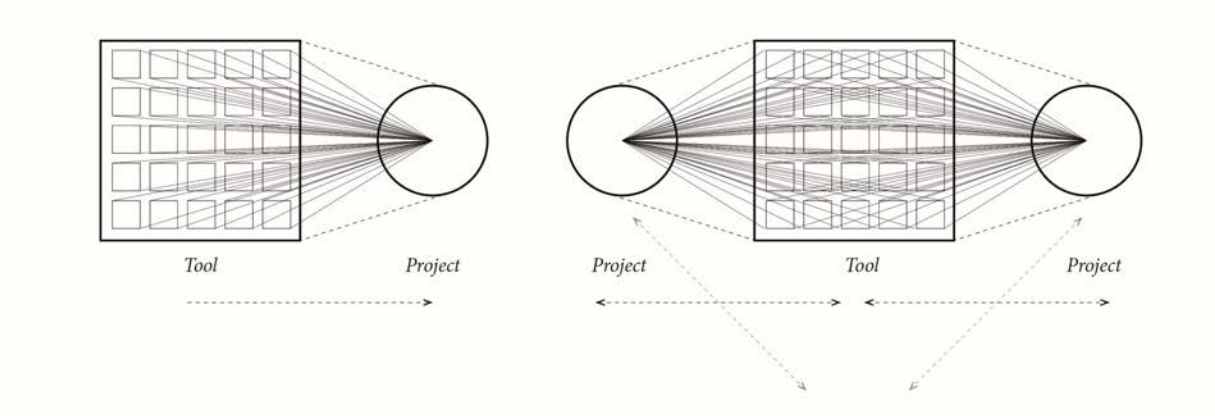

Figure 1. The information exchange process between tool and design.

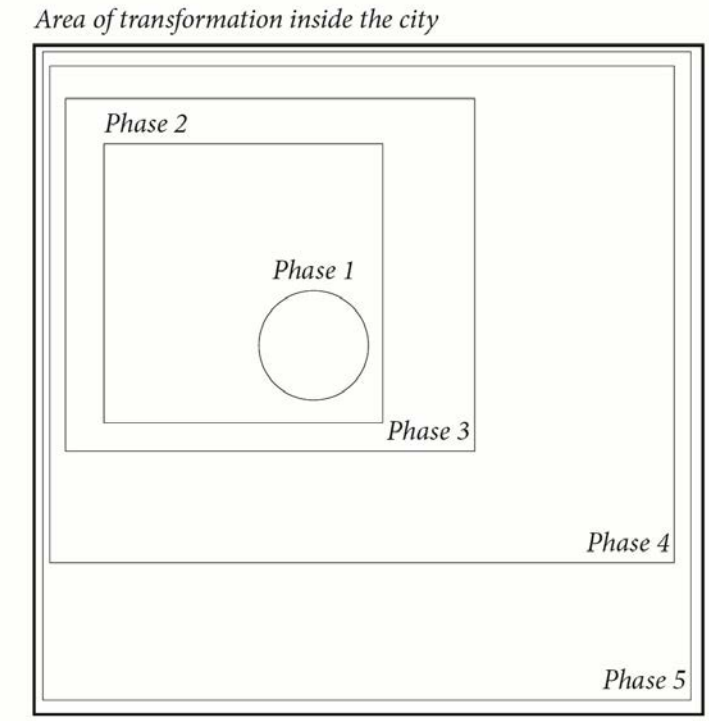

Figure 2. Process of identification of the macro-phases of transformation.

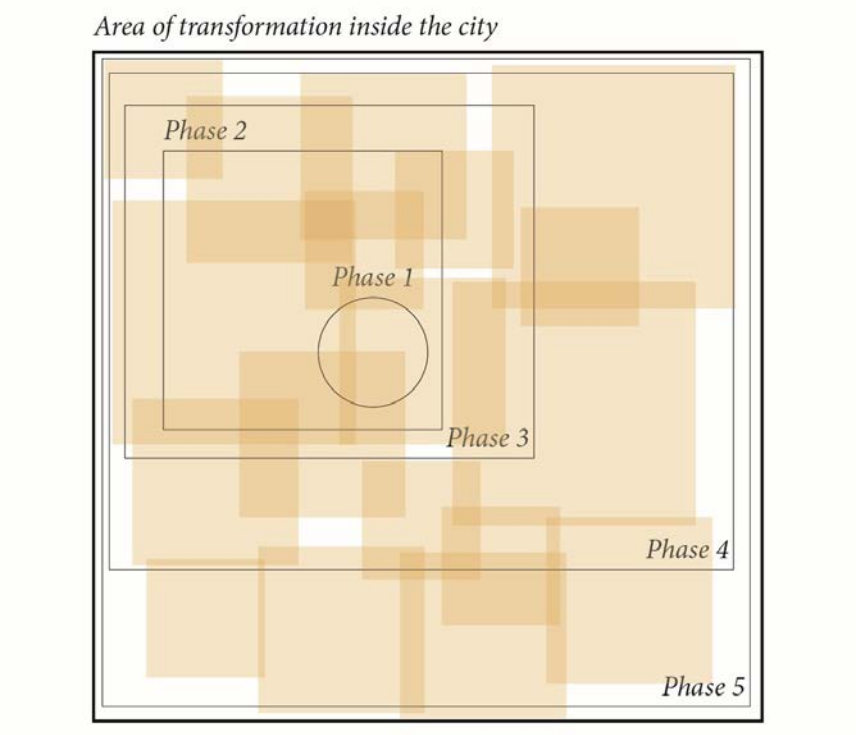

Figure 3. Identification of micro-phases.

