Formal Indicators: Quantifying the Contribution of Form to Urban (Social) Sustainability

Sergio Porta

Abstract

The form of cities does affect the way people use cities. The way people use cities does affect the urban quality of life, the richness of local economy, the level of social cohesion, the level of safety and equity, the amount and the kind of human activities in public spaces. The above are all components of the urban sustainability issue.

Making a reflection on urban form relevant to urban (social) sustainability, from the point of view of an urban designer, means to develop affordable, reliable and operable planning tools for the analysis of a new family of SDI (Sustainable Development Indicators), which I named Formal Indicators. Formal Indicators are a quantitative measure of some components of urban public space form, identified in previous researches as having a positive impact on two different aspects of social life: 1- the amount and the kind of human activities, ie. walking, sitting, doing commercial exchanges, making pictures on a sidewalk, talking, glancing at shop windows ...; 2- the quality of urban life.

In this paper, after a brief introduction dealing with the relevance of walking and face-to-face interacting in the progress and evolution of social systems (with reference to Niklas Luhmann), the concept of Formal Indicators is presented together with a first review of the relevant literature. In addition, the question of the search of formal components and measurements (Formal Indicators) is addressed.

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He has been visiting scholar at UC-Berkeley developing his doctoral thesis. Focus of his doctoral research was the theory of "Observation" as a field of city planning and design. His current work focuses on the development of the concept of Formal Indicators and the testing of Formal Indicators in real urban settings. For this reason he is co-ordinator of the FISUS (Formal Indicators of Social Urban Sustainability) project, a broad case-study research running under the Fifth Framework Programme of the European Community.

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Introduction – Setting the Stage for Walking as a Social Urban Activity.

"The pedestrian is a social being: he is also a transportation unit, and a marvellous complex and efficient one. (…). Formulas based on the pedestrian as a transportation unit are most applicable to transportation situations, such as getting from concourse exit A to gate B. But pedestrians are social beings too. Sometimes they stop and chat with someone, even on the concourse. They cluster in doorways. They pause to look at a shop window. In a word, they self congest. The crowding and the pleasure are inextricably bound up. To put it another way, part of what attracts people to the street is a measure of the congestion the high standards would save them from" (Whyte W.H., 1988, p.56, 77).

This paper deals with the pedestrian as a social being seen from the perspective of an urban designer. Saying that pedestrians are social beings means that they are "context-sensible": they are affected by the cultural, economic, social and eventually environmental contexts. This paper focuses on the environmental context of pedestrians, and more specifically, it analyses the formal components of urban public space which could increase and foster the presence and mutual interaction of pedestrians on the street, in its everyday, ordinary urban life. The hypothesis is that the ever-changing forms of human exchanges within a public space are the "genius" of the city, the very reason cities have been built for.

In this context is also important to investigate the contribution of the form of public spaces to a diverse, dense urban life as a whole. The thesis, in fact, is that to foster human exchanges in a public frame may result in fostering social cohesion, local identity, mutual aid and "natural surveillance", public health, and even local economy. Unfortunately, this is not a widely accepted concept, especially considered the current emphasis on non-material aspects of communication when considering the info-city of the future. The micro sociology of "face-to-face" interaction in a public frame could probably gain much more consensus if considered under a macro sociological perspective, as in Niklas Luhmann's general theory of social systems.

The first section of the paper highlights the relevance assumed by interactions in Luhmann's theory of social systems. The second section presents the concept of Formal Indicators as a way of linking urban form to urban social sustainability. The third section proposes a first list of Formal Indicators selected after an analysis of related literature, as a first step towards the construction of new Urban Design tools.

The Systems of Interaction in Niklas Luhmann's General Theory of Social Systems.

As long as we speak of direct human exchanges in a built environment, Luhmann would say that we are dealing with *interactions* and the whole question should be posed within the mutual interdependence of Social Systems and Systems of Interaction (Luhmann N., 1990). These are two separate systems, both social, mutually dependent, but characterised by one basic difference that defines their boundaries: *communication* (dominated by language) for the Social Systems, *physical co-presence* (dominated by sensorial perceptions) for the Systems of Interaction.

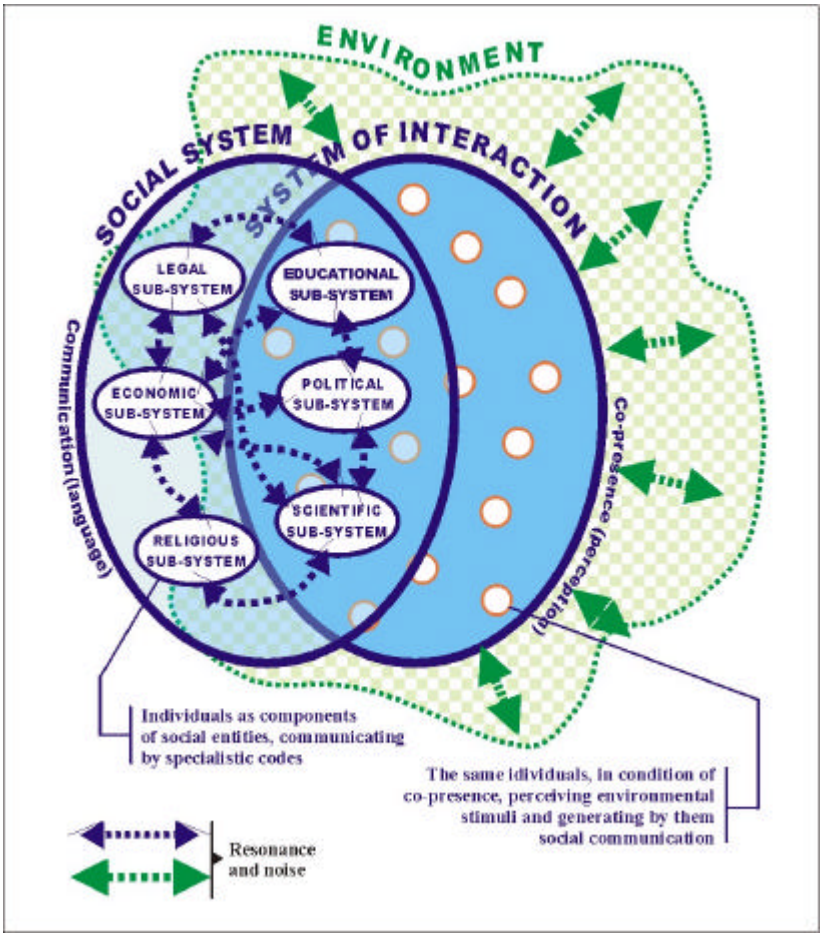

Figure 1. Social System, System of Interaction
and the environment in Niklas Luhmann

What characterises the Social System, according to Luhmann, is its self-referential and communicative nature. "In sociology a term which means the unity of the social dimension as a whole must exist, (…). We will use for that aim the concept of society. Society is, in that expression, the comprehensive social system that includes everything is social, and therefore does not recognise any social environment. If anything social is added, if new partners or issues of communication emerge, society grows with them, in the same way they grows as part of the society. Those news cannot be placed outside, that is considered as something belonging to the environment of society, for everything is communication is society. (…). In similar conditions, the unity of the social system cannot be anything but that self-referential closure. Society is the authopoyetic social system for excellence. Society implements communication and anything which implements communication is society" (Luhmann N., 1990, p.630-631). The progress of

societies through history is, in Luhmann's vision, a movement from simplicity to complexity by the gradual diversification of social systems in different sub-systems specialised according to their function. In Fig.1 the six functional sub-systems identified and discussed by Luhmann in a successive work (Luhmann N., 1989) are presented. The relationships among the sub-systems and between the social system as a whole and its environment cannot be considered communication. No proper communication can take place, for instance, between the legal and the political sub-systems because of the difference between their respective linguistic codes, which are and must be specialistic. Moreover, no proper communication can happen between society and its environment, because in that case both communicating entities would be part of the society. The influence sub-systems can have on each other, and the influence environment can have on the social system as a whole, is a sort of "interference"; that is: generating stimuli which will be perceived as a sort of "noise", or better, in Luhmann's words, a "resonance" (double arrows in Fig.1). The receiving entities will react it according to their own internal conditions and rules, often unforeseeably. What is relevant in the context of this paper is the recognition of the positive impact of this type of exchange on the "progress" of societies. Taking into account the sole exchange between society and its environment, it is the ever changing "pressure" of the environment on social systems which ensures their gradual diversification in more complex, functionally diverse forms. On the other hand, the complexity and diversity of social systems is the basis for their potential response to more complex environmental challenges. In evolutionary terms, the "good maintenance" of the exchange between social systems and their environments is nothing less than vital for societies. Now, according to Luhmann, who manages the environmental "noise" and capitalises it in favour of the proper social communication, who in short actually goes to this encounter with the environment and listens to its "requests" on behalf of the Social System, is the System of Interaction.

If Social Systems are characterised communication, Systems of Interaction are characterised by physical co-presence. If in Social Systems language dominates, in Systems of Interaction sensorial perceptions dominate. "In the case of society, the problem is posed whether an event is or is not a communication. (…). In the same way, also the Systems of Interaction have sufficiently defined boundaries, in that they include whatever could be acknowledged as physically present. (…). The use of the selective criterion of the physical co-presence outlines the particular relevance of the processes of perception for the constitution of Systems of Interaction" (Luhmann N., 1990, p.635). Compared with linguistic communication, perception acquires information in far less selective, less demanding, more rapid and more simultaneous forms. Human beings see, hear, touch others and the environment. This sensorial activity is, according to Luhmann's general theory of Social Systems, the crucial step in the evolution of societies. Beginning from perceptions and psycho-emotional situations people establish relationships with others and those relationships may initiate the communicative cycles among functional sub-systems and inside the Social System as a whole. For instance, beginning from the perception of an environmental disease, arguments and interventions in the environmental field as well as in urban or transportation planning may emerge. Environment generates "resonance" in society "by" human sensorial interaction. No surprise that the recent rebirth of interest of urban sociologists for the question of space does find in human interaction, in face-to-face exchanges and in "proxemic rituals" a privileged ground; that is the interpretation of Bagnasco, who so interprets studies like those of Giddens and Goffmann.

Once set the stage for the *specificity* of human exchange in condition of co-presence, the different exchange in condition of absence (non-material communication) gains its own specificity. As Bagnasco underlines: "The reciprocity of practices among actors in condition of co-presence is what Giddens terms '*social integration*'. The extending of social relationships in space and time poses the question of *systemic integration* that means of interconnections among those who are physically absent. That second spatial/temporal condition of interaction, non directly mediated by the sensorial abilities of the body, is based on different processes and social webs" (Bagnasco A., 1992, p.15).

Table 1. A map of societal forms and their principal characteristics.

	Sate of the Other	Practices of Integration	Dominant Relationship	Means of Relationship
Social Systems	Absence	Systemic Integration	Communication	Language
Systems of Interaction	Co-presence	Social Integration	Perception	Sensorial Abilities

With reference to Table 1, let's direct our attention on those contributions of a disciplinary nature (of Urban Design), which deal with Systems of Interaction, and focus on a particular kind of environment: the urban public space. Space is a component of what we called "environment", and urban public space is a component of space. Therefore it is crucial, and inherently relevant for urban planners, to understand if and to what extent spatial configurations seem to inhibit or to favour processes of perception within the Systems of Interaction.

The city of pedestrians is far more than the city where pedestrians can walk. It is the city where human personal exchanges find a favourable environment and diverse, reactive, creative and healthy communities can grow.

