

THE ROUTLEDGE HANDBOOK OF URBAN DESIGN RESEARCH METHODS

Parameters for action: Urban morphology as a framework for research in the built environment

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Abstract

As reflected in current research agendas, the idea of good city form would appear to be both timeless and contingent. On the timeless end there is the work that seeks to identify forms and patterns that satisfy deep rooted human preferences. On the contingent end, there is the growing global imperative to find alternatives to longstanding habits of building in order to deal with increasingly immediate environmental crises. These examples also suggest that research in urban design is both descriptive-theoretical and normative. As explored in this chapter, the field of urban morphology provides a set of concepts and methods that can clarify the interrelationship between the descriptive and normative modes of research. A central concept serving that purpose is the typological process. Within the framework of the process, further concepts such as the principles of persistence, the compositional hierarchy and derivation, provide parameters for focused investigation and action. The chapter illustrates these ideas with examples of research focusing on different parameters and highlighting the intertwining of descriptive and normative modes. The concluding discussion reinforces the need and benefit of seeing the typological process as both social and adaptive.

1. Introduction

In recent decades, the study of urban form has become increasingly international in scope. This is in part because the issues facing cities – or rather, facing the people who live in, govern, administer and design them – are increasingly global in nature or extent (Jarzombek 2019). One of the fundamental challenges in addressing global issues is acknowledging the structural and cultural particularities of different places on the planet and the effect they have on the success of any solutions that come forward. The challenge is particularly acute when one of the issues is the perceived loss of local identity in the face of globalized design and production of the built environment. Ironically, this issue can be accentuated because the very real danger of universal homogenization induced by place-indifferent international capital is easily overstated. We lose track of local idiosyncrasies in the effort to emphasize the severity of the problem.

To reverse the common phrase – as others have (Carattini and Tavoni 2017) – globalizing research, practice and education in the built environment points toward thinking locally and acting globally. And while effective long term action might require both perspectives, to progress with either requires in turn that we attend to both similarities and differences, to both the generic and the specific, the abstract and the particular.

Within the broader field of built environment studies and practice, urban morphology provides a conceptual framework that situates similarities and differences so they can be more clearly articulated (see Malfroy 2021, Kropf 2017, Oliviera 2016, Scheer 2010, Panerai 1999 for general texts on urban morphology and typology). This chapter explores the ways that the concepts and methods of urban morphology can provide effective means for resolving these dichotomies into both complementary and reciprocal elements in a dynamic process.

The chapter starts by setting out a number of core principles of urban morphology, rooted in observations of long term dynamics in the formation and transformation of the built environment.

The chapter goes on to explore the implications of those principles for research with reference to a number of examples. It concludes with some indications for a common structure in the process of learning.

1.1 Descriptive and normative modes of inquiry

Urban morphology has roots equally in geography, urbanism and architecture. A central legacy of those origins is that, as a field of study, it combines both objective-descriptive and normative approaches. The two overlap – or more accurately, intertwine – to the extent that normative approaches make reference to and seek explanatory support from the results of objective-descriptive research both as a starting point and to test normative proposals (Kropf 2021). The objective-descriptive approach is not purely "descriptive" but is also abductive in that it posits as hypotheses a range of mechanisms or theories to in turn explain the observed phenomena – the characteristic workings of built form (the approach might also therefore be referred to as "descriptive-theoretic" or "explanatory"). The interrelationship between the two approaches is complementary and will be explored in more detail in the following sections. For clarity and simplicity of expression, the two approaches will be referred to respectively as the descriptive and normative modes of research.

One of the central methods of the descriptive mode is to compare cases in order to identify both differences and similarities between them and establish general features and principles. Perhaps the most fundamental observation in urban morphology is that the physical form of the built environment is the result of formative and transformative *processes*. Cities are founded, grow, change and in some cases contract or suffer destruction or abandonment. Within the field of morphology more generally, that observation is taken as an explanatory principle. That is, from a morphological perspective, the layout, structure and three-dimensional form and character of cities can be most clearly explained and understood by examining the long and short-term processes of their formation and transformation in time, identifying common processes and seeking to understand the mechanisms underlying them.

1.2 Persistence, compositional hierarchy and derivation

From this general perspective, there are three notable observations or 'discoveries' that have been made over the course of more than a century that provide the theoretical core of urban morphology: persistence, the compositional hierarchy of built form and derivation.

In the case of persistence, Italian engineer Gustavo Giovannoni (1931) and French geographer and urbanist Pierre Lavedan (1926), working independently in Rome and Paris respectively, used historic maps to compare the layout of the city at different points in time and identified that the street *pattern* remained relatively consistent over centuries. Archaeological evidence confirms the persistence in the case of both city streets and longer distance routes, with the current alignments of many roads corresponding to routes laid out centuries earlier, for example, by the Romans and in some cases along prehistoric routes. Lavedan in particular noted the continuity of a number of elements of urban form and posited the idea of *persistence* as a general principle.

A further observation based on the analysis of map evidence, reinforced and extended by the work of MRG Conzen (1969), is that the pattern of different elements do change, but at different rates. In particular, street patterns tend to change relatively slowly while plot patterns change more rapidly and building patterns more rapidly still. This led Conzen to posit the idea of a hierarchy of element complexes - street systems, plot patterns and building patterns, one 'containing' the next from the top down. Saverio Muratori and his student Gianfranco Caniggia, amongst others, put forward a similar principle based on the observation that the composition of buildings forming urban fabric involves the relationship of part-to-whole between elements that generates a hierarchy from the bottom up: materials, structures, rooms or spaces and buildings, extending up to urban tissue and the settlement as a whole (Muratori 1959, Caniggia and Maffei 1979). Later analysis

identified a formulation of the hierarchy that unified the two versions of Conzen and Caniggia (Kropf 2014, 2017).

The third principle, *derivation*, was identified by Muratori working with Paulo Maretto and others using detailed cadastral records from Venice and Rome (Muratori 1959, Maretto 1960). Extensive analysis of the building plans from different periods revealed first, that ordinary buildings constructed at a given period tended to be reproduced according to a common idea or *type*, second, the analysis revealed that specific adaptive changes to buildings tended to be repeated to a significant extent within the existing stock and third, that the adaptive modifications to existing buildings were incorporated into the common idea for new buildings. The evidence from the records suggested that the plans of the new buildings were *derived from* the experience of living in and modifying existing buildings. The result is a degree of continuity over time while still adapting to changing circumstances. This conception was then put forward by Muratori, Maretto and others as a general principle referred to as the *typological process* (see also Malfroy 2021, Strappa 2014 and Petruccioli 2007)

The idea of the typological process as formulated implies two key refinements of the general morphological principle that form is the result of a process of formation and transformation. The first refinement is that the typological process is self-evidently *social*. It is worth firmly reinforcing this point in order to guard against forms of expression that imply some kind of "autonomy" on the part of human settlements. Concepts such as "self-organization" are misapplied to cities if they deny the agency of the people and groups who interact with each other and their environment to build and modify it. That does not, however, preclude the identification of emergent phenomena that cannot be attributed to any specific intention on the part of particular individuals or groups. Indeed, it can be argued that the phenomena of persistence, compositional hierarchy and derivation are emergent features of the interactions of humans with each other and their environment - fundamentally dependent on both the physical characteristics of the environment and the bio-psycho-social characteristics of humans and subject to the limitations and pathologies to which they are prone.

The second key refinement of the general morphological principle is that the typological process is *adaptive*. Like all other forms of life on the planet, humans are part of a multiplicity of adaptive systems in which actions are triggered in response to environmental conditions or stimuli, driven by a range of needs. The adaptive nature of the process was clearly acknowledged by Muratori, Caniggia, Giancarlo Cataldi (1981) and others, who saw changes in the typological process as responses to *crises* - a change in physical or cultural environmental conditions.

The principle of adaptive response helps to explain, on the one hand, the normative impulse underlying the creation of new forms and, on the other, the diversity of specific forms corresponding to differences in environmental conditions and culture. From both a practical and philosophical perspective, successful adaptive responses depend on a clear understanding of the 'behaviour' of the environment - its physical-mechanical characteristics. Improving our responses in meeting our needs requires improving our understanding of those characteristics as well as creative thinking about potential solutions. The adaptive system is, in effect, a process of learning.

2. Applications in urban design research

The characterization of the typological process as a form of learning suggests that it provides not only a descriptive-theoretical picture of the formation and transformation of the built environment but also a framework for further investigation and research. From a methodological perspective, the three 'discoveries' of persistence, compositional hierarchy and derivation all involved an abductive inference from the evidence by putting forward an hypothesis to explain the phenomena in terms of a general principle. Subsequent work by the original authors along with other researchers and practitioners has tested those hypotheses by applying them to a range of different cases. By coming up against further evidence as well as through critical analysis, the hypotheses,

as general principles, have been adjusted, refined and extended.

The three principles can be articulated further by (deductively) working out the logical implications of the ideas. One step is to acknowledge that the terms used to describe the principles focus on only one end of a continuum. Persistence, for example, necessarily implies or assumes, by contrast, change or transformation. There is a continuum that runs from total stasis to evanescence or unpredictable, protean change. Similarly, if derivation is not limited to mechanical replication down to the last detail, it implies innovation at the other end of a spectrum.

While the compositional hierarchy explicitly describes a continuum from the lowest to the highest level in the hierarchy, it also implies a continuum from the generic to the specific, from unity to diversity. That is, at the abstract end, there is the unity of common generic elements of built form. On the other end, there is the abundantly evident diversity and variation in the specific types of form that emerge in different places and different times as well as in a range within a given time and place.

Under close scrutiny at increasing levels of resolution, the specific diversity is effectively infinite. At various levels and degrees, we find a gradient between abstract, generic similarity and tangible, specific diversity. An example is the path, route or street. As an abstract, generic element it is ubiquitous and genealogically a proto-urban element. In its specific, tangible diversity from prehistoric trackway to motorway, trunk road, avenue, boulevard, high street/main street, side street and back lane, the variation is palpable.

At the same time, the route occupies and can be defined by its position within the hierarchy, that is, its relationship to other generic and specific elements of built form. The notion of "definition" in this context can be taken to refer both to "identifying characteristics" and the role an element plays in the larger whole, with an associated set of limits and potentials of function and meaning. Identifying the position of an element within the local hierarchy such as a street or open space, can therefore provide significant insights into the element and, potentially, predict its performance in particular roles - based on the performance of other examples of elements in the same relative position.

For the purposes of research in urban design, these considerations suggest an interrelated set of parameters for investigation that tie into and build on the body of descriptive-theoretic findings - what we already know about the built environment.

The parameters are in effect axes of attributes that provide a framework for research.

Summarizing, the parameters are:

Persistence-transformation

Derivation-innovation

Generic-specific

level of specificity

generic and specific position (part-to-whole and part-to-part).

The following section summarises a number of research efforts that work along and help to illustrate the parameters as set out above. The examples come from a range of stages in the progress from post-graduate degree and mid-late career research. In this respect, the examples also serve to highlight the potential pedagogical benefits of the parameters. The summaries also point out the distinction between descriptive and normative modes in order to illustrate the ways in which they intertwine.

2.1 Derivation-innovation

Within the derivation-innovation parameter, the work of Deborah Wyatt (2020) on intergenerational housing provides a good example that actively employs both the descriptive and normative modes. The first stage of the research involved describing examples of innovative types of housing that provide alternatives to the "single family" dwelling predominant in the UK. Analysis of the

examples sought to identify any common elements or aspects such as configuration, tenure and management. The research then shifted to the use of interviews and questionnaires focusing on the satisfaction of the residents. The results of these were then analysed to identify common successful elements as "best practice". Working within the derivation-innovation parameter, the research is clearly focused on innovation, which stands out against the background of the predominant types reproduced by housebuilders derived from a body of standard types. One of the advantages of setting the research within the framework of the parameters is that it situates the phenomenon within the broader interpretive context of the typological process. In that context, the research can be seen as tracing a step toward codifying an emerging type, moving from latent to active status. As importantly, situating the normative element of the research within the typological process provides a context for interpreting the perceptions and ideas of occupants and stakeholders as part of the adaptive response driving the emergence of the type. The accumulation of changing views and cultural habits are precursors and triggers to changes in physical form. Further research might then examine the conditions under which the emergence of types occurs more readily as a basis for action to encourage or limit it.

2.2 Persistence-transformation

An example of research working mainly within the persistence-transformation parameter is research done by Michael Hayes at University College Dublin (Hayes 2020). In the descriptive mode, Hayes examined the issue of urban sprawl, first to explore and develop computational methods of identifying and describing different types of sprawl, their characteristics and extents. He then investigated the potential for the transformation of the different types to accommodate higher densities within a normative aim of achieving greater resource efficiency. The testing of potential transformations was framed in terms of the compositional hierarchy and one of the key results was to highlight the specific ways in which existing street, plot and building patterns can constrain potential transformations of sprawl that seek to achieve higher densities. In doing so, Hayes also explored the competing aims and values of maintaining existing patterns on the one hand and improving performance in terms of car use and vitality on the other.

2.3 Generic-specific

As indicated in the list of parameters and brief discussion above, there are two "dimensions", as it were, associated with or inherent to the hierarchy of built form. On the one hand, there is the compositional series of levels corresponding to generic elements related part-to-whole - simple to complex; brick to city. On the other hand, there is the gradient from generic to specific, from the unity of abstract elements to the diversity of unique instances - from "building material" to "handmade bricks produced at Northwick Brickworks for the construction of Battersea Power station in the early 1930s" (Battersea Power Station 2018).

The simple-complex parameter is most powerful as a tool in research when it is seen as both a series of discrete levels occupied by generic elements of physical form and a framework or structure within which elements can be defined by their position within it. The structure of the hierarchy provides a double reference, looking up the hierarchy to the composition of which a given element is a part and down to the components out of which the element is itself composed. An example of research making use of this framework is Lowri Nicholson's study of open air market places in market towns in England (Nicholson 2021). Taking a normative and comparative approach overall, the aim of the study was to identify the attributes of successful market places, with particular interest in the context of covid restrictions. In essence, the research adopted a three-way perspective looking at 1) the position of the market spaces within the higher level elements of urban tissue and route pattern/street pattern; 2) the shape and size of the spaces and 3) the specific configuration of element parts (pitches/stalls, paths and surrounding shop buildings) within the market spaces. The study concluded that attributes at all three levels contributed to the success of the cases studied. As employed in the research, the hierarchy of levels provided a robust multi-perspective framework for the research tasks in the descriptive mode, identifying the

attributes of the existing markets and the dynamics of their use. The same framework was then used for the normative tasks of assessing the performance of the cases against criteria and compiling a set of ideal attributes for successful spaces, acknowledging the respective contributions of context or position within a larger structure, shape and size and the configuration constituent elements.

3. Discussion and conclusions

Comparing the examples of research set out above as well as considering the role of the findings of urban morphology as a foundation for research, a central distinction is the difference between the descriptive and normative modes of enquiry. This is not a 'finding' of the comparison of cases but a starting point based on the logical difference between the two modes. The descriptive mode is seeking to determine "how things work" irrespective of any particular purpose. The normative mode seeks to identify the "good", the best means to achieve a particular purpose. It is the difference, for example, between the study of fluid dynamics, which seeks to explain, amongst other things, the phenomenon of aerodynamic lift, and the study of aeronautical engineering, which seeks to identify the optimum shape of a wing to make the best use of aerodynamic lift for a given purpose, such as heavy lifting, high speed, fuel efficiency or high or low altitude flying.

The core of both fluid dynamics and aeronautical engineering with regard to aerodynamic lift is the interaction between moving air and a physical body. This suggests that a further descriptive discipline involved along with fluid dynamics is the study of structures (statics and mechanics). The aeronautical engineer also needs to identify the optimum structure of a wing to achieve the desired performance for a given purpose.

The core of urban design is the interaction between human populations and the natural and built environment. Urban design therefore draws (or should draw) on a wide range of descriptive disciplines. On the human side of the interaction, as an indicative sample, there are the fields of physiology, psychology, environmental psychology, environment-behaviour studies, neurobiology, sociobiology, sociology, anthropology, cultural geography, political science and economics. On the environment side, again as an indicative sample, there are the fields of physical geography, ecology, urban ecology, urban geography, urban morphology, cultural and historical geography and history. Clearly, some of these disciplines deal with both sides of the interaction.

As noted above, the examples of research set out all involve the intertwining of the descriptive and normative modes. The intertwining highlights the more general point that any normative research requires grounding in objective-descriptive research that provides some degree of certainty that the assumptions, principles or "rules" involved are valid. The descriptive element is by and large undertaken at an initial stage to establish the relationships and interactions between existing or emerging forms and habits as a foundation and context for examining potential purposes and means. The normative mode is engaged to explore, select and test the performance of the means for a given purpose as well as re-evaluate those purposes. Once a new form/habit is put into practice and becomes established as part of the fabric of the settlement, the descriptive mode can then again be used to investigate the actual long term interactions and their overall effects.

Characterizing the intertwining of modes, there is, first, the level of understanding of "how the world works" - a descriptive-theoretical understanding - and second, the adaptive normative understanding that involves identifying our purpose and associated criteria for success and then finding the best means of achieving the purpose. To complete the feedback loop, a necessary part of the two modes is to check predictions and expectations against experience of the performance of the way things works and our chosen means of adaptation. Periodically, we also need to check that our purposes remain adaptive in the face of any environmental change, physical and cultural.

At a finer level of resolution, it can also be the case that the descriptive mode is used to test some aspects of performance where there are objective criteria for aggregate behaviour. An example would be testing the performance of a configuration of streets as a means of reducing vehicle

congestion or encouraging pedestrian flows. The descriptive-theoretical analysis of flows is not concerned with the question of what level of flow is "good" or "bad" but only with what the levels are. The mode switches back to normative where the overarching purpose of the specific objectives is to achieve a "better" result - which assumes a normative idea of what is better or worse.

Irrespective of the detailed intertwining of modes, the overall process outlined above is an alternating cycle between identifying means to serve a purpose on the one hand and testing the performance of the means in achieving the purpose on the other. That alternating cycle is in principle and effect, the same as the typological process as posited in urban morphology - developed through descriptive research. From this perspective, the actual process of generating, constructing, using and judging the success of some part of the built environment can be seen as a form of embodied research. From that same perspective, the activity of design research using 'mind tools' to simulate, predict or at least anticipate the result of particular means, is in principle and effect part of that actual, tangible process, reinforcing the point that the typological process is a process of learning that incorporates two complementary component types of learning - descriptive-theoretical and normative.

Seeing the typological process as both the *product* of descriptive-theoretical research - a set of working relationships onto which we can map descriptions of the process of development - the formation and transformation of the built environment - and a *tool* for research introduces a reflexive dimension. We are seeking to learn about a process of learning. The reflexivity is not a paradoxical confusion but an opportunity for meta-learning. That is, we can switch from the descriptive mode to the normative mode and seek to learn how to learn more effectively. By understanding the process of learning, we can search for ways to improve the process.

The foregoing has sought to show that amongst the many descriptive disciplines on which urban design research necessarily draws, urban morphology provides a number of central principles on which to build. Those principles include the fundamental notion that the built environment is the result of an adaptive, social process that can be articulated as the typological process. They also include the principles of persistence, derivation, the compositional hierarchy and the parameters that extend from them:

Persistence-transformation

Derivation-innovation

Generic-specific

level of specificity

generic and specific position (part-to-whole and part-to-part).

The fundamental premise of this chapter is that these "working relationships" can facilitate our understanding of and ability to learn more about the built environment as a complex adaptive system, to learn how to find means of adapting the built environment to changes in both the external environment and our own habits (and the habits that are changing the environment) so that we might learn how to improve those modes of learning.

3.1 Internationalization

Returning to the starting point of the chapter, the internationalization in the study of urban form might be seen as an adaptive response to a number of trends or issues. The most obvious and probably most urgent trend to which internationalization may be an adaptive response is the crisis of climate change (along with habitat and biodiversity loss, resource depletion and accumulations of waste and pollution). In light of that crisis, an increasingly international purpose in design is to reduce energy use, resource use, carbon emissions, waste and pollution. And in dealing with these issues, it is not enough to merely identify similarities and differences. To find working solutions it is necessary to have an understanding of the working relationships. The typological process and the parameters of innovation-derivation, persistence-transformation and generic-

specific provide a solid initial set of relationships. Essential to that set is the qualification of the process as adaptive and social – and explicitly incorporating the notion of crisis within the process. As adaptive and social, the typological process acknowledges that the crisis induces a shift from the normal circuits of *feedback* that result in improvements to the means of achieving a purpose to the circuit of *calibration*, which results in the reassessment of purposes (Bateson 1980).

The identification of both feedback and calibration within the process, the distinction of descriptive and normative modes and between general principles and specific solutions suggests that the working relationships of the typological process are not adequately rendered by single sided slogans. We need to find the general in the specific and to formulate specific solutions using general principles. The single sided slogans may be effective in motivating people but do not necessarily provide better solutions.

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