

## Understanding Urban Dynamics

While this dynamic can be frustrating and depressing, it's better to be aware of what we're up against. A key point Forrester makes below is that "programs aimed at improving a city can succeed only if they result in eventually raising the average quality of life for the country as a whole." Therefore, it's important that regions cooperate and not compete with one another.

### Excerpts from "Counterintuitive Behavior of Social Systems" by Jay W. Forrester

This paper was first copyrighted © 1971 by Jay W. Forrester. It is based on testimony for the Subcommittee on Urban Growth of the Committee on Banking and Currency, U.S. House of Representatives, on October 7, 1970. The original text appeared in the January, 1971, issue of the *Technology Review* published by the Alumni Association of the Massachusetts Institute of Technology. Updated March, 1995

Counterintuitive Behavior of Social Systems [464K] (Jay W. Forrester) (D-4468-2). Download at <http://sysdyn.mit.edu/road-maps/rm-toc.html>. An introduction to the concepts of system dynamics, discussing social policies and their derivation from incomplete understanding of complex systems.

#### IV. DYNAMICS OF URBAN SYSTEMS

Our first major excursion outside of corporate policy began in February, 1968, when John F. Collins, former mayor of Boston, became Professor of Urban Affairs at M.I.T. He and I discussed my work in system dynamics and his experience with urban difficulties. A close collaboration led to applying to cities the same methods that had been created for understanding corporations. The resulting model structure represented fundamental urban processes. The computer-model structure showed how industry, housing, and people interact with each other as a city grows and decays. The results are described in my book *Urban Dynamics* (Forrester, 1969).

I had not previously been involved with urban behavior, but the story emerging from the urban model was strikingly similar to what we had seen in corporations. Actions believed to alleviate the difficulties of a city can actually make matters worse. We examined four common programs for improving the depressed nature of central cities. One program was creation of jobs by busing the unemployed to suburban jobs or through governmental jobs as employer of last resort. Second was a training program to increase skills of the lowest-income group. Third was financial aid to depressed cities from federal subsidies. Fourth was construction of low-cost housing. All of these were shown to lie between neutral and highly detrimental regardless of the criteria used for judgment. The four programs range from ineffective to harmful judged either by their effect on the economic health of a city or by their long-range effect on the low-income population. The results both confirm and explain much of what has been happening over the last several decades in cities.

The investigation showed how depressed areas in cities arise from excess low-income housing rather than from a commonly presumed housing shortage. The legal and tax structures have combined to give incentives for keeping old buildings in place. As industrial buildings age, employment opportunities decline. As residential buildings age, they are used by lower-income groups who are forced to use them at higher population densities. Therefore, aging buildings cause jobs to decline and population to rise. Housing, at the higher population densities, accommodates more low-income urban population than can find jobs. A social trap is created where excess low-cost housing beckons low-income people inward because of the available housing. Unemployed people continue coming to a city until their numbers sufficiently exceed the available jobs that the standard of living declines far enough to stop further inflow. Income to the area is then too low to maintain all of the housing. Excess housing falls into disrepair and is abandoned. Extreme crowding can exist in those buildings that are occupied, while other buildings become excess and are abandoned because the economy of the area cannot support all of the residential structures. Excess residential buildings threaten an area in two ways—they occupy land so it cannot be used for job-creating buildings, and they attract a population that needs jobs. Any change, which would otherwise raise the standard of living, only takes off the economic pressure momentarily and causes population to rise enough that the standard of living again falls to the barely tolerable level. A self-regulating system is thereby at work which drives the condition of the depressed area down far enough to stop the inflow of people.

At any time, a near-equilibrium exists affecting population mobility between different areas of a country. To the extent that there is disequilibrium, it means that some area is slightly more attractive than others and

population begins to move in the direction of the more attractive area. Movement continues until rising population drives the more attractive area down in attractiveness to again be in equilibrium with its surroundings. Other things being equal, an increase in population of a city crowds housing, overloads job opportunities, causes congestion, increases pollution, encourages crime, and reduces every component of the quality of life.

A powerful dynamic force establishes equilibrium between all areas in total attractiveness. Any proposed social program should take into account the eventual shifts that will occur in the many components of attractiveness. As used here, attractiveness is the composite effect of all factors that cause population movement toward or away from an area. Most areas in a country have nearly equal attractiveness most of the time, with only sufficient disequilibrium in attractiveness

The model below is based on the description of the dynamics in paragraph #3 of section IV. DYNAMICS OF URBAN SYSTEMS in the “Counterintuitive Behavior of Social Systems” by Jay W. Forrester. While **B1** & **B2** moderate the attractiveness of an area. **R3** leads to a cycle of residential decay.

