

The new factory, the new city, and an expanded idea of urban ecology

Howard Davis¹

¹University of Oregon, Eugene, OR

ABSTRACT: This paper puts a transformed building type, the contemporary factory, into a theoretical framework that is guiding a larger research program concerning the city as a locus for value-added production. American cities are experiencing the beginning of a manufacturing revival, with much new industry cleaner, smaller, spread over smaller firms, and located closer to residential areas than the “old” industry was. This is important in policy and the emergence of new types, and also helps further an understanding of cities as complex adaptive systems. Urban ecology can be expanded to include understandings of urban social and economic structure.

The work is based on the following two conjectures: (1) Craft and manufacture, or adding value to material inputs, is analogous to the increase of organization in an ecological system, and (2) The city’s resilience is analogous to the resilience of an ecological system. These ideas are being tested with research in London, including historic investigations of the geography and architecture of furniture manufacture, and in Portland, looking at the establishment of small manufacturing firms, with products such as bicycles, outdoor clothing and food. Using mapping, historic directories, interviews and architectural analysis, the work is leading to representations that combine physical and economic pictures of urban districts and building characterized by small manufacturing firms.

The research is showing 1) that urban resilience and inclusivity may be supported by a variety of sizes of buildings, some with a fine-grained distribution among other uses, and flexible in their function and patterns of ownership; 2) that although old factories and warehouses may often be usefully retrofitted for new industrial uses, there is a need for accurate typological specification of buildings and spaces for such new uses; and 3) there is a need to define industrial zones close to the central city and residential districts.

These results suggest the need for initiatives in zoning, financing and development, and how relationships between urban form and function help expand ideas of ecology to include social and economic configurations.

KEYWORDS: Urban Production, Urban Ecology, London, Portland, Factories

INTRODUCTION

Toward the end of the twentieth century the American city experienced the replacement of manufacturing with the service and knowledge economies. Material goods—clothing, furniture, food—are sold and consumed in cities, but their production takes place elsewhere, in places with very low labor costs, made possible partly by the low unit cost of container shipping. To large extent cities have become places of consumption. This has allowed American industry to provide large quantities of goods at low cost, and it has also provided a means for many people in so-called developing countries to enter the labor market, as the first step toward economic independence. But it has also proven difficult to ensure workplace safety and fair working conditions, as evidenced most tragically two years ago by a factory collapse in Bangladesh in which over 1100 garment workers were killed. Container shipping has negative environmental effects. And less measurable but also harmful is the separation between people and the source of the things they use the most in their everyday lives, without knowledge of where they come from, how they are made, or who made them.

Partly as a reaction to these issues and partly because of rising labor costs in Asia, manufacturing is returning to American cities. The volume is still small, and some of it is in the form of “niche” operations that cannot compete with the enormous volume of offshore manufacturing—but there is enough to raise questions about its effect on buildings and urban form. Some new industry may be in smaller shops; it may be cleaner; production, design and sales may be more closely related; it may be closer to residential areas. Even if industry does return to our cities, the paradigm of twentieth century industrial space, with single-use factories removed from other urban functions, may require change.

A series of investigations into historic and contemporary urban industrial formations has helped contribute to

an understanding of what the new paradigm might be. These investigations, in London and in Portland, Oregon, are yielding two kinds of conjectures. First are ideas about urban design and building types, which are helping me develop prototypes and patterns that directly influence design, planning and policy. Second are more theoretical ideas, based on seeing the city as a complex adaptive system, and the importance of production within that formulation. This paper will describe two case studies currently underway, and how they support each of these two kinds of conjectures.

1.0 LONDON

In the nineteenth- and early-twentieth-century furniture industry in London, furniture manufacture was concentrated in at least two places: the adjacent districts of Shoreditch and Bethnal Green, and the area around the northern end of the Tottenham Court Road. Both places have undergone massive changes beginning in the mid-twentieth century, as the result of redevelopment and rebuilding following World War II bombing. But using historical business directories and large-scale historical maps, it is possible to gain an understanding of the historic geography of the industry.

Table 1: 1839-1841, East side of Tottenham Court Road, 1839-1841. Source: (Edwards 2011)

137	new and second-hand furniture warehouse	195-196	piano manufacturer
142	wholesale leather warehouse	196	French bed-maker
147	upholstery and furniture	204	upholstery warehouse
154-156	drapers	211	furniture ironmonger
167	upholstery and furniture	219	cabinet-maker and upholsterer
169	glass and lustre manufacturer	231	upholsterer
170	cabinet-maker	240	trimming warehouse
177	fringe manufacturer	246	plate glass supplier, carver, and gilder
178	whitewood manufacturer	247	furnishing ironmonger
185	furnishing ironmonger	258	upholsterer and cabinet-maker
193	furnishing undertaker		

Tottenham Court Rd is now lined with large commercial buildings with retail shops. Some of the shops are large furniture stores, continuations of the furniture businesses that were there before. But historical photographs and maps confirm that those businesses were once housed in much smaller premises, most of which were variations of the London terraced house. The 1839-1841 business directory for just a portion of one side of the street indicates a rich mix of businesses (Table 1).

The majority of the buildings were narrow terraced houses, 20' or so wide. The list along with the views of the street facades suggests several things about the local geography of furniture making:

1. Manufacture and sales happened in relatively small shops.
2. There was a competition among businesses offering the same goods or services.
3. Manufacture of furniture was geographically interspersed with sales, as well as with materials suppliers and the manufacture of components of furniture (furniture ironmonger, fringe manufacturer).
4. Businesses were mixed with residential accommodation.

Only one principal street is represented here. Further research will indicate whether side streets have a similar mix, proportionally more suppliers and subcontractors, neighboring shops such as groceries and pubs, or some other arrangement. But even looking at this one street, a complex economic structure, accompanied by a particular set of physical characteristics, is suggested. This structure has functional redundancy (in the repetition of types of businesses), functional hierarchy (sales, manufacture, manufacture of parts, supply), adjacency of different kinds of uses, and spatial flexibility (seen in an examination of the same house numbers over multiple years, as uses change).

As the street changed, retail uses began to predominate as manufacture moved to larger factories further out from the center of the city. Already by 1915, the same section of the east side of Tottenham Court Road looked very different, with most businesses named "house furnisher" rather with the name of a specific trade. By 1915 there was much less specialization of individual businesses, increase of size of businesses and their consolidation into multiple buildings, and a change from manufacturing to sales. Today, there are a few large furniture retailers on the street, and although there is still evidence of the old building fabric, the street is characterized mostly by large buildings with long frontages, many of them built in the last ten or fifteen years.

2.0 PORTLAND

In Portland, we looked at a district that has been the site for industrial uses for over a century. Located near downtown, the district has been designated by the city as an "industrial sanctuary," and large parts of it have been resisting the efforts by housing developers to rezone, raise land values and change uses.

In the nineteenth century, docks, warehouses and factories began to occupy the western part of the area, and then most of the area was transformed to warehouse and industrial uses. Now, virtually all buildings have those uses. Zoning was introduced in 1924, but until the 1960s, there were few zoning categories, and the ordinance made no distinction between retail and manufacturing uses.

Beginning several decades ago, many light industrial and warehouse uses left the area because they needed larger buildings or better access to transport. But in the last twenty years, the district has gained a renewed life with new businesses, many associated with the growing artisan, technologically-oriented, small-scale economy. They include craft distilleries, microbreweries, woodworkers, designers of prototype clothing sold to NASA and Nike, furniture refinishers, coffee roasters, workshops in which anyone can rent space and share equipment, recording and art studios. In some cases these businesses are in buildings that once housed businesses such as produce distributors, lighting-fixture warehouses, welders, auto-body shops, that served the twentieth-century industrial economy.

We looked at typical buildings in the neighborhood in two ways: (1) the history of the building, emphasizing the succession of businesses that occupied it since its construction, and (2) the history of the business now in the building, in terms of why it moved from location to location, eventually finding itself in this building.

One building houses a business that designs and makes prototypes and small production runs of products sold to organizations like Nike and NASA. The building was originally built as an auto-body shop in the late 1930s. After ten or fifteen years; the building was occupied by the United Salad Company, one of a number of vegetable distributors in the area. They used the building to park their trucks and as warehouse space for produce before they moved to a larger facility near the airport. The present owner bought the building fifteen years ago. He was originally looking for a smaller space, but bought the building realizing that there was enough of a market to be able to rent space to other creative businesses. Other tenants include a woodworker, a sign maker, and a card printer.

A second example is a building built in 1964, for a wooden-box company serving the produce markets—an example of synergies between different businesses. Trees that came into the building were cut and milled; and the boards nailed together to make the boxes. The current owner began a woodworking business in a garage, moved to a five-thousand-square-foot rental space nearby, then rented this building, and finally bought it. His business reproduces historic milled sections for a national customer base. The building allows large trailer trucks to enter at one side and leave on the other, facilitating materials delivery and product shipments. Most of his fifteen employees bicycle to work.

The third example is a building occupied by a company that restores old building components and furniture. The building was built in 1902 as a garment factory. Three years later an addition was built, and later a second floor was added. In the 1930s the building was sold to the Oregon Flower Growers Association and became the Portland Wholesale Flower Market until 1990. The present company moved into the building in 1992. Since 1992, along with the primary occupant, a variety of tenants have occupied the building, including two door-and-window companies, a design firm, two custom contracting firms, a café and an architecture firm.

The company was founded in 1977 in a small facility in north Portland, consisting of a store and factory. Five years later the business moved to a larger mixed-use building that included apartments; in 1986 it moved to a space with 7700 square feet; and in 1992 to the present location with 47,000 square feet. Finally, in 1998, the factory function was moved to a new location almost double the size of the existing building, separating the factory from the retail location.

These three buildings exemplify other buildings in the area, and share common attributes. They all originally housed businesses that were secondary to the earlier manufacturing and distribution economy: auto repair, fruit-and-vegetable wholesaling, wooden crate manufacture, garment manufacture. Many of these businesses ultimately moved to larger buildings. The buildings we're looking at now house businesses associated with the so-called "new economy": design prototyping, furniture sales, distillery, physical therapy, environmental engineering. And many of those businesses began in people's garages or smaller spaces, and moved to the area because it is convenient for their customers and because the buildings could be readily re- configured for their business.

Four attributes have helped keep the district attractive for new businesses.

First, is its location. It is easily available to the central city and to the gentrifying residential districts to the east. This is ideal for businesses that need visibility to a young professional population, like the distilleries and micro-breweries, that is interested in coming to work by bicycle or public transportation.

Second, the 200' x 200' block, characteristic of central Portland, puts a maximum size on buildings, so that when businesses expand they may move to places where warehouse and industrial sites can be much larger—allowing these buildings to become available for smaller and newer businesses.

Third, although the area has good access for smaller trucks, it is not as convenient for large semi-trailers or rail cars, for which larger sites outside the central city are more suitable.

Finally, the zoning of large sections of the area prohibits or highly restricts residential uses, keeping land values down and making land available to smaller, start-up businesses.

3.0 COMPARISONS

There are similarities between the Tottenham Court Road district and the East Side Industrial District. Both districts had easy proximity to the residential areas where the labor force lives; in both cases there were relatively small buildings; in both cases businesses moved out when they expanded; in both cases there was both a mix of kinds of businesses and synergies between primary and secondary businesses in the same industry; in both cases buildings were flexible enough to easily accommodate new uses. Although London and Portland are quite different from each other in their history and visible urban form, the fact that they share features that relate function, urban structure and use suggests the possibility of a theoretical formulation that incorporates them both.

4.0 AN EXPANDED IDEA OF URBAN ECOLOGY

"Urban ecology" and "urban resilience" are part of contemporary discourse concerning sustainability.

Urban ecology deals with relationships between urban built form and natural processes, including such issues as species diversity, effects of urbanization on natural habitat, water flow, the temperature effects of cities, etc. Here, ecology refers to biological systems, and research in urban ecology tends not to be extended into the more general realm of complex adaptive systems.

Urban resilience largely deals with the city's ability to recover from sudden, large-scale disturbances, such as storms, earthquakes, wars, and large human migrations such as a rapid influx of refugees. It tends not to deal with issues of slower change such as development, gentrification, or displacement.

In the last chapter of *The Death and Life of Great American Cities*, "The kind of problem a city is," Jane Jacobs suggested seeing cities as phenomena of "organized complexity." "The history of modern thought about cities is unfortunately very different from the history of modern thought about the life sciences. The theorists of conventional modern city planning have consistently mistaken cities as problems of simplicity and of disorganized complexity, and have tried to analyze and treat them thus." (Jacobs 1993, 567) Recent work of Stephen Marshall, Luis Bettencourt, and Michael Batty, for example (Marshall 2008; Batty 2013; Bettencourt, Offenhuber and Ratti 2013) has looked at cities in terms of organized complexity, and there is ample work in business, economics and sociology to support this formulation. The argument may be continued by suggesting a direct analogy between ecological systems that are based on biological organisms and their environment, and urban systems that are economic, social and architectural (as well as biological). Table 2 summarizes this.

Table 2: An ecosystem-city analogy

ECOLOGICAL SYSTEM (BIOLOGICAL)	URBAN SYSTEM, OR CITY
STRUCTURE	
species	type
individual within a species	a particular business, family or person
species diversity	diversity of people, businesses or building types
genetic codes	cultural and procedural norms
scales of systems and subsystems	scales of systems and subsystems (not spatial)

SPACE AND PHYSICAL ORGANIZATION	
habitat	buildings, streets, districts
patch (a place where a species is clustered)	an area where particular classes, affinity groups, ethnicities, kinds of businesses or buildings are clustered
ecotone (the boundary between two biomes, or ecological zones)	building or district edge that "belongs" to places on either side of it
FUNCTION	
energy inputs	inputs of raw materials or products
energy and information transfer between organisms	social and economic relationships and transactions
increase of biological organization, growth, reproduction	production of goods, buildings, the city itself. Added value to materials or products.
resilience	resilience; flexibility of buildings and districts

In this table, ecological systems and urban systems are treated in parallel ways. Species are analogous to types, habitat to physical elements of the city, ecotones to edges between ecological zones, genetic codes to cultural and procedural norms. The idea that a city is a complex adaptive system provides a theoretical framework that helps explain the importance of particular attributes. If the ground-floor edge of a building is indeed like an ecotone, the importance of seeing that edge like a thick boundary, containing functions both of the street and of the building, is more clearly seen. Jane Jacobs wrote about the importance of having buildings of varying ages in a district, to support economic enterprises at different stages of development; this is one manifestation of species diversity.

So there are now at least two kinds of urban ecology:

1. The usual definition, which we call "urban bio-ecology," the relationships among built form, urban systems, and the biological organisms and ecologies that are in or are affected by the city; and
2. A new definition, which we call "urban socio-economic ecology," the relationships among built form, urban systems and the economic and social structure of the city.

In each case, the system being considered is a complex adaptive system, and because of this, the two systems have similarities of structure and function. The usual idea of urban (bio-) ecology has helped to give rigor to questions of the city's impact on plants and animals: the need to take actions that mitigate this impact is given increased urgency through the knowledge that an entire ecosystem is affected. The same kind of importance may be ascribed to the city's socio-economic ecological system and the role of individual elements—and actions affecting them—within it.

And to extend the point, the physical environment is implicated with each of the two ecosystems. In the urban bio-ecological system, such elements as habitats, wildlife corridors, and ecotones provide physical frameworks for bio-ecological function. In the urban socio-economic ecological system, configurations of buildings, streets, transportation systems and open spaces provide physical frameworks for social and economic function. (Of course, these "two ecologies" are not independent of each other. But even in their interdependence, it is important to recognize the existence and role of social and economic elements and relationships.

How does this apply to the industrial district in London and Portland? Referring back to Section 3.0, both districts have repetition of small units and therefore a potential redundancy of buildings and businesses; both have a mixture of kinds of businesses with functional synergies among them; both have resilience that is associated with the flexibility and adaptability of buildings. Although the two districts differ in their uses, outward physical forms, economic purpose and cultural background, they share deep structural attributes that are connected to their socio-economic ecological systems.

5.0 MANUFACTURE AND THE INCREASED ORGANIZATION OF AN ECOLOGICAL SYSTEM

But it is the realm of function that is perhaps most important. In a working paper for the Santa Fe Institute that has the same title as Jane Jacobs' question, Luis Bettancourt suggests that the analogies used to describe cities have focused on form rather than urban processes. But it is with the functional analogies that production is important.

When something is crafted or manufactured, value is added to it. The energy added to the product through the making process results in a higher level of organization, analogous to the emergence of order in a bio-ecological system. Likewise, a city's production activities may be critical to its health as a socio/economic ecological system. These activities are part of the input/output flows of money and materials, have controlling mechanisms of contracts and social agreements, and provide sustenance to the other systems. This is the meaning of adding value to materials or to goods that are in the process of manufacture. Those materials or goods become more ordered, more organized through the production process in which materials and energy are being brought into the equation.

Furthermore, in both biology and material production, the entire system gets more ordered so that order can be increased in the thing which is produced. To be able to add value to a product, aspects of the entire system need to have value added as well. In the case of manufacture, higher levels of organization in the overall system are achieved through such things as the development of craft expertise, systems of crafts organization and training, the manufacture of tools and machines, the setting up of assembly lines and production protocols in factories, the development of complex and responsive supply chains, the emergence of systems of accountancy and law, the development of design and prototyping practice. Urban production processes use energy and materials to provide the city itself with higher levels of functional and material organization.

The functions of adding value through manufacture require buildings in which these functions can happen; the buildings, in turn, may be specialized in their design; and their location must allow for the complexity of association with other businesses required by the structure of the system. This was seen in the Tottenham Court Road furniture industry with its mixture of retail shops, small factories and suppliers, making use of buildings that were either built for particular purposes or that were flexible enough to adapt to accommodate those purposes, and possibly with a street system that provided for different degrees of access depending on necessary visibility to the public (this last statement is still to be tested in the research). And similar attributes are present in Portland's East Side Industrial District, where flexibility of use allowed for synergies, for example, between produce-distribution firms, other firms servicing trucks, and still other firms making wooden crates for distribution of the produce.

6.0 MANUFACTURE AND A RESILIENT BUILT ENVIRONMENT

Well-functioning ecological systems, as complex adaptive systems, are resilient in their response to disturbances: they "bounce back" after the disturbance without irreversible damage to the overall system. (Holling 1973) This ability depends on diversity, redundancy of parts, and redundancy of connections between the parts. Functionality may be through a structure that is essentially that of a network with multiple paths between points. Disturbances in bio-ecological systems may include weather events, invasions of foreign species or man-made changes. In the case of socio-economic ecological systems, disturbances may include such things as sudden increases in population, recessions and depressions, changes in sites of manufacture, or changes in import/export balances.

If such changes are to be effectively dealt with, the physical environment needs to accommodate them. When large firms greatly downsize or disappear, as happened in Detroit and other "rust belt" cities, existing buildings need to house new start-up businesses to fill the gap. In New York, the Brooklyn Navy Yard, once an enormous government-run operation for the construction of aircraft carriers and naval destroyers, now houses hundreds of small industrial and design firms, occupying the old buildings. In Portland's East Side Industrial District, the success of firms occupying small buildings allowed them to move to larger buildings elsewhere—but then freeing up the original buildings for new, small firms. The resilience of the buildings—i.e., their ability to be physically adaptable in the face of change—supported the resilience of the economic system they housed.

7.0 CONCLUSION: IMPLICATIONS FOR RESEARCH, DESIGN, PLANNING AND POLICY

The speculative theoretical ideas described here provide the basis for research that links the city as a site of material production with the city as a complex adaptive system, making both urban theory and ecological theory more robust, and giving additional justification for advances in design and policy that support the city as a site of production.

As manufacturing returns to cities, it will take on a different form than it had during most of the twentieth century. Building types and urban formations that can support this new manufacture in efficient and human ways may include:

- Mixed land uses, even for certain kinds of industrial buildings,
- A variety of lot and building sizes,
- Public transportation serving industrial uses,

- Efficient systems of materials and product distribution,
- Adaptability of buildings allowing for small firms to come and go,
- Closer relationship between industrial uses, dwellings and residential areas,
- Vertical factories allowing for efficient land use,
- Sharing of facilities for incubator businesses and start-ups,
- Buildings in which humane workplaces can be designed.

The further development and refinement of these attributes, which can be implemented in design, zoning and development practice, represent one practical result of the research. As part of an overall research program, this work is happening, through design investigations, actual building and development projects, and studies of ongoing projects that involve new small industries, startup manufacturing, and incubator/shared production facilities.

The research as a whole, therefore, puts practical understandings of the form of the (re)-emerging industrial city into the context of a theoretical understanding of urban form and function, as an expanded idea of urban ecology.

REFERENCES

- Batty, M. 2013. *The New Science of Cities*. Cambridge: MIT Press.
- Bettencourt, L.M., D. Offenhuber and C. Ratti, "The kind of problem a city is." In Bettencourt, L.M., D. Offenhuber and C. Ratti (eds.) *Die Stadt Entschlüsseln: Wi Echtzeitdaten Den Urbanismus Verändern*. Heidelberg: Birkhauser.
- Edwards, C. 2011. "Tottenham Court Road: The changing fortunes of London's furniture street 1850-1950." *The London Journal*, Vol. 36 No. 2.
- Holling, C.S. 1973. "Resilience and stability of ecological systems." *Ann. Rev. of Ecology and Systematics* Vol 4: 1-23.
- Jacobs, J. 1993. *The Death and Life of Great American Cities*. New York: The Modern Library.
- Marshall, S. 2008. *Cities, Design and Evolution*. London: Routledge.