Evolving cities into a sustaining and sustainable habitat

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Creating a new habitat for humanity

Cities have become the habitat of a rapidly growing majority of humanity. Since cities can neither create nor destroy the matter and energy required for their maintenance and evolution and for the lives of their inhabitants, an ever more important reciprocal interaction with the biosphere has been created. Between cities and their inhabitants, we encounter another reciprocal interaction: as people change cities, cities simultaneously change people. The latter interaction stems from the influence cities have on human activities, human lives and the societies of which they are a part. Insofar as this urban habitat permeates human experiences, this influence can reach the organization of the brain-mind through synaptic and neural changes (VANDERBURG, 2005). Since cities help to constitute a new habitat for humanity, the historical record implies that these changes could be decisive.

Humanity has lived in two previous habitats:

- During what is commonly called prehistory, it was the biosphere, when human beings lived in groups whose ways of life were mostly based on food-gathering and hunting.
- When societies began to be formed during the epoch generally referred to as history, they interposed themselves between the group and the biosphere, thereby making societies the primary habitat and the local ecosystems the secondary habitat.

These habitats were internalized through daily-life experiences and symbolized by means of cultures. As a result, they contributed to a diversity of human consciousness and cultures that were very different during history than their precursors in prehistory. All this is well known and widely accepted.

What is not well recognized is that with industrialization and urbanization, people began to change their habitat once again. To put it in another way: as people changed their technology, their technology simultaneously changed people (VANDERBURG, 2005).

Today, it is not only cities that interpose themselves between portions of many societies and the biosphere, but also the many technologies on which contemporary ways of life depend. For example, telephones, fax machines, the Internet, and the mass media interpose themselves between people, between people and groups, and between people, groups and societies. Such technological mediations are not neutral, since they filter out certain things and not others, as is obvious in a telephone conversation, where eye etiquette and body language are not transmitted. The high density of these technologies, together with the rapidly-growing cities constitute a new habitat that mediates between people and their previous habitats. It is reasonable to expect that the accompanying changes in human consciousness and cultures may well be as great as those that accompanied the transition from human beings living in groups to their living in societies. There is considerable evidence to suggest that this is the case since industrialization created first *homo economicus*, and later, *homo informaticus*. Similarly, traditional cultures have been transformed into those of a mass society, to take on entirely different characteristics (VANDERBURG, 2005). In sum, as we reengineer our habitat, we simultaneously recreate ourselves and our cultures.

The "cities changing people" component of our interactions with our new habitat has significant negative aspects. Although cities bring people into closer geographical proximity, these aspects make it more difficult for people to live together. I will briefly refer to four of these aspects.

- First, in bringing together people from different cultures, a process of cultural desymbolization and relativization sets in. During the early days of western civilization, Socrates and Plato sought to combat this effect on Greek culture by discovering the underlying rules – a project that in our time has been taken up by artificial intelligence. Weakening the culture of a community undermines its common unity and, hence, its survival.
- Second, contemporary cities contribute significantly to the effect crowds have on individuals, and hence to what is commonly referred to as a mass society.
- Third, conventional city planning separates people into socio-economic groups housed in different neighborhoods. It also separates the places where people work, shop, relax and live. This spatial separation contributes to a situation in which all these activities are carried out with different groups of people, in effect segmenting individual lives and thereby greatly weakening the social image people have of themselves and others, further contributing to the mass society.
- Finally, cities expose people to a variety of stressors such as sensory or social overload, crowding, noise, pollution and tall

buildings. Such stressors make it more difficult for human beings to carry out a variety of activities, including making and sustaining meaningful social contacts (VANDERBURG, 2000).

It would appear, therefore, that the effects cities have on human life and society will have a significant negative component. As is now widely recognized, contemporary civilization has not done a very good job in creating a habitat that socially sustains individual and collective human life. In sum, humanity may well be facing a social crisis as profound as the environmental crisis. The biosphere cannot sustain contemporary ways of life, including their dependence on the urban habitat. We should also recognize that unless we succeed in making our cities a great deal more livable, that is, capable of sustaining individual and collective human life, we may well be plunging ourselves into an equally profound social crisis.

The economic soundness, social viability and environmental sustainability of contemporary ways of life, as well as the possibility of justice, peace and security, will substantially depend on our ability to evolve our urban habitat in ways that will make it progressively easier for the biosphere to sustain its reciprocal relations with humanity, and for this habitat to sustain individual and collective human life. At least to Western thought, the importance of the city for this leg of the human journey ought to come as no surprise, given its fundamental role in Jewish and Christian thought (ELLUL, 1970).

The present paper argues that a substantial change in the direction in which we evolve cities is virtually impossible if we maintain the current intellectual and professional division of labor between groups of specialists, such as civil engineers (involved in infrastructure, structures, building materials, water and sewage treatment, and transportation), architects, urban planners, urban managers, social service administrators and politicians. The bodies of knowledge built up by these groups of specialists jointly constitute the knowledge infrastructure that supports the countless decisions that evolve contemporary cities The weaknesses of such an infrastructure with respect to achieving livable and sustainable cities must be carefully examined.

The knowledge infrastructures of societies

The knowledge infrastructure of a society supports the decisions of countless specialists, which contribute to the evolution of its way of life. In the following paragraphs, I will briefly consider three characteristics of the knowledge infrastructures of contemporary societies (VANDERBURG, 2005).

- First, on the macro-level they institutionalize an end-of-pipe approach to dealing with the undesired effects that flow from any decision.
- Second, as I will show shortly, on the micro-level, they trap individual specialists in a triple abstraction. This has led to an ongoing decline in the ratio of desired to undesired effects flowing from their decisions.
- Third, on an intermediate level, they bar the road towards genuine solutions to many difficulties faced by contemporary societies because they lie outside of the domains of specialization of the practitioners who would normally deal with them.

As noted, the evolution of contemporary ways of life depends on the decisions of countless specialists. Most of the consequences of these decisions fall beyond their domains of expertise where they cannot "see" them. As a result, the undesired or extraneous issues must be dealt with by other specialists in whose domains they fall. Consequently, the "system" institutionalizes an end-of-pipe approach to undesired effects. Instead of getting to the root of any problem, the "system" adds technologies or services. There is a great deal of evidence to suggest that the system now produces undesired results at a greater rate than desired results. The costs incurred in the production of wealth are growing more rapidly than the increases in gross wealth production; and a number of economists have calculated that, as a result, net wealth has been declining for decades (DALY and COBB, 1989). Similarly, we are now producing pollutants (products that we produce but cannot sell) at a far greater rate than desired goods and services. A study from the American Academy of Engineering estimates that, of what we extract from the biosphere, 93 percent is turned into undesired products (pollutants) and only 7 percent into goods and services (ALLENBY and RICHARDS, 1994). Our materials and production systems may well turn out to be among the most uneconomic and environmentally destructive ones ever created by humanity. Some time ago, Blue Cross was the largest supplier to the largest corporation in the world. Apparently, physically and mentally ill workers were the company's most valuable undesired output (KARASEK and THEORELL, 1990). To deal with these and other health problems, we have expanded our "disease care" system. Rapidly growing health care budgets would suggest that the rate at which contemporary ways of life produce illnesses outstrips their ability to deal with them. It is easy to multiply these kinds of examples, but the deep structural crisis is obvious. We have created a "system" whose "signal-to-noise" ratio of desired to undesired effects is steadily declining as a result of our increasingly global knowledge infrastructure.

This knowledge infrastructure traps specialists in a triple abstraction that makes them almost impotent to do anything about the present situation.

- In separating a domain of expertise from the remainder of the world, the latter is represented in any specialty by the desired outputs it hopes to contribute to that world and the requisite inputs received from that world to produce these outputs.
- In a second abstraction, only those aspects of the process that convert requisite inputs into desired outputs that are coterminous with a specialist's domain of expertise are retained.
- A third abstraction flows from the way a domain of specialization seeks to make improvements. It begins by creating a model of the process that converts requisite inputs into desired outputs, followed by varying its form and correlating such variations to performance in order to select the "best" one.

Since no specialist has the knowledge of which form is best for human life, society and the biosphere, the "best" one is reduced to the one that obtains the highest desired outputs from the requisite inputs, as measured by output/input ratios including efficiency, productivity, profitability, cost-benefit comparisons and GDP (obtained from a society interacting with the biosphere). As a result, a specialist has no idea of whether any gains in desired outputs are realized in part or in whole at the expense of human life, society and the biosphere. There is, therefore, a significant tendency for such decisions to obtain the desired results but at the same time to undermine the integrality and context compatibility of what has been "improved." As a civilization, we succeed brilliantly in the domain of improving performance, and fail equally spectacularly to prevent performance from undermining human life, society and the biosphere.

The third characteristic of the knowledge infrastructures of contemporary societies follows directly from the second. What if a genuine solution to a particular set of difficulties cannot be achieved by optimizing one or more aspects of the process of obtaining the desired results from requisite inputs? In such cases, practitioners may be unable to arrive at genuine solutions, trapped as they are in the triple abstraction. For example, is it reasonable to expect that the solution to the traffic congestion of modern cities lies in optimizing the present transportation system? It may well be that the real solution lies in reducing the need for mobility. In that case, the urban form would have to be rethought; and this is clearly well beyond the traditional domain of traffic engineering. Similarly, it is highly unlikely that, in the long term, the energy crisis can be dealt with by improving the efficiency of power generation and distribution and building more power stations. The exponential growth in energy demands will have to be reshaped; and this is clearly beyond the domain of power engineering. Hence, the present intellectual and professional division of labor and the knowledge infrastructure built on it together prevent genuine solutions from emerging when these represent a non-cumulative development.

These three characteristics of contemporary knowledge infrastructures give rise to the technical approach to life, which represents a shift from asking: How can this or that improve human life? to: How can this be made to yield its greatest power by converting requisite inputs into desired outputs? To sum up: the technical approach to life begins by abstracting whatever is to be made "better" and representing the remainder of the world only in terms of the inputs it must provide and the desired outputs it will receive. Next, whatever has been abstracted in this way is studied by further abstracting those features that are directly relevant to the goal of transforming the inputs into outputs, as well as being coterminous with the expert's domain of competence. These aspects are included in some kind of model, while the remaining features are excluded from it. The model is then manipulated to determine which of its forms functions best in terms of contextless output-input ratios. The previously excluded contexts continue to be left out of the picture. Finally, the results are used as the basis for reorganizing the portion of reality originally abstracted. It is a strategy for reorganizing human life and the world, piece by piece, with minimal consideration being given to the context in which they occur.

What a technical specialist does when he or she examines a portion of reality in order to make it "better" is to behave as if the world is unmanageably complex. Instead, whatever is to be made "better" is placed in the simpler and more manageable intellectual context of a technical specialty, supplemented by the limited physical context of a laboratory experiment designed to examine a few variables, preferably one at a time. Parceling out the task of knowing ourselves and the world in this way has turned out to be so manageable and efficient that technical knowledge has grown exponentially. However, it is not a growth of knowledge of things in their real-world context but in a context delimited by the triple abstraction. Hence, the exponential growth of technical knowledge of things out of their usual context is accompanied by an exponential growth of ignorance of what things are like in their real-world context. The technical approach takes whatever is made "better" out of the fabric of human life, society and the biosphere in order to reorganize it, which creates a tension between what has been made "better" and this fabric. Improving performance as measured by output-input ratios is rarely compatible with the maintenance of its integrality and context compatibility, and hence with evolving the natural and human order (VANDERBURG, 2005).

The following case study illustrates how the technical approach makes it next to impossible to get to the root of any problem to arrive at a genuine solution. A group of experts examining a hunger problem in a Colombian valley, under the auspices of the United Nations, ran into the following problems (VANDERBURG, 2000 and 2005). The nutritionist made an inventory of all the foodstuffs grown in the valley in order to determine the most nutritious diet possible, supplemented it as required, and made the appropriate recommendations. The specialist in community health suggested that these recommendations would not solve the problem because the inhabitants of the valley suffered from intestinal parasites, resulting in diarrhea and their inability to absorb a nutritious diet. Instead, this specialist recommended that the water supply be improved, sewage treatment be started, and basic health care provided. The economist smiled politely, suggesting that the inhabitants did not have these things because they lacked the resources; and these could only be created by economic development based on cottage industries and some inhabitants working outside of the valley to send money to their families. The agronomist on the team recommended instead that the inhabitants be taught modern agricultural methods to enable them to grow enough food for themselves and to sell the surplus to generate income, thus enabling them to procure the above necessities of life. The political scientist firmly disagreed. All these things were not happening because the hungry people in the valley had no political voice, and this would not change until they were empowered by forming a political party.

I could go on with the diagnoses and recommendations of the sociologist, the demographer and an expert in systems. However, the point is obvious. Each expert "paints" a picture of the situation by putting those aspects that correspond to his or her specialty in the foreground and everything else in the background, thereby creating incommensurate diagnoses and recommendations. Each and every expert has the answer but really does not know what the question is. It is impossible to scientifically integrate the findings of different specialties to arrive at a comprehensive interpretation of the situation. We would encounter a similar confusion of technical tongues if we had asked specialists what it is that socially and environmentally ails our cities, and what we should do about it.