Formal Indicators: moving the question of form toward urban sustainability.

In previous research (Porta S., 1999 and 2000) I found that Urban Planning and Design has not contributed all that much to the study of relationships between spatial configurations and human face-to-face daily interaction. On the other side, I argued that it is possible to identify a number of authors who dealt with that, beginning with the seminal work of Jane Jacobs in the early Sixties, and who actually had to counter a consolidated heritage of disciplinary ideologies, professional habits and organisational forms. I mentioned, among others, figures like Oscar Newman, Raquel Ramati, Clare Cooper-Marcus, Jan Gehl, Peter Bosselmann and Allan Jacobs. I said those researchers could be grouped together for their focus on public space and a shared "style" of research, which I termed "Observation". One crucial point of that "style" was the disposition to rely on the "ethnographic" observation of people in real life rather than building abstract "visions" of what real life ought to be. The "observative" approach allowed the richness and diversity of daily urban life to emerge with all its connections with the configurations of the built environment. In these authors, the scene of Luhmann's Systems of Interaction steps out, and highlights the issue of the relationships between form and social wellness in all its richness. A number of achievements could be identified as the contribution of this line of studies, in several fields, namely urban design, crime prevention and transportation planning; however, beside their direct

findings, those studies leave a threefold treasure for further research: on one side they define something like the "street life" and acknowledge it as a relevant business for making contemporary cities work; on the other side they build conclusions on what components of the urban form seem to support the richness and diversity of street life; finally, they rise the issue of the quantification of those formal components.

Building on these pillars it seems possible to move one step forward in the direction of making the walking city a more recognisable task for urban planners and decision makers: *to make the whole problem of street life and urban form a relevant component of the urban sustainability question.*

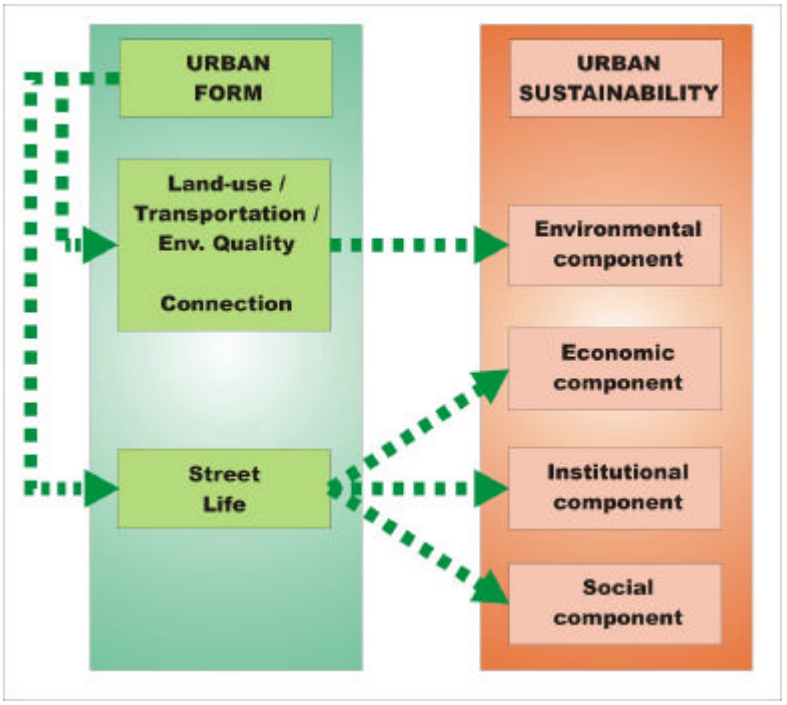

Figure 2. The contribution of urban form to urban sustainability, by the Land-use / Transportation / Environmental Quality "connection" and by the Street Life concept.

There is a substantial agreement at the international level in articulating the broad concept of sustainability into four sub-areas, concerning environmental, economic, institutional and social issues (Pezzoli K., 1996; Eurostat, 1998). When applied to the urban environment, the concept of sustainability faces several contradictions, due to the displacement from a "natural-oriented" to a mainly "social-oriented" setting. Reflections on how the form of cities plays a role in urban sustainability have mostly dealt with the impacts of city form onto natural resources balances and energy efficiency (the "environmental" component of sustainability), deepening the Land-Use/Transportation/Environmental-Quality "connection". Here, urban form has been reduced mainly to land uses, focusing on city size, density, or on the relationships between land uses and transportation systems. Little research, if any, has addressed the impact of city form onto *social* behaviours as part of the urban sustainability question, and by that its impact on economic and institutional issues (see Figure 2). It is interpreting the social component of urban sustainability under the light of the street life

concept that the crucial link with urban form can be built on the basis of the yet established "observative" tradition in urban design.

Now, in more operative terms, to move a reflection on urban form into the field of social sustainability means to develop *measurements* of both the form of spaces and street life. Under this new light, the problem is to identify what are the components of the urban form which are likely to foster street life, to understand how to measure them, and to test on the ground if and to what extent a positive correlation between those formal components, street life and quality of life emerges. In more appropriate terms, it means to develop Formal Indicators (indicators of physical form), and to investigate their correlation with Street Life Indicators (indicators of human activities within urban public spaces) and Quality of Life indicators (indicators of social wellness). As the role of Sustainable Development Indicators (SDIs) is "to assist decision makers and policy makers at all levels (…) to point to trends and relationships in a concise way [and therefore to] help to guide national policies for sustainable development and facilitate national reporting on measures to implement sustainable development" (UN-CSD, 1999), the identification and verification of quantitative indicators of selected components of urban form appears to be the key for an evaluation of form in urban sustainability terms.

Formal Indicators: Jane Jacobs' landscape and a preliminary list.

As said above, a relevant disciplinary tradition for the identification of formal components as well as their quantification can be found in what I termed "Observation" in Urban Design.

At the core of this "style" of works we can find a positive idea of urbanity. It was Jane Jacobs who described this idea since 1961 (Jacobs J., 1992, c.1961), setting up a powerful framework, capable to comprehend and be enriched by a number of later studies. The same framework, far from being now significantly outdated, is showing a noticeable power of self regeneration at the core of the urban sustainability concept of our days (O'Meara M., 1999; Newman P., Kenworthy J., 1999). The compact, diverse, dense city appreciated by Jane Jacobs for its potential of fostering urban communities in social, economic and institutional terms, is the same city which seems to show the best performances in terms of energy efficiency and balanced modal split in transportation. That street-life/compact-city perspective is common to all the "observative" authors, therefore embedding the compact city concept of formal quality both in the selection of relevant formal components and in the definition of criteria for their quantitative measurement. Thus, here we find a great attention to things like the "transparency" of street facades, the number of shop windows and entrances, the need for many medium or small size buildings, the need for a tight relationship between building fronts and streets, the continuity of the transition from the more private to the more public spaces, the need for "anchor objects", the need for integration rather than separation of different uses and users within the same urban spaces (also for integration of cars and pedestrians), the primary importance of places and objects to sit on, and so forth.

As a personal reflection on the basis of a broad review of "observative" studies, I find that the whole body of formal components, which were recognised as *positive* for the flourishing of street life, can be grouped in three synthetic "qualities": *Definition*, *Softness* and *Complexity*. In other words, it seems useful to refer each basic formal

component (say: shop windows), and thus each Basic Formal Indicator, (say: extension of shop windows over extension of the whole facade) to one or more of these three synthetic "qualities", which can be termed "Synthetic Formal Indicators" (say: Softness).

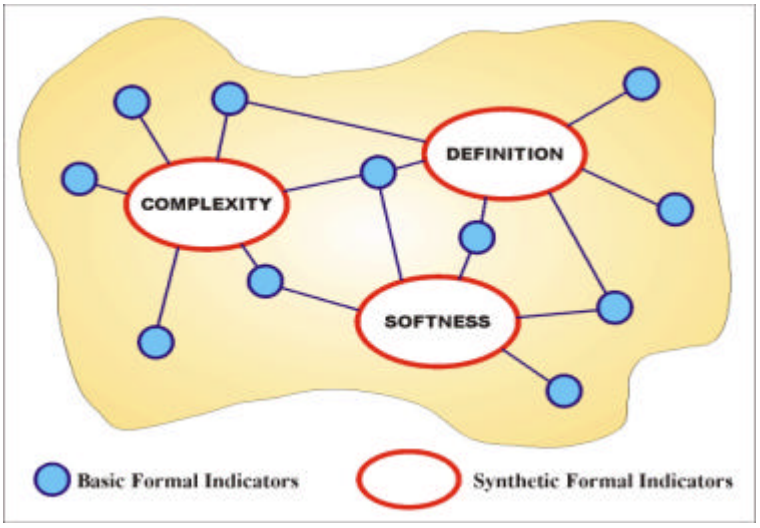

Figure 3. The relationship between Synthetic and Basic Formal Indicators.

Several of the authors I referred above, namely Allan Jacobs and Peter Bosselmann, consciously tried to develop means for the quantification of such formal components of public spaces: that is in particular the focus of some of the best student's works at their course IDS 241 at the UC-Berkeley.

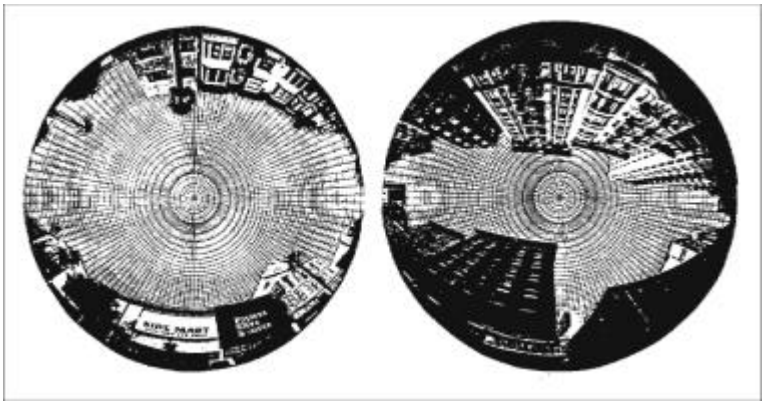

Figure 4. Measurements of "Sky exposure" from reports
by students of Allan Jacobs & Peter Bosselmann's course "IDS 241" at Berkeley.

Building on this literature it is possible to identify a preliminary list of Basic Formal Indicators.

Table 2. A preliminary list of Formal Indicators.

Basic (Synthetic) Indicators	Description	Reference
Sky Exposure (Definition)	Exposure to the sky vault measured by the overlaying of a polar grid and a fish-eye picture taken from the middle of the street;	- Jacobs A. & Bosselmann P., (IDS 241);
Street Walls (Definition)	Continuity of the facades front line;	- Ramati R., 1981;
Tree Canopy (Definition)	Trees coverage measured by sum of trees representation in section and plan;	- Jacobs A. & Bosselmann P., (IDS 241);
Transparency (Softness)	Extension of windows, shop windows and entrances on the overall extension of building facades;	- Gehl J., 1987, c.1980; - Jacobs A. & Bosselmann P., (IDS 241);
Transitional Spaces (Softness)	Continuity of the 4-steps transition: private, semi/private, semi/public, public;	- Newman O., 1973; - Newman O., 1996; - Gehl J., 1977;
Anchor Objects (Softness)	Presence of "Anchor Objects" (objects where it is possible to lean to);	- Whyte W.H., 1980; - Whyte W.H., 1988;
# of Crossings (Complexity)	Number of street crossings in a given territorial unit represented in plan;	- Southworth M., Ben-Joseph E., 1997; - Jacobs A., 1993;
# of Buildings (Complexity)	Number of property parcels in a given territorial unit represented in plan;	- Bosselmann P., 1998;
Social Width (Complexity)	Percentage of streets whose width makes possible social exchanges between the two street fronts;	- Gehl, 1987;
Volume Articulation (Complexity)	Measurement of recesses, projections and separations from the face of the building facade;	- Jacobs A. & Bosselmann P., (IDS 241);
Height Articulation (Complexity)	The degree of regularity or irregularity of the roofline, measured as the average height difference between adjacent buildings;	- Jacobs A. & Bosselmann P., (IDS 241);
Colour Articulation (Complexity)	Number of different colours/materials and approximate percentage of each colour/material relative to the total street facade;	- Jacobs A. & Bosselmann P., (IDS 241);
Detail (Complexity)	Percentage of different levels of facade decoration relative to the total street facade;	- Jacobs A., 1993;
Goods Exposure (Complexity)	Percentage of facade showing outdoor exposure of goods relative to the total street facade.	- Jacobs A. & Bosselmann P., (IDS 241); - Whyte W.H., 1988;

Conclusions: pitfalls and perspectives in using the Formal Indicator concept.

The preliminary Basic Formal Indicators list showed above has to be "handled with care". The most dangerous pitfall in reflecting on and using Formal Indicators is the risk of *determinism*. An ingenuous approach to the relationship between physical settings and social behaviours may easily lead to three contradictions. On one side, it is possible to make the question of form too comprehensive, to the detriment of other and even much more relevant factors affecting social cohesion and wellness, say economic, cultural, legal, historical and properly social factors; the point here is not that the form of public spaces determines anything, but that *also* the form of public spaces is one factor, among others, on the stage. On the other side, it is possible to take the question of form somehow "too seriously", being tempted to draw from quantitative measures a number of "laws of progress" and big arrows showing the way to the good future. It is not hard to imagine the relevance that Formal Indicators could gain if used as *analytical* tools of a new kind in monitoring the state of the urban environment and its evolution in time, contributing to set objectives of sustainability and to represent the moving of the whole urban system backward or toward them. Much more care is needed when thinking of Formal Indicators as *normative* tools for urban planners and designers: form is a very complex business and may be approached from a number of perspectives, nothing to say of social behaviours and concepts of quality. In my opinion, the right normative dimension for Formal Indicators is what Clare Cooper-Marcus termed "Performative Urban Design Guideline". According to Cooper-Marcus, the advantage of the performative guideline format is "that the wording is more specific, yet it doesn't restrict the designer to any particular solution; it allows the designer creative freedom by reminding him or her of a need, but not specifying how to fulfil it" (Cooper-Marcus C., 1985, p.7). In a later work (Cooper-Marcus C., Sarkissian W., 1986), the same author offers a broad example of the systematic use of performative guidelines. Finally, it is very easy to make the same reflection on a list of Formal Indicators something inherently abstract, detached from the same local communities they are thought for. That would be inconsistent with the most basic assumptions of the "observative" approach. In my opinion, a middle way must be found and preserved between an ingenuous "behaviourism" and an ingenuous "culturalism". It is the same convincing middle way, between culture and nature, that led Edward Hall to say: "Even though cultural systems affect behaviour in fundamentally different ways, they are deeply rooted in biology and physiology. (…). Even taking into account that great differences are given between spatial needs of different individuals and cultures, nevertheless we can make certain generalisations, and we can define a criterion which will allow us to 'objectively' order the meaning of different spatial experiences" (Hall E.T., 1968, p.10, 72-73). Much of the sense of Formal Indicators is in those "certain generalisations". Nevertheless, the problem is still open.

References.