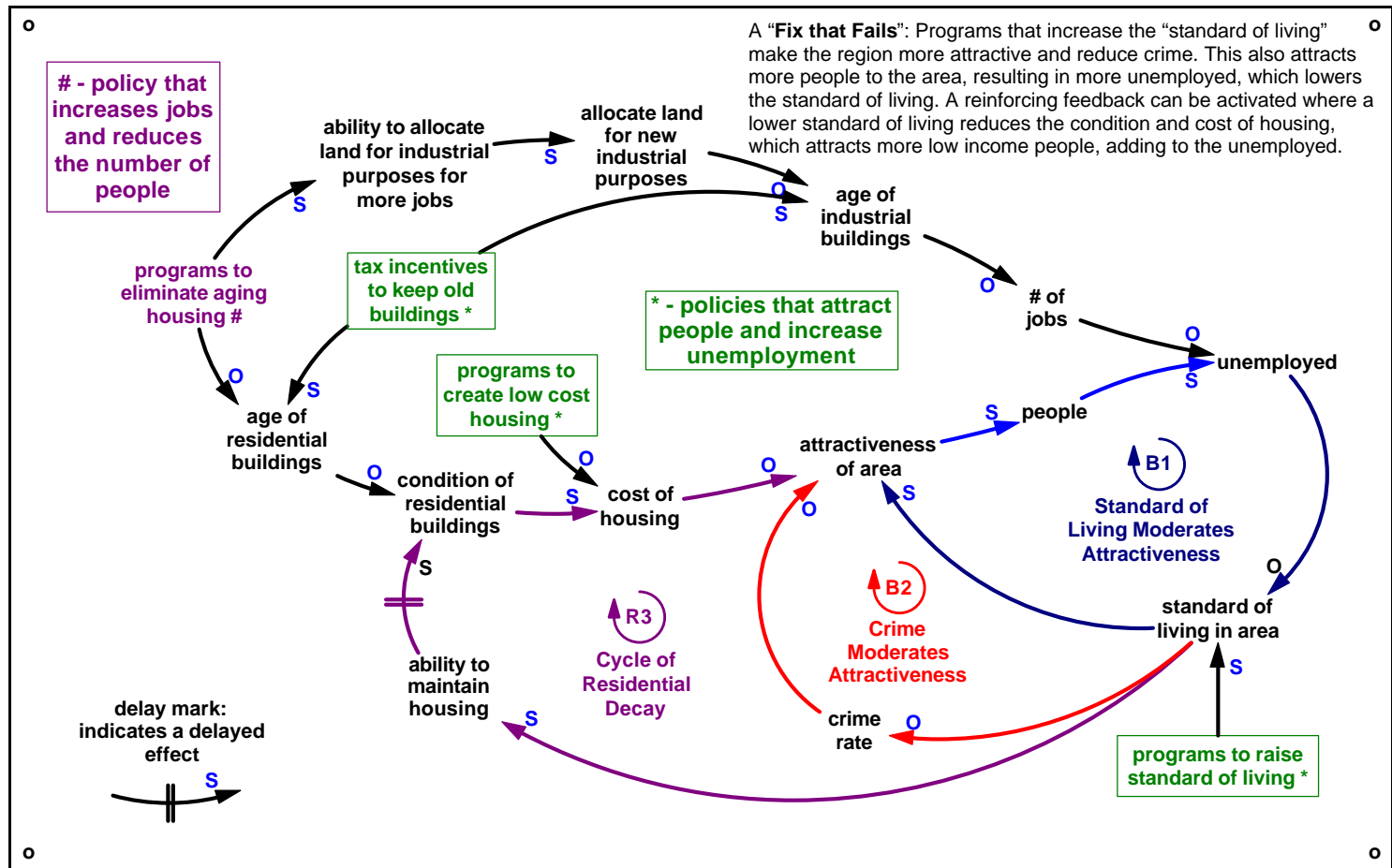
**Policies that don't work:** “Tax incentives to keep old buildings” increase the age of industrial buildings, decrease the number of jobs and increase the number of unemployed. They also increase the age of residential buildings, decrease the cost of housing, increase more people and hence, also act to increase the number of unemployed. “Programs to create low cost housing” increase “attractiveness of the area” to attract more people and increase the number of unemployed. Similarly, “programs to raise the standard of living” increase “attractiveness of the area” and the number of unemployed.

**B1 - Standard of Living Moderates Attractiveness:** As the number of unemployed increases, the standard of living declines to make the region less attractive and reduce the number of people and the number of unemployed.

**B2 - Crime Moderates Attractiveness:** As the number of unemployed increases, the standard of living declines, to increase crime and also make the region less attractive and reduce the number of people and the number of unemployed.

**R3 - Cycle of Residential Decay:** As standard of living declines, residents have less ability to maintain housing, which results in a lower “cost of housing” to attract even more people and increase the number of unemployed.

**A policy that works:** Eliminate aging housing to make room for more industry and decrease the age of residential buildings.



to account for the shifts in population. But areas can have the same composite attractiveness with very different mixes in the components of attractiveness. In one area component A could be high and B low, while the reverse could be true in another area that nevertheless had the same total composite attractiveness. If a program makes some aspect of an area more attractive than its neighbor's, and thereby makes total attractiveness higher momentarily, population of that area rises until other components of attractiveness are driven down far enough to again establish an equilibrium. Efforts to improve some condition of a city will result primarily in increasing population until other conditions deteriorate to reestablish an equilibrium. The overall condition of urban life, for any particular economic class of population, cannot be appreciably better or worse than that of the remainder of the country to and from which people may come. [Programs aimed at improving a city can succeed only if they result in eventually raising the average quality of life for the country as a whole.](#)

## V. ON RAISING THE QUALITY OF LIFE

There is substantial doubt that urban programs have been contributing to the national quality of life. Concentrating population in urban locations, undermining the cohesiveness of communities, and making government bureaucracy so big that individuals feel powerless, all reduce the quality of life. Any proposed program should deal with both the quality of life and the factors affecting population. "Raising the quality of life" means releasing stress from crowding, reducing pollution, alleviating hunger, and treating ill health. But these pressures are the influences that control population movement. If one pressure is relaxed, population will then move in until other pressures rise to stop the inflow. To raise one component of quality of life without intentionