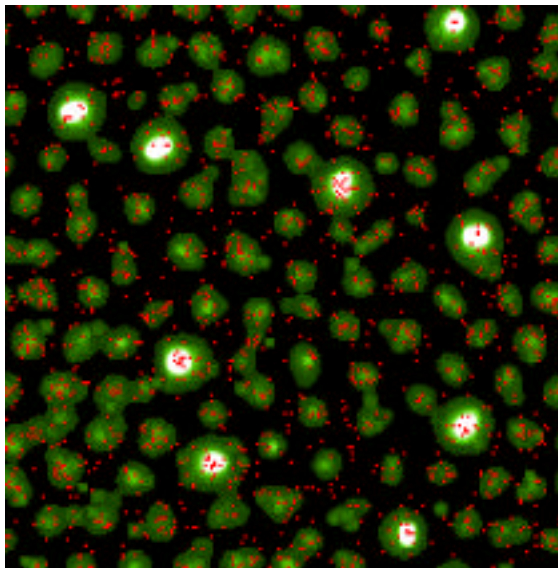


## Evolution of Places: Intentionality in the Built Environment

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*Within the evolution of places including metropolises, cities, towns and neighborhoods, human beings and human organizations are the actors that make deals resulting in architectural changes to the built environment. The patterns that evolve are intentional at two levels: at a simple level, the actors (city planners) in the system directly intend to create certain features; and at more complex levels, the interactions of many autonomous actors (developers, transportation officials, financiers, etc.) indirectly give rise to yet different patterns, notably metropolitan sprawl. This paper proposes an organizational mechanism intending to evolve the built environment into a highly correlated fitness landscape of human deal centers which reflect actual building densities and land values. The final section considers the implications of this mechanism relative to the human limitations of structuring the built environment.*



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### Context

Technological advances in the past 300 years have prompted a variety of means and methods to manipulate building and construction within cities, towns, metropolises and neighborhoods. Theoretical debates range from absolute generalization and self-sufficiency, ie. Walden Pond types, to absolute specialization and system dependence, such as Brave New World types. The current paradigm for manipulating places, Zoning-by-Function, was an intentional response to a fitness landscape defined by the industrial conditions affecting places 50-150 years ago.

Cities such as Brasilia and Canberra have been built strictly according to this paradigm and have demonstrated the limitations of changing fitness landscapes. Unable to predict the viability of businesses and industries over many years makes it impossible to layout a city based on clearly identified areas for different functions. However these intentions are still visible in most communities' Master Plan. Alternatively many places have simply evolved without any governmental guidance such as shanty towns which can be witnessed in many economically stressed places; others such as the city of Houston, have evolved with a minimum of governmental guidance on a large scale.

Recent technological advances define a new fitness landscape, one that is more sensitive to transportation and communication networks. The resulting increased mobility of people, goods and services, dramatically limits the effect of direct intentions by municipalities because people and organizations move from place to place much more frequently. However the effect of indirect intentions, those patterns that emerge due to the interactions between many different organizations, are substantially changing the way places are built. Within this fitness landscape many different organizations are building and re-locating according to their own needs and desires.

This research is developing an organizational mechanism for manipulating the built environment at the level of indirect intentions. The goal is to direct the evolution towards a highly correlated, multi-scaled network of distinct places. It is suggested that on such a fitness landscape, places are most suitable for human living. The organizational mechanism coordinates the range of possible interactions such that places maintain a balance point between extremes, ie. the edge of chaos. Near this balance point, places are stable enough to maintain a sense of community and build history; and yet, also open enough to accommodate significant changes in the operating environment, whether developed internally or pressured by the fitness landscape. To understand the patterns that emerge in the built environment, this paper reviews three influences on the built environment: *historical chance*, *self organization*, and *selective pressures*.

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*Historical Chance* The operating environment for places is rooted in chance events occurring in three areas: physical features, human actions, and natural stress. Places are defined by strong differentiation, or contrast in the physical features: water and land, forest and fields, mountains and valleys. Great examples of differentiated environments are harbor cities such as Hong Kong, which emerged because the physical features were the most suitable for land/water shipping within an entire region.

Human actions first emerged in places where there was easy availability of food, water and shelter. Subsequently organizational structures for groups of people exceeding 2500 also began to shape places because physical structures were required for the operation of the community. Archeologists studying these early villages built by humans in many parts of the world, have identified patterns of open spaces associated with different scales which supported the need for human interactions.

Also natural stress continually changes the built environment in unpredictable ways. From meteors to plagues to economic swings, nature itself is constantly changing the character of a place with the passing of time. The discovery of gold in California and the abandonment of the Yucatan Peninsula are intriguing examples of natural stresses which dramatically changed the built environment.

An example of the interplay between these three types of chance events can be illustrated through the brief 200 year history of Chicago. Geographically situated at the crossroads of land, river and Great Lakes trading routes gave it a reason in 1831, for existing. In the 1870's, St. Louis was forecast to be the biggest Midwestern city due to its location on the Mississippi as well as the gate way to the west. However human actions like the opening of the St. Lawrence seaway, the emergence of railroads, and the invention of refrigeration changed the fitness landscape substantially. Additionally the natural stress of the enormous 1871 Chicago Fire, presented huge opportunities to update the underlying infrastructure preparing the city for the 20th century. In a matter of 50 years, Chicago's population far out paced St. Louis' and the city became the hub of the midwest.

*Self Organization* Through time humans and human organizations continually make *deals* between each other to accomplish individual objectives. In this research, deals include all human interactions, recreational activities as well as actual monetary transactions. Additionally the actors are considered to be entities such as developers and land owners in the real estate industry, entities creating regulations in the government, and entities needing spaces for deal-making of any reason. Notably any specific deal requires three events: two or more actors come together at a specific place; they exchange ideas, goods, or services; and then they depart.

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Through these interactions buildings such as homes, offices, arenas, factories, exhibition halls, schools, etc. are built to facilitate deal-making activities. High density environments reflect a higher quantity of deal-making, and the diversity of buildings reflects the kinds of deals being made. In places with a long history of deal-making and stability of location, buildings are built to endure longer periods of time. By contrast in places where the location is unstable, and deal-making is temporary or swings dramatically, buildings are built cheaply reflecting a temporary character of place.

The value of a place is determined by how effective it is at facilitating deals. Places therefore are extremely sensitive to the actors mobility and to the facilities available for making deals. In varied cultures and many different places throughout history plazas, squares and open urban spaces supported deal-making with a few minor amenities: water and open space. These spaces were typically surrounded by high density buildings for every functional purpose, and were accessed on foot or by animals and carts. They became the center of community life with boundaries defined by a reasonable walking distance, after which agricultural open spaces were required to provide necessary amenities. In today's global marketplace the scale has grown tremendously and a similar phenomenon can be seen as large exhibition halls are located within close proximity to airports. In addition to water and open space, these new deal centers provide power, telecommunications and climate control, but basically the same underlying deals are being made.

### *Selective Pressures*

Identifying the focal level is necessary to assess which selective pressures occurring at higher levels are influencing patterns at the level of interest. This research primarily focuses on the level of multiple municipalities, but can be extended both to smaller levels such as neighborhoods and towns; as well as higher levels such as metropolises and regions. The level of multiple municipalities is where runaway patterns of sprawling autocentric development is evident. If these patterns are to be addressed in any intentional manner, we will have to look at higher levels of events for solutions.

Selective pressures change the population dynamics, and therefore the underlying evolution of a place and its corresponding ability to facilitate deals. Pressures at the focal level of multiple municipalities include: warfare and political organization, major economic transformations, environmental devastation, and radical change in the beliefs of society. Population in the city of Detroit rose and fell substantially between 1910 and 1970. It grew rapidly in the effort to produce automobiles, which once established as the primary means of transportation expanded peoples mobility. Then many different selection pressures left the city's built form obsolete: built for a different way of life people equipped with economical automobiles and new beliefs preferred to live in the suburbs.

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### Organizational Mechanism

The organizational mechanism utilizes five features to effect changes in the built environment. Two are used to specify conditions at the focal level of multiple municipalities, *Levels of Mobility* and *Access Points*; and two features specify conditions locally within municipalities, *Urban Open Space* and *Degrees of Freedom*; and then the *Parameters* relates all conditions together. The two operational features are demonstrated through a Starlogo simulation, and the two local level issues are explained relative to functioning communities. The organizational mechanism does not specify how communities should build, but coordination of these features would effectively change the way developers play the game of building projects and assessing risk.

#### 1.) *Levels of Mobility*

Today there is a huge variety of modes for traveling, however it is possible to identify distinct levels of mobility that are independent of specific modes. It is essential to consider mobility without reference to a particular mode of travel. This allows the organizational mechanism to be open to new technologies, and open to the most efficient modes of travel for any purpose. Early engineering studies have provided an analysis of the energy efficiencies of different modes relative to rates of travel. Using this as a starting point we can identify the following distinct levels of mobility, using the existing network of travel for reference:

Level 0	• pedestrians	5mph
Level 1	• small streets, mostly residential access	20mph
Level 2	• busy roads, mostly commercial access	40mph
Level 3	• highways, mostly local distribution	80mph
Level 4	• high speed rail, mostly between regions	200mph
Level 5	• airports, mostly between continents	600mph

These levels exist relative to each other and have energy efficient rates with respect to various technologies. Specific modes of transportation vehicles are suited for certain ranges, capacities and rates of travel better than others. Also within a particular level, there are a variety of transportation modes such as Level 1 including bicycles, scooters and delivery vans; and Level 2 including ferries, light rail, trucks and cars.

#### 2.) *Access Points*

The mechanism limits the distribution of access points to a particular level of mobility based upon the distance that level of mobility travels with no access. An example might be that a Level 3 interstate highway would have to run 10.5 mi. with no access, which could then be followed by 1 mi. of unlimited access points, and again followed by 12 mi. of no access. Similarly a Level 2 "busy road" might run 3 mi. with no access, followed by 0.3 mi. of unlimited access, and then another 3.2 mi. of no access. It is essential to note that since capacity is variable, the restriction on *distribution* of access does not affect the rate of flow,

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allowing transportation networks to accommodate the traffic potential for any particular route.

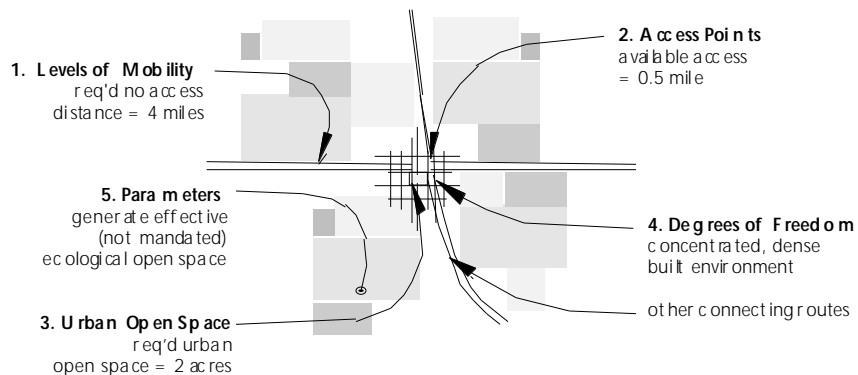
### 3.) Urban Open Space

When a community decides to add access or a new level of transit, a specified amount of urban open space is required. Simply, these are area requirements for plazas or squares, that are located immediately adjacent to the access points to transportation. Although this may seem unnecessary when most financial transactions today are electronic, as stated previously, deals are simply meetings between people or organizations and the subsequent exchange of ideas, goods or services and therefore encompass all of human activities. These activity centers provide a focal point for public life and the opportunity for people to interact in planned and spontaneous ways.

### 4.) Local Degrees of Freedom

When the access to mobility is coordinated across a network, it becomes possible to ensure the stability of place, because really large scale activities can only occur where there is support for equally large scaled mobility. Therefore as a part of the organizational mechanism, municipalities would eliminate density restrictions, setbacks and functional restrictions imposed on the changing needs for buildings that facilitate deal making. This gives actors in a community the ability to shape things according to locally determined need, both direct intentions and indirect intentions are open to evolve depending upon various selective pressures

Figure 1 :  
Mechanism  
Features



Rather than separate activities by function, the network created by the organizational mechanism filters mixed-use places by level. Large scale activities occur with other large scale activities, and small scale activities occur with other small scaled activities. Previous strategies have yielded performance regulations that restricted noise levels and traffic within certain districts of a municipality, unfortunately they cannot go beyond a municipal jurisdiction to address multi-municipality auto-centric sprawl. Additionally performance regulations are still

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tied to arbitrarily defining districts on a Zoning Map of a community by planners, rather than accommodating the evolution of the built environment.

- 5.) *Parameters* Levels of Mobility and Access Points are focused on operational features that coordinate transportation between places. The Urban Open Space and Local Degrees of Freedom are focused on physical features that facilitate deal making within places. All of these features are interconnected by a intricate web of relationships, or the Parameters. Calibrating the ratios between these features is the artful and intentional task of building a highly correlated fitness landscape which successfully allows the built environment to evolve at that point between chaos and stasis.

Observed values used to determine the levels of the mechanism are populations and rate of travel. Sociological literature is filled with observations of optimum populations for communities based on stable patterns which have evolved over millenniums. These observations include many different political methods in history and culture. The observed values indicating rates of travel for various levels of mobility, have emerged in the relatively short period of a few hundred years. Similar to other complex adaptive systems, these values are clearest at the focal level and slowly become less precise as one tries to apply them to levels further from the focal level. This condition is not a problem because it is the few levels closest to the focal level that are most important to the functioning of the mechanism.

### **Effects**

A simulation of Levels of Mobility and Access Points was developed to demonstrate the effects of deal making activities on the landscape. Five stages of the simulation using Starlogo from MIT, illustrate the fundamental approach towards the development of the mechanism.

**Initialization** A number of agents are randomly located on the landscape, each selects a random direction (360°) and begins moving at a rate of 1 space per time step.

**Deals** Agents make deals with other agents when they meet in the same location, and then add value to that place. Additionally, after completing a deal each agent selects a new random direction and continues moving.

**Levels of Mobility** At the third stage agents are given the ability to utilize a second level of mobility allowing them to travel at the rate of approximately 12 spaces per time step. This occurs only for one time step after they complete a deal, i.e. they leave quickly.

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**Motivation** The next stage gives agents the ability to see the value of the landscape and the motivation to seek places of high value.

**A Network of Places** Finally when all of these features are combined, the agents proceed to build a loosely structured network of high valued places approximately 12 spaces apart according to the rate of travel for the second level of mobility. The value of the landscape becomes highly contrasted with spaces in-between being of substantially lower value. Abstractly, the random directions selected by the agents as they run around the landscape is essential because it frees the system from physical tracks or routes. Even though today many forms of transport are "track based" some are not, and air travel is reducing the need for physical routes to determine which directions are possible.

**Evolution of Landscape Value** Stuart Kauffman's notion about highly correlated fitness landscapes being more robust for evolution is related to the need for increased spatial contrast between places and therefore increased land value contrast. In this context, smooth landscapes are exemplified by suburban environments and extremely rugged landscapes can be seen in urban areas where neighborhoods can change value by crossing a street. He states in At Home in the Universe:

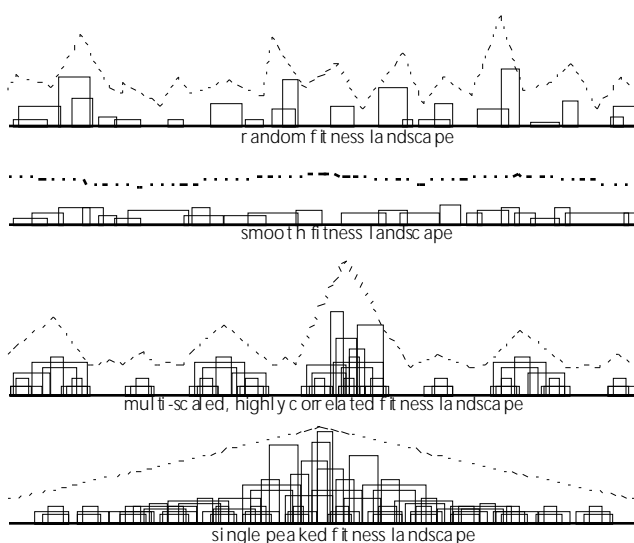
*Since selection faces an error catastrophe on very smooth landscapes and can become excessively trapped in small regions of the space of possibilities on very rugged landscapes, we must also begin to suspect that selection seeks 'good' landscapes. We do not as yet know in any detail what kinds of landscapes are 'good,' although it seems safe to conclude that such landscapes must be highly correlated, not random.*

The organizational mechanism is an attempt to provide a highly correlated and multi-leveled fitness landscape where peaks and valleys of land value are related to a system for distributing access to levels of mobility. Developers compete for projects based on a generally defined fitness landscape, where land value is high near access points, also due to the relative stability in the location of access to mobility, they are also challenged to create projects uniquely tailored to a specific place.

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Figure 2:  
Types of  
Fitness  
Landscapes



### *Nested Levels of Places*

Patterns of mixed-use pedestrian supported, amenity saturated, higher density places will instigate much greater integration of community functions visible to people living in a place. By contrast Zoning-by-Function induces formal patterns with each function in its logical but not necessarily effective location.

The following diagrams indicate levels of places which are nested within each other. T, the double ended arrow, represents the transportation level; SO, the small grid, represents the Urban Open Space requirement; SS, the small circle, represents the nested smaller scaled spaces, and the curving arrow represents the direction towards the next larger level.

### *Boundedness*

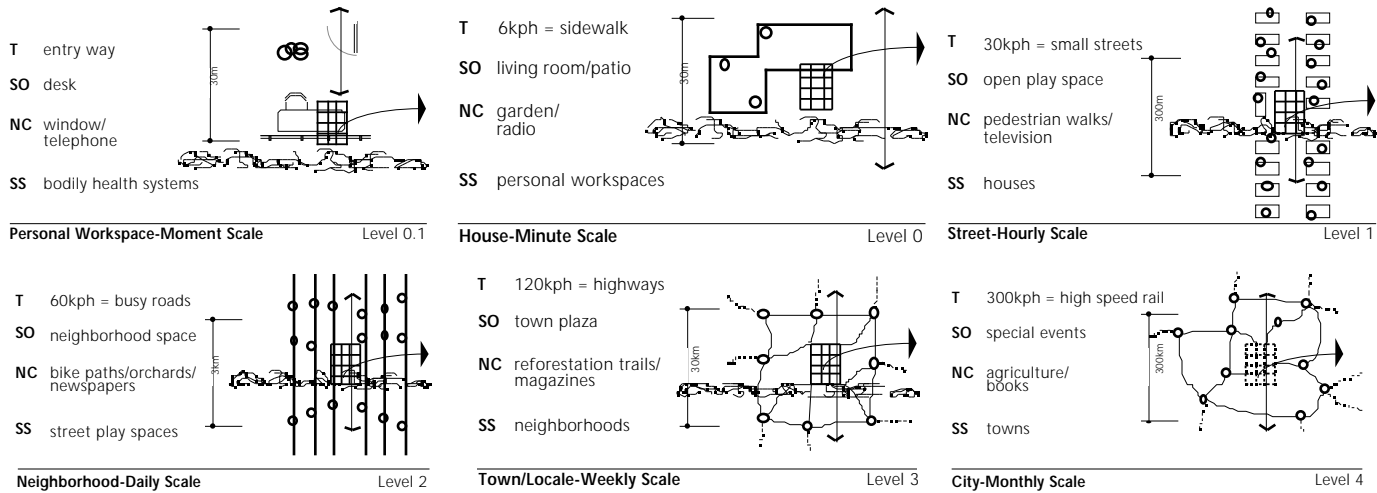
The idea of boundedness is essential in creating a cooperative environment which can support the dynamics of living systems. Boundedness for human beings and the communities we live in, consist of two aspects: activity centers and spatial perimeters. Activity centers such as plazas or squares, and perimeters including the Great Wall, nation-state borders, and garden fences work together to create a sense of boundedness.

The Urban Open Space parameter is included to instigate the formation of activity centers. The large distances without access points to transportation provides a sense of perimeter by incorporating ecological open spaces between activity centers, defined by openness rather than property lines.

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Figure 3 :  
Nested Levels  
of Places



Recent actions by some metropolises strive for a sense of boundedness by defining a city perimeter beyond which no more development can occur, or by identifying certain lands as "Preservation Areas" and then allowing developers to build as they see fit on the remaining lands. These strategies involve a high level government agency determining which portions of the landscape will be used for which types of activities. They have an arbitrary and non-adaptive character.

Considerations

The prevailing operating system of places determines a range of possible lifestyles for the people living within those places, eg. it is pretty difficult to live in a large suburban metropolis and not drive a car. Many do not perceive these as limits, and yet they strongly influence the patterns of how we live. To what extent can or should humans direct the system? Indeed intentions do exist both direct and indirect, the difference is simply our awareness of them as actors within the system.

Sustainability one often heard goal, seems contrary to evolution which is more about survival. Can we develop organizational tools that direct our human evolution? or should we develop organizational tools that ensure the stability of where we are at? The organizational mechanism is open for evolution to a number of unpredictable perturbations, however it also attempts to evolve toward a built environment that supports human interactions gracefully.

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Thus it is an attempt to intend patterns at a more complex level than humans have been able to manipulate in the past.

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