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Porosity and fragmentation of the block in the city core: a Nolli's innovation perspective

Rafael Reinoso Bellido, Francisco Sergio Campos-Sánchez and Francisco Javier Abarca-Álvarez

Department of urban and spatial planning, University of Granada, Granada, Spain

ABSTRACT

Urban centrality demands building space that erodes and implodes blocks in the most accessible places. Nolli's map made in 1748 was the first known graphic reference that visualised the phenomenon. The map and its contemporary interpretation are the starting point for this paper. The research has graphic support from existing maps that used Nolli's idea to represent those cities, and other maps created *ad hoc*. It is argued how territories are divided into small units that fold and wrinkle, drawing the conclusion that they do it to (i) find the maximum useful surface area in the minimum amount of space; (ii) concentrate activity; (iii) enable interaction; (iv) optimise resources; (v) accelerate processes; and (vi) cure urban diseases. Methodologically, this is done in two large sections, one showing erosion, division and fragmentation of the central urban layouts, and another emphasising the importance of architecture extending urban layouts to other directions.

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1. Introduction

The central areas of cities are subject to pressures that translate into numerous transformations. Sometimes it is a constant pressure contained in time, and although some may seem discordant, such transformations are assimilated by their natural growth process and urban evolution. At other times, these pressures are highly intense and arise in a short time, caused by very special, concentrated situations generating highly radical changes that are sometimes controlled by a policy of creating projects, but left to chance at others.

The main reason explaining why they undergo this pressure lies in the fact that they are the most accessible and inter-related urban places. The relationship machine that is a city finds it highest density of connections and possibility of relationships there (Reinoso-Bellido et al., 2020), and therefore its blocks – well-named *intervías* (i.e. between streets) by Cerdá (1867) since they are urban spaces delimited by the urban layout– are put under stress by a heavy demand for use that requires space. Thus, they sometimes fragment to produce more façades, and at others, *implode*, meaning that they explode within a single perimeter, growing upward and downward.

This research undertakes to explore the effects of these formations. By using graphics and examples to explain a situation common in cities, especially affecting the blocks, by breaking them up and filling them with pores, generating 'porosity', a term used to describe how the public uses of the streets are extended within the blocks. This incorporates many activities that need a large perimeter and urban space to be shown.

The drawing of the city, as a research subject or support in expressing concepts, has background.

Camilo Sitte (1889) redesigned cities to remind us of the key points that, in his opinion, make cities and their spaces more exciting and beautiful. Kevin Lynch (1970) used maps as a critique of the context of cities built in the 1950s and 1960s. Venturi et al. (1972) mapped the centrality of Las Vegas in their design of the Strip with all its pseudo-urban trappings as an extension of public use. They interpreted Nolli, in what could be said to be the earliest precursor of the interpretation to be made of this paper. All of them with the technique of the figure-ground with black and white contrast.

In the 1990s, other authors used the mapping of cities and territories to develop research and knowledge of them. Mario Gandelsonas (1994) or Stan Allen (1999) experimented with maps to find lines of force, patterns, identities, etc., of urban forms through urban layouts in the 1990s. At the same time, Rem Koolhaas and Bruce Mau (1987) explored how cities are congestion, times and hybridisation, as well as urban layouts. Paola Viganò (1999), from a more metropolitan and territorial perspective, with less abstraction, helped to explain these urban landscapes by using drawings to further their analysis and understanding.

CONTACT Rafael Reinoso Bellido rafaelreinoso@ugr.es
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The examples chosen below show the power of maps to express and provide answers to little-explored questions. Therefore, the main aim of this work is to explain, featuring simple drawings, the urban form generated by the energies of centrality, and in this way, showing how this phenomenon repeats simple patterns, the same everywhere, but at the same time unique, because of the distinctive local identity.

In particular, this paper aims to analyse the phenomenon of centrality and its spatial effects on an urban and architectural scale using a graphic representation inspired by Nolli's Map. Knowledge of this phenomenon could help urban policy in making decisions about the intervention/renewal of urban spaces that are exposed to processes of centrality or have the potential to become so.

The maps shown reveal that the centrality makes the blocks porous, that it fragments them into smaller pieces because it needs more façades and that when all that has been done it implodes them in height. A city that cannot perform this metamorphosis in its central spaces is a city with problems.

2. Materials and method

Drawings were used as a tool for analysis and discussion, supported by sufficient explanations on historical and theoretic periods in which the most important urban transformations took place.

The methodology was based on a selection of case studies from mapping urban centrality, inspired by Nolli's drawings of Rome. The selected case studies are based on capital cities where this phenomenon has been highly visible and studied, as opposed to others where it has not been so intensely and analytically produced.

The methodological process is carried out according to the following steps:

(1) By reflecting on the Map of Rome that Giambattista Nolli drew in 1748 to see the phenomenon of centrality in the most central and interconnected urban layouts. The study is also contrasted with other recent research on the capacity of mapping innovation to explain contemporary phenomena that have their seminal insight in the Nolli Map.
(2) Identifying the spatial effects of centrality with another concept called 'expansion vessel' in Physics –i.e. a device that collects excess flow or pressure of a fluid–. This analyses how urban activity implodes the urban layout of cities by breaking up and folding their blocks and filling them with public spaces and public functions.
(3) Drawing centrality using Nolli's Map as a means of expression that can be evaluated and measured in several steps: (i) choosing very different cases in form and concept of centrality in Map 1 as the first row of the Main Map; (ii) comparing similar cases, underground cities, in Map 2 as the second row of the Main Map; (iii) and bringing the analysis closer to the scale of architecture in Map 3 as the third row of the Main Map. Comments to the Main Map: Map 1. 100 hectares of central porosity (1km x 1km. Rome, 1748, Giambatista Nolli. Santiago. Passages and galleries in the colonial centre (Rosas, 1986) New York. Theatre district between Broadway and Park Avenue (drawn by the authors). Nolli's example has been used to explain the complexity of the form of centrality in two three different cases: Santiago and , New York, and Toronto. These three cases concern American cities at different times in the 20th century, forced to find space to comply with huge demands for a room made by centrality, going beyond historic streets that proved severely lacking, for various reasons. The first two were tried it out on the surface. Map 2. Subterranean cities (drawn by the author). The extension of urban activity under ground level (in places where the extreme weather does not facilitate the continuous use of the street most of the year) has given rise to large underground networks of commercial, financial and cultural land uses linked to public transport networks. Map 3. Mies van der Rohe Pocket´s Park. Federal Center, Chicago (drawn by the authors). Seagram Building's Plaza, New York (drawn by the authors). Dominion Centre, Toronto (drawn by the authors). Architect Mies van der Rohe's projects for New York, Chicago and Toronto develop further the urban apple fragmentation, due to the invasion and use demand taking place inside of it. This turns building ground floors into an extension of the squares formed by these projects. Such ground floors work like an interchange area between street/square land uses and private land uses, the latter being sometimes public, linking vertical communication volumes to each other. The interior-exterior transparency of the buildings, evidenced by the Chicago's Post Office or the Toronto's Bank, are the maximum expression of such integration. The case of Toronto is significantly indicative of this manuscript as a whole. This case not only expands streets into the block while forming squares and getting inside building ground floors, but this activity overflows into the expansion vessel in which Mies has turned his projects. It happens downwards by linking below to metro stations and other underground land uses, and upwards. They were innovative projects as they traced the path that many nearby buildings followed immediately.

3. Results and discussion

3.1. Maps of urban centrality following Nolli 2.0

The large cities often face demographic and functional invasions, not always destructive, which require 'expansion vessels' in their urban layouts. Nolli shows that concept in his well-known map of Rome in 1748 (Map 1), a graphic representation of the energy and complexity of this city at that time, papal Rome at its moment of greatest splendour. This illustration is completed with a legend that describes the activities that took place at that time, thus showing the urban area with the greatest concentration of public functions, in other words, the centrality of that territory. The body of the city –the residential part– is shown in black, and the public areas and buildings –temples, patios, palaces, streets, and squares– in white. It can be seen how the symbols of religious, political and economic power are found in new buildings within blocks, making them more porous, but also how these buildings and spaces form part of paths and networks that are different from the historical urban layouts. They are an extension of the public domain within the blocks.