Figure 4. Decomposition of the macro-phases in micro-phases

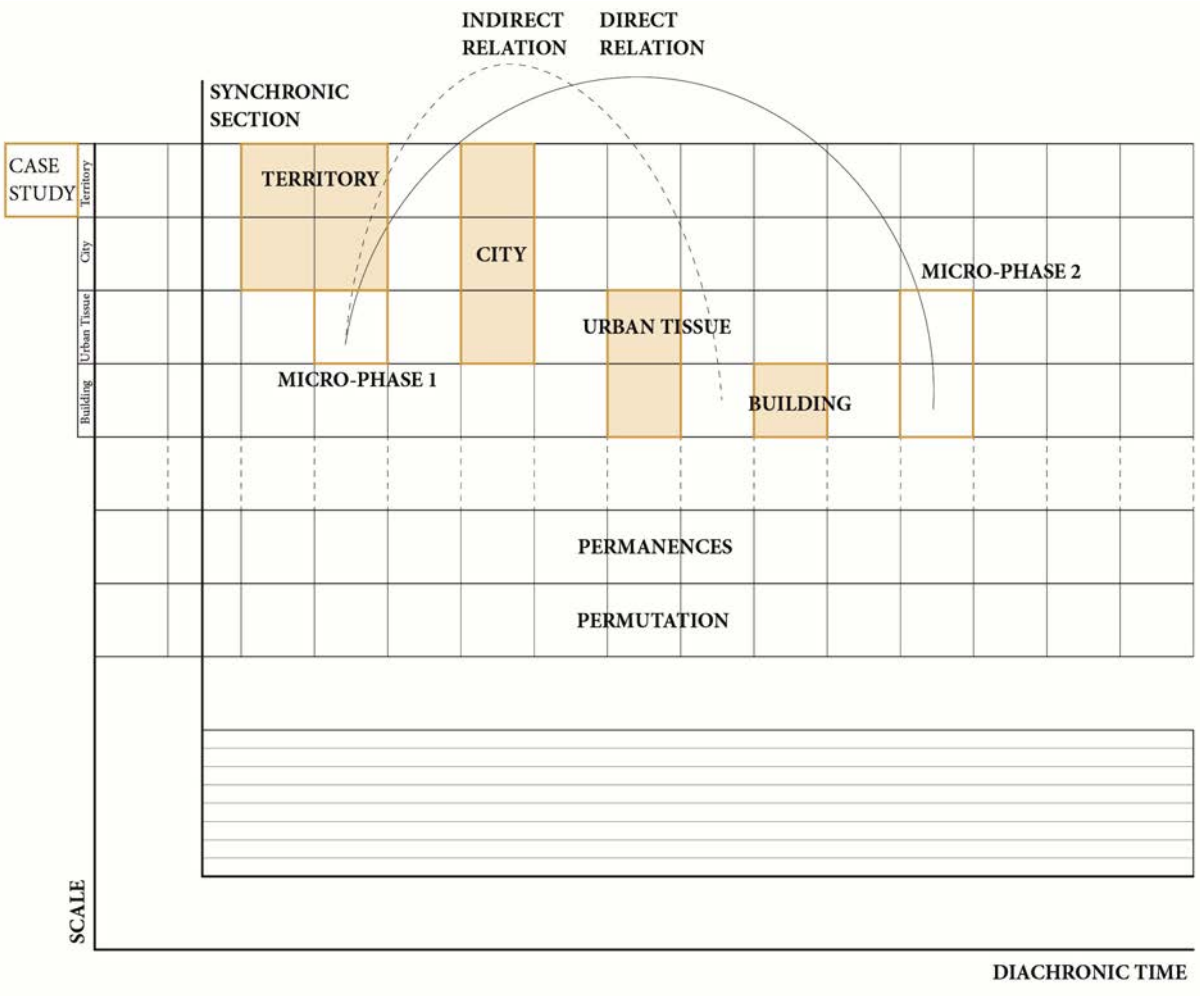

Figure 5. The diagrammatical space of transition. Constituent of the diagram.

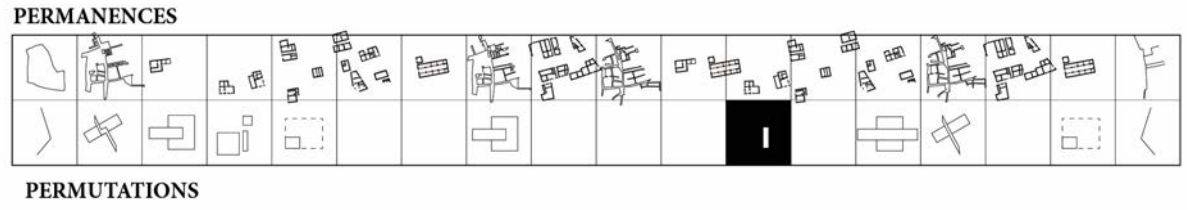

Figure 6. Permanences and permutation. St. Bartolomeo as paradigmatic example.