Knowledge infrastructures for cities

The implications for creating and evolving contemporary cities are obvious. If we continue to do architecture, urban planning, civil engineering, urban management and politics based on the present knowledge infrastructure, it is almost guaranteed that undesired effects will be created at a greater rate than the desired ones and that the urban crisis will continue. For this reason, conventional approaches need to be gradually supplanted by preventive ones. These make use of the knowledge we have of how the urban habitat affects human life, society and the biosphere in a negative feedback mode, to adjust design and decision making to accomplish the desired results but, at the same time, prevent or greatly minimize undesired effects. In this way, preventive approaches can overcome some of the limitations of our present knowledge infrastructure. Fortunately, this is not merely an idea. A conceptual framework for preventive approaches has been created (VANDERBURG, 2000), which was recognized by the Canada Foundation for Innovation as one of 25 recent leading Canadian innovations. This framework is able to integrate the many embryonic and piecemeal attempts reported in the literature, which have been documented in four annotated bibliographies (VANDERBURG et al., 2001, 2001a, 2001b, 2004).

Introducing a preventive orientation into a particular area of specialization

- begins with determining the typical undesired consequences that flow from the design and decision making of its practitioners;
- next, the areas of specialization in which these undesired consequences "land" are consulted to discover what they know about the effects these have on human life, society and the biosphere;
- finally, this knowledge is internalized into the original area of specialization to provide its practitioners with the capability of adjusting their design and decision making to achieve the desired results while simultaneously preventing or greatly minimizing undesired effects.

To create a knowledge infrastructure capable of guiding the evolution of the urban habitat toward livable and sustainable cities requires the introduction of a preventive orientation into each and every relevant area of specialization. This, in turn, will lead to beneficial, synergistic effects between these areas of specialization. Not the least of these is a gradual transformation of the intellectual and professional division of labor, which builds the portion of the knowledge infrastructure of a society related to the urban habitat.

Fitting together the many available preventive approaches can best be accomplished by starting with what we know about how urban form affects the livability of cities. After all, there is no point in creating cities that can be metabolically sustained by the biosphere but that are not good places to live. From a sociological perspective, the principles set out many decades ago by Jane Jacobs (1961) are, to the best of my knowledge, still the most fruitful point of departure. These principles are based on extensive, overall assessments of whether a certain street or neighborhood "works" for people. Such judgments can only be made on the level of experience and culture (VANDERBURG, 2000 and 2005) and not within the boundaries of any discipline or professional specialty. Once made, these assessments can be analyzed by abstracting various aspects to examine how they contribute to the livability (or the lack of it) of the street or neighborhood. Livable and sustainable cities depend on livable neighborhoods which, in turn, depend on streets that are safe and feel comfortable. This depends on a constant flow of people using the street for a wide range of functions that remain active all day and much of the evening. These people help to maintain a kind of shared public order that supports those who intervene, when necessary. There is little doubt that the further evolution of mass society has made this much more difficult since Jane Jacobs formulated her original principles, but they remain generally applicable.

According to Jacobs, four principles can guide us toward more livable urban habitats.

- First, to ensure people's presence on the streets for most of the day and evening, it is essential not to separate places where people live, work, play and shop. City blocks should mix these functions through an appropriate diversity of buildings that each serve as many of these functions as possible. For example, on a main street, buildings might accommodate shops, restaurants and theatres on ground level, and offices and apartments on the higher floors.
- The second principle aims to bring such diversity within easy walking distance of as many people as possible by arranging buildings on short city blocks. This will reduce the demand for mobility. A better balance may thus be struck between building cities for people or for private automobiles.
- The third principle aims to ensure a variety of accommodations for different functions. For example, the buildings on a city block should be somewhat diverse in age and quality, with the result that a startup business can find something affordable and, if things work well, can move into a better and more expensive location later.
- The fourth principle aims at ensuring a reasonable density of dwellings per hectare to have enough people on the street engaged in various functions for as long a time as possible during each day.

Intensifying cities through smart growth, traditional neighborhoods, pedestrian pockets or transit-oriented development must not be confused with slums, which occur when the density of people per room or per dwelling becomes too high.