Nolli mapped an abstract reality for the time, which was far from historical mapping. An innovation that was copied by other cities of the time, that inspired other complex and creative ways of representation, such as those made by Piranesi and that opened a door to a prolific interpretation of contemporary urban reality, which is offering huge research potential, as recent works show: applied to geo-location in historical cities, as a complementary tool to urban mobility (Navarro-de Pablos et al., 2019), three-dimensional scanning (Barbera, 2017), or even mappings that provide an interpretation of the subjectivity of what is or is not associated with the public and added to the system of public spaces and roads assumed (Hwang & Koile, 2005).

The drawing of the city, as a research topic or support to show concepts, has a background. As James Corner (1999) explains, when making a map it is possible to create a different world, creating new limits showing hidden things that work in the background at the same time as on the surface, discovering invisible or unimaginable elements, but above all the best mapping is the one that helps to create territory with new and diverse consequences.

Nolli did not only show what is already evident but also what is not, he discovered realities that were not seen or imagined, he described the qualities of things (Corner, 1999). By using the technique of the figure-ground, mapping in black and white, he also started a useful path that was imitated by other important cities soon after to improve the readability of the complex and dense public space that has its core areas through the strong visual contrast (Hebbert, 2016).

In this paper, the concept of centrality is shown graphically in a contemporary way, either by strategies that take up space to widen the public activity of the street, which is called 'porosity', following Nolli's idea for Rome (and New York on its surface or Montreal under it) or by fragmentation of the historical blocks to provide more street network and thus more facade (Santiago). Both New York and Santiago are examples of the transformation of deprived areas (i.e. capable of change) into new theatres and galleries, respectively (i.e. new more fixed parts) (Aureli, 2011). This often happens in the core of the city. The city centre captures its hinterland with radial access routes that are hundreds of years old, absorb functionality and, therefore, erode their layouts by making them gateways to the interior of blocks where the public area and spaces representing power are expanded. The blocks compete to house non-residential uses requiring façades facing outwards to the street and network of urban layouts. A competition to be in the street and to give visibility to their uses.

Nolli's Rome is the first historical image of that effects of centrality on urban layouts and blocks; the photo of a concept not interpreted at the time but expressed with an artist's intuition.

This way of representation, similar to Nolli's, was repeated afterward but did not always explain porosity caused by centrality, which occupies blocks with public, religious or institutional functions. To explain it, we have chosen some well-known exceptional situations, looking at something more than porosity: the fragmentation and implosion of blocks.

In the 1980s, José Rosas drew a plan of the centre of Santiago, following Nolli's style (Map 1, Rosas, 1986). The pretext of giving an overview of the division of the block at the end of the nineteenth century and beginning of the 20th made it important to have a plan representing the form of the urban centre, explaining the energy that capitalised the incipient wealth of the country. It is probably the first study that explains and details a paradigmatic case of the breaking up of blocks in the core areas of cities.

Santiago doubled its population in a few years at the beginning of the twentieth century, thanks to an increase in copper mining, among other things. Thousands of people flocked to the capital that had an excellent public transport network, mainly radial –24 tram lines in 1908– able to provide great accessibility to an urban centre with a colonial layout.

The accumulation of capital invaded this colonial layout and, like the Hittites done 3500 years earlier, the city responded by 'excavating' horizontally and 'imploding' the blocks vertically. It was a way of collecting the enormous energy that arrived, the same as happened in Rome, where a national road network leading to the capital city and from which it dominated the whole country.

The mechanisms added by Karl Brunner's Plan in 1932 regarding the design of the road network, but more especially with zoning and 'bonus' policies (Brunner, 1932), gave a further boost to the public porosity inside the central colonial blocks. Passages and shopping arcades enabled the old colonial centre of Santiago to make spaces to take hold of the energy by multiplying the potential of linear metres of useful facades in the colonial layout many times over. It was the way to 'defend' themselves from an invasion of institutional, representative, commercial, etc. uses seeking a place.

In the same scenario of American urban grids, Manhattan tried out policies to encourage the creation of public space beyond the streets of the urban fabric (Map 1). The well-known POPs (Privately Owned Public Space), arising from New York City's 1961 Resolution, opened up over 100,000 square metres of new public space in exchange for incentives between 1961 and 1973 (Kayden, 2000).

Although it was deemed a miracle, it was only partially successful. Far from the central areas, it was a noticeable failure; 'expansion vessels' were neither needed nor useful in places away from the centrality generating the pressure of transport and main functional urban land uses.

The results in that central area encouraged innovation, and ideas became more sophisticated and specialised. New York, a tourist city with one of its foundations in the theatreland of Broadway, launched a new 'bonus idea': build theatres instead of open spaces.

The New York City's Theatre District 1969 built five new theatres, the first since the Great Depression. However, alarms raised over the immediate effects led to reconsidering the initiatives (Garvin, 2002). The modernity of the latest theatres made a stark contrast with the obsolescence of the old ones, some of which were historic buildings that eventually fell into disrepair and disappeared. The consequences brought new rules into play; from 1982, the bonuses were only given for refurbishing theatres.

Despite everything, Broadway won. Beyond the street, the theatre area opened up space among the blocks, and the synergy among the theatre buildings boosted new internal interconnections.

In Las Vegas, the drawings carried out by Venturi, Scott Brown and Izenour revealed that the idea of centrality is broader than was previously thought. Following the same process of representation that the previous cases, they drew the Strip beyond the sidewalks, incorporating that public space of private property that were the ground floors of the casinos, hotels and open malls. This shows the fruitfulness of Nolli's representation over the centuries in the expression of new ideas. In 1972 it was not easy to imagine what half a century later would become the Strip. The choice of Nolli Map to explain that territory opened up a new and broader way of understanding public space.

In other places, this porosity was carried out differently. The weather conditions in many cities in North America make it difficult to pursue 'street' markets, so they were developed underground. It was also very easy. Metropolitan access and most metro and regional train stations going to urban centres are underground, being at the same time business centres imploded on the old central blocks.

Commercial premises were connected underground to a metro or train station, and this one was connected to another, and another, and another, and the last one linked to a different metro/train station. This idea has already existed since the beginning of the twentieth century when some department stores interconnected underground in these cities. Thus, an independent network was formed of the surface area whereas many expansion vessels as demanded at the time could be built upward or downward; interminable kilometres of pedestrian networks, such as those in the 1960s in Toronto (PATH), Montreal (RESO) or Chicago (Richards, 1990). They were curiously situated in the same geographical parallel as the Great Lakes in North America (Map 2)

Similar ones were done in Houston and Dallas, this time planned *ex-professo*. The Dallas Pedestrian Network (1969), inspired by the Canadian cities, designed by Vicente Ponte, who planned the Montreal metro, had over- and under-ground connections to buildings and car parks with shops, offices, and restaurants (Garvin, 2002; Terranova Charissa, 2009). Although used by thousands of people every day, the lack of (orientation) signposting and little support from the public authorities meant that it was not a comparable example to the previous ones. For the time being, at least.

Similarly, Houston built its 'analogous city' (García-Vázquez, 2004) away from its streets under extreme weather. Independent from the exterior surface, this other air-conditioned city has shopping and leisure centres, restaurants, etc. In order to make it work, about 10 km of tunnels were planned to connect the basements of the most important buildings and link almost three million square metres of urban activities in which professional word of these sectors moves (García-Vázquez, 2004).

It is not quite the same as with the cities on the parallel of the Great Lakes. Here, public transport runs on the surface and the buildings are connected, not the stations, so the two cases operate differently.

3.2. Excavated buildings and extended streets. Continuous urban layouts and architecture

Expansion vessels can also be architectural. Buildings can connect to urban streets and 'extend' them.

With some buildings, the city is enriched and increases its urban functions and layout, new land uses and relationships. There are not many examples of the urban network extending through buildings, with urban life inside buildings prolonged by transferring activities among themselves.

One of the best known, and perhaps the first, that explains this idea is the Rockefeller Centre. The traditional city of urban layouts and blocks are confused in this example. Three blocks between 5th and 6th Avenues broke up into multiple buildings, highly porous both horizontally and vertically, providing a giant expansion vessel to house the huge quantity of uses demanded by the energy of the place. A 'centre within the centre', i.e. one centrality inside another that morphologically became one of Manhattan's most porous places.

North America subscribed to these strategies from the nineteenth century with the ground floor of the stores: a new way of understanding public space that added public activities to the interior of private properties, halfway between a market and the lobby of a hotel.

The contact surface, i.e. transition areas between buildings and street are very important. How buildings are placed on urban layouts, and how the former collect flows from the latter are key factors for successful working of links between people and their affairs and especially for users of the spaces to live in harmony.

Mies van der Rohe knew intuitively that this relationship was an added value for architecture and persuaded his clients of it, and even better, he could see how his intuition improved the city in these places through what can be called the pocket's park (Map 3). His buildings worked together with their urban surroundings, inside and outside the city, first from Lake Shore Drive houses (1949–51), and following with the Illinois Institute of Technology (IIT) (1950), and meaningfully in the Federal Center (1964–73), all of them built in Chicago. The membrane dividing the building from the exterior, usually transparent, was dissolved by joining the public and private domains, by housing lifts connecting horizontal and vertical paths, similar to a transport hub.

He explained it very simply with the Seagram Building (1954–58). By moving back from the permitted alignment, he made his building more visible from the street, and the enclave became a milestone. Park Avenue in New York, a highly porous street in the stores and very public uses on the ground floors of its buildings, 'expanded' with the Seagram Building's Plaza project, and at this point was no longer just a pavement for transit, but a relational space.

However, there was something else that made it valuable. It was not just a pavement widening, many buildings on the same street did it later without the same result, it was also the careful design of the space that allowed many people to stop there to sit, read or have a snack, among other pursuits.

In Toronto, van der Rohe went further, with a project similar to the Rockefeller Center, but smaller: The Dominion-Center (1963–69), 300,000 square metres of offices located in two towers, with shops, restaurants, a 700-seat cinema and underground car park for 700 vehicles, to ensure commercial success for the developers, Dominion Banks, and Cemp Investments Limited. This system of buildings and public spaces engaged the city upward with offices, downward with metropolitan facilities and services, and at ground level by building priceless relational and visual benchmarks at less than 200 metres from regional and city public transport stations.

When Mies van der Rohe planned and built Westmont Square (1965–68) (Carter, 2006), a similar unit in Montreal, following the same lines as in Toronto, he innovated once again. This time it was not a financial district, but a suburb. The latest unit of buildings and public spaces was connected to the metro in a network with the commercial centre of the city, but providing the outlying districts with a point of centrality removed from the urban centre.

At the same time, Hans Scharoun was doing something similar in Germany. His projects for the Philarmonic, built in 1959, and the Staatbibliothek, built in 1964 in the Kulturforum of Berlin, together with a small similar building, the Fluvial Museum of Bremerhaven (1969), are just some examples of the relationship between public facilities and their streets. The buildings are not 'plugged into' the access, they prolong and qualify access on a human scale through pavements that broaden in the interior of the buildings and excavate them.

Scharoun used these projects to explain his thoughts on how Berlin ought to be rethought following the war-time devastation with the daring Kollektivplan: a mesh of motorways on the ruins dividing the city into sectors but which was interpreted differently from Scharoun's intuitions. Scharoun sought to do something else, to fit in with the German tradition of Stadtlandschaft (Aguirre, 2015) and continue the tradition's logical thread relating the city with the landscape. Scharoun's drawings have been collected from Pfankuch (1993).

4. Conclusions

Through case studies and the discussion above, it can be seen how the flow of city intensity running along central urban layouts appears by transforming them. Also that the places where this flow is seen depends a great deal on the characteristics of the urban layout and the architecture, a point of high interest for cities and urban regions.