- Bagnasco A. (1992), La ricerca urbana tra antropologia e sociologia, introduction to the italian edition, in Hannerz U. (1992), Esplorare la città: antropologia della vita urbana, Il Mulino, Bologna; original edition Hannerz U. (1980), Exploring the City. Inquiries Toward an Urban Anthropology, Columbia Univ. Press, New York.
- Bosselmann P. (1998), Representation of Places: Reality and Realism in City Design, University of California Press, Berkeley.

- Cooper-Marcus C., Sarkissian W. (1986), Housing as if People Mattered: Site Design Guidelines for Medium-Density Family Housing, University of California Press, Berkeley, Ca.
- Cooper-Marcus C. (1985), Design Guidelines: a Bridge Between Research and Decision-Making, Paper Presented at the U.S.-Japan Seminar on Environment and Behavior Research, Dep. of Psychology, University of Arizona, Tucson.
- Eurostat (1998), Indicators of Sustainable Development.
- Gehl J., Gemzøe L. (1996), Public Spaces Public Life, Arkitektens Forlag, Copenhagen.
- Gehl J. (1987, c.1980), Life Between Buildings: Using Public Space, Van Nostrand Rehinold, New York.
- Gehl J. (1977), Interface Between Public and Private Territories in Residential Areas, Department of Architecture and Building, Melbourne University, Melbourne.
- Hall E.T. (1968), La dimensione nascosta, Bompiani, Milano; original edition Hall E.T. (1966), The Hidden Dimension, Doubleday, New York.
- Jacobs A. (1993), Great streets, M.I.T. Press.
- Jacobs J. (1992, c.1961), The Death and Life of Great American Cities, Vintage Books, New York.
- Luhmann N. (1990), Sistemi sociali, fondamenti di una teoria generale, Il Mulino, Bologna; original edition Luhmann N. (1984), Soziale Systeme. Grundriß einer allgemeinen Theorie, Suhrkamp Verlag, Frankfurt am Main.
- Luhmann N. (1989), Comunicazione ecologica. Può la società moderna adattarsi alle minacce ecologiche?, Angeli, Milano; original edition Luhmann N. (1986), Ökologische Kommunikation. Kann die moderne Gesellschaft sich auf ökologische Gefährdungen einstellen?, Westdeutscher Verlag, Opladen.
- Newman O. (1996), Creating Defensible Space, U.S. Department of Housing and Urban Development, Office of Policy Development and Research, Washington D.C.
- Newman O.(1973), Defensible Space: Crime Prevention Through Urban Design, Collier Books, New York.
- Newman P., Kenworthy J. (1999), Sustainability and Cities. Overcoming Automobile Dependence, Island Press, Washington D.C.
- O'Meara M. (1999), A new idea of City, in Brown L.R. et al. (1999), State of the World '99. A Worldwatch Institute Report on progress Toward a Sustainable Society, Worldwatch Institute, Washington, USA.
- Pezzoli K. (1996), Sustainable Development: A Trans-disciplinary Overview of the Literature, paper at joint international congress of Collegiate Schools of Planning and the Association of the European Schools of Planning, Toronto.
- Porta S. (2000), La riconquista dello spazio pubblico urbano: contributi della pianificazione tra forma e vita sociale, in Quaderni di Architettura, DPA-Politecnico di Milano, Milano.
- Porta S. (1999), The Community and Public Spaces: ecological thinking, mobility and social life in the open spaces of the city of the future, in Futures, 31, p.437-456.
- Ramati R. (1981), How to Save your own Street, Doubleday, New York.
- Southworth M., Ben-Joseph E. (1997), Streets and the Shaping of Towns and Cities, Mc Graw-Hill, New York.
- UN-CSD, (http://www.un.org/esa/sustdev/isd.htm, visited 23 March 1999) Indicators of Sustainable Development.
- Whyte W.H. (1988), City: Rediscovering the Center, Doubleday, New York.
- Whyte W.H. (1980), The Social Life of Small Urban Spaces, The Conservation Foundation, Washington D.C.