It is immediately apparent that making the urban habitat more socially sustaining converges with making it more sustainable metabolically. This is confirmed by a growing body of evidence. For example, mixing functions should reduce the way urban form shapes the demand for mobility, both qualitatively and quantitatively. Trips could become shorter and could thus make walking and cycling possible and attractive. In turn, reducing dependence on the private automobile could substantially change the way urban form shapes the demand for energy, since transportation now consumes a very large portion of overall energy requirements. It may also positively change the way urban form shapes the demand for materials. For example, infrastructure requirements per functional unit (apartment, store, restaurant, etc.) are likely to be smaller. Alternative forms of transportation may also substantially reduce the throughput of materials in a community. Functional diversity creates a potential for more aesthetic and diverse streets and neighborhoods, moving away from the equivalent of monoculture in construction. In addition, these and other synergies may help to make cities more financially affordable by improving their "signal-to-noise" ratio of desired to undesired effects.

The above kinds of synergies may be further enhanced by preventive approaches in other domains. For example, the problem of municipal waste needs to be addressed by preventively restructuring our materials and production systems (VANDERBURG et al., 2001). Linear throughput patterns of materials in the network of flows of matter should be made circular as much as possible by businesses adding value to end-of-life products as an alternative engineering and business strategy to producing materials, components or entire products from virgin resources. Closing materials loops will require a decentralization of production and a reduced dependence on transportation, which will become significantly more expensive as fossil fuels run out. Converting markets for products to markets for the services these products render, as well as product take-back, design for environment, and industrial ecology are some of the preventive approaches capable of restructuring our materials and production systems, to the benefit of urban habitats (VANDERBURG, 2000). Such changes could make a substantial contribution to solving the increasingly difficult problems associated with the running out of, and having to create, new landfill sites.

We also know how to preventively restructure our **energy** systems. The engineering, operation and evolution of these systems have always focused on "production" and distribution, and have all but ignored energy end-use. The result has been systems that perform rather well in terms of production and distribution but are incredibly inefficient in their energy end-use. Furthermore, these systems were designed with little consideration of their human, social and environmental contexts, yielding a very poor "signal-to-noise" ratio of desired to undesired effects. We know how this imbalance can be redressed by integrated resource planning, distributed production and, most importantly, demand-side management. It is here that urban form can make an enormous contribution toward reshaping our energy systems. The lessons we have learned from designing energy systems to include energy end-use have not yet spread to the design of other urban systems related to water, sewage, natural gas and transportation. These systems must also be redesigned by integrating end-use. For example, buildings and what goes on inside and around them shape the demand-side of these systems and, hence, should be considered as system elements.

As noted, industrialization has produced spectacular improvements in labor productivity and an equally spectacular increase in workplace-related physical and mental illness (VANDERBURG et al., 2004). Healthy workplaces that are well integrated into the urban habitat to reduce stress from commuting and the need for mobility can make a substantial contribution to improving the social viability of urban communities (VANDERBURG, 2000). They can also contribute to reducing the rate at which the urban habitat "manufactures" disease, thereby reducing the need for end-of-pipe social and health services.

In order to realize the above kinds of synergies between preventive approaches, the intellectual and professional specialties that design, build and evolve the urban habitat must address the fact that this habitat is more than the sum of its constituent elements. A new nexus will have to be created between the university, the knowledge infrastructure and the city.

The previous nexus produced ways of designing and evolving the urban habitat by dealing with its constituent elements as though they primarily contribute to one or two larger entities, which in turn contribute to still larger ones: neighborhoods, electricity and gas supply systems, water and sewage systems, transportation systems, communication and information systems, to mention only some of the more prominent ones. The city was regarded as a relatively loose aggregation of all such systems.

The creation of a more livable urban habitat requires that each constituent element becomes a local manifestation of that larger whole by providing as many of its functions as possible. For example, a building may be constructed from materials participating in an industrial ecology system, collect rainwater and reuse grey water, contribute positively to power generation through solar collectors and negatively by means of a passive solar shell, participate in urban agriculture by its roof-garden, provide "eyes on the street" for security, support a variety of neighborhood functions by means of shops, offices and dwellings, provide a sufficient population density to help make public transportation feasible, and aesthetically enhance the livability and appeal of the neighborhood. In sum, good design incorporates as many of the functions of the urban habitat as possible to each and every constituent element, so as to make the whole as economically affordable, socially viable and environmentally sustainable as possible. We must move from megacities that present a highly *unfolded* complexity to a genuine habitat with a highly *enfolded* complexity.

For a building to contribute a diversity of functions to an urban habitat, a blurring of the boundaries must occur between many areas of specialization. Once again, this may be accomplished by internalizing a knowledge of these diverse functions into every appropriate area of specialization. This task is greatly facilitated when every specialty begins to think about its contributions to particular urban forms. In other words, urban form thus becomes an over-arching concept capable of integrating the many decisions made by the practitioners of various areas of specialization.

To date, several urban forms have emerged that are moving in the direction of more livable and sustainable cities. They include: traditional neighborhood design, pedestrian pockets, transit-oriented design and smart growth. Each one embodies the principles set out by Jane Jacobs many years ago. Once areas of specialization begin to identify with these and other urban forms, they will have begun to re-interpret their mission: helping to make these urban forms as sustaining as possible of human and social activities, and as easily sustainable as possible by the biosphere. Such a development will move them away from concentrating on particular urban elements and aspects as if they were relatively independent and distinct "building blocks" of the urban habitat. Identifying these particular urban forms also links knowing and doing *separated* from experience and culture with knowing and doing *embedded* in experience and culture (which results from the way people experience these urban forms and the extent to which these urban forms satisfy their aspirations and values) (VANDERBURG, 2005). When this occurs, each area of specialization is no longer limited to optimizing whatever is contained within its triple abstraction. Each area of specialization now takes charge of particular aspects of these more livable and sustainable urban forms, and as such, contributes to a larger whole, which challenges the triple abstraction.

The use of urban form as an over-arching concept can thus fundamentally transform each and every area of specialization concerned with some of its elements or aspects. For example, the design of a water system for this habitat no longer needs to stop at the supply line to each building. The building itself can be incorporated into the water system as not only shaping the demand for water, but also as an active contributor by collecting water from its roof to be held in a tank from which toilets draw water for flushing; or alternatively, grey water may be used for this task. Roof water may also be used for the irrigation of gardens. There is a parallel here with what we learned from electricity systems. Integrating energy end-use into them opened up entirely new approaches for the design and evolution of these systems, such as integrated resource planning, energy end-use efficiency improvements, and demand-side management. These negatively produce electricity by saving it. In other words, the energy system no longer stops at the fuse-panel of a building. It now includes the building as an energy transducer. In the same way, water and sewage systems can be re-thought to better serve particular urban forms and integrate as many of their functions as possible. The result will be that each and every element of new urban forms will no longer be designed and evolved by separate areas of specialization. Instead, each area of specialization will attempt to enfold as many functions as possible of an urban form to make it more economically sound, socially viable and environmentally sustainable.

Toward a genuine habitat

The initiatives outlined in previous parts of this paper would lead to the urban habitat more closely resembling humanity's previous two habitats, nature and society, in the way that their elements relate to each other and to the whole. In Western thinking, as well as in scientific knowing and technical doing, the fact that everything appears to be related to everything else is depicted in mechanistic terms. The first generation of mechanistic world views was based on the clock and the second on the computer, but neither of these encompasses the kinds of relationships found in a social and natural habitat. In these living wholes, the whole is enfolded in each of the "parts," and the "parts" come into being within the whole by progressive differentiation. For example, each and every cell in our bodies and hence each tissue and organ has enfolded into it the blueprint of the whole in the form of the DNA. Similarly, by growing up in a particular society, the organization of the brain-mind progressively differentiates and expands as a result of symbolizing the experiences of our lives, to the point that this organization symbolically maps our lives as lived in a particular society and ecosystem. There is no separate society "out there." Others help to make up our society, as we help to make up theirs. We are both society and individual because something of our way of life and culture is enfolded into our brain-minds. In the same vein, there is no separate environment "out there," as was first depicted in the painting of the Mona Lisa. We help to make up the biosphere of all other life forms, as they do for us.

Although the urban habitat can never be a living whole, nevertheless its internal structure can be made to resemble more closely those of nature and society by the previously-suggested changes to the intellectual and professional division of labor and the knowledge infrastructure built up by it. The more each aspect and element of an urban habitat is a local manifestation of this whole, and the more their functions contribute to those of that whole, the more these aspects and elements enfold something of it. It may be expected that moving in the direction of structuring the urban habitat in this way will improve its economic soundness by virtue of the fact that as many aspects and elements as possible contribute to as many functions as possible. It may also be expected that this urban habitat will become more livable, for reasons discovered by Jane Jacobs. It will certainly reduce the ecological footprint of this urban habit, although it remains an open question whether an evolution based on the potential of preventive approaches and their synergistic effects can, over the decades, make cities fully sustainable. Nevertheless, reshaping the intellectual and professional division of labor and the knowledge infrastructure by means of which we evolve cities can make a substantial contribution to our common good.

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