This intense urban flow will always need places where it can emerge, and it sometimes does so by 'bursting into' unexpected places, like a volcano

erupting into lava at the largest pressure point, or simply at the point of least resistance. A mindful project constructs expansion vessels, which are one of the most developed and important concepts of this work, to help the eruption appear in the right place, without breaking the mould of the historic urban layout inappropriately. An unaware project will break the mould at random, very often informally.

Centrality appears where there is a demand for urban functions and accessibility is provided. When such centrality is projected in a forced way in a place where there is none of that, it is not always successful, as seen in New York with the POPs policy in outlying areas; far from the central areas, where access and supply were not great, failure was notable. Expansion vessels were neither needed nor useful in places away from the centrality generated by the pressure of transport and main functional land uses.

The continuous reformulation of shopping malls on the outskirts is telling. Built on empty layers of previous urban contents, playing at inventing the centre – even in their architectural forms imitating the urban landscapes of the centrality–, they ended up as a drain on resources, due to the continuous formal reformulations needed to artificially boost their use, to appear attractive and attract demand.

It is not enough to design devices that channel the energy of centrality in an orderly fashion, as happened with many PATHs in North America, or with reconstructing historic centres, inventing speculative centralities, regenerating districts, etc.; there must be constant insistence on the need for projects that care for medium and small details. Seagram Building's Plaza designed by Mies van der Rohe, with its little benches and fountains, worked; but those nearby, with no attention to detail, are empty of people. The PATHs improved greatly when the interface that included infrastructures and the exterior paid attention to the design details beyond the function.

When looking at large scales, indeterminacy, deregulation, etc. are not a threat if when designing details on the scale between the intermediate one and the urban object, such as a simple pavement or bench to sit on, care is taken of matters that are not always very demanding but need attention.

The expansion vessels to host the overflow of urban activity that generate this 'porosity' in the blocks are not enough by themselves to ensure this mission of hosting activity. In the field of architecture, urban design and town planning there is a need for a portfolio of contemporary good practices from which to draw useful lessons. So that lines of research can also be started to help make decisions that are more effective, sustainable and resilient.

The central places enjoying the energy created by demand and access must be common places which, as well as attracting us to the same place and connecting, link us with each other (Reinoso-Bellido et al., 2020). This means that they become devices generating the relationship capital making our common spaces increase our social, cultural and economic capital.

The reference to Nolli in this study has mainly served as an instrumental support for representing the phenomenon of contemporary centrality. However, the Nolli's Map represented is not only expressions of the form of centrality, expressed in the diversity of that concept. The Nolli's Map is also an interesting piece of work that could be further investigated in the future, because the public space in the central areas of cities, in the streets and in the public buildings, can be measured.

In this sense, considering the managed maps, on the one hand, Rome and Santiago have similar percentages of public space, despite their enormous morphological differences. This may be because Rome is more porous but Santiago is more planned, which balances the total amount of exterior and interior free space. NYC, on the other hand, has lower ratios, despite the large amount of POPs. This may be since internally it has hardly any public use, despite the density of theatres in the selected district. That is, it has less open space inside than Rome and less open space outside than Santiago.

The Nolli's maps could also be a useful tool for new research aimed at (i) measuring the 'porosity' and fragmentation of apples induced by public use of highly accessible and demanded central areas; and (ii) assessing the efficiency and thresholds of deficit and surplus of public space to prevent diseconomies and social imbalances due to inefficiency or overexploitation of land uses.

The knowledge of these phenomena could help to avoid the degradation and obsolescence of urban centres, as well as to guide new lines of research. Likewise, beyond these central districts, towards where a new urban centrality is wanted or needed, these lines of research should help to design tools that allow to carry out the projects in a more efficient way, avoiding the waste of resources and choosing places potentially more suitable and able to play new roles as centres (see Main Map).

Software

The authors' maps were partly designed by hand as well as using Adobe Photoshop®. Both Map 1, Map 2 and Map 2 were subsequently saved as PDF files and edited using Adobe InDesign® for the final result.

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ORCID

Francisco Sergio Campos-Sánchez http://orcid.org/0000-0003-3097-7085
Francisco Javier Abarca-Álvarez http://orcid.org/0000-0002-2725-8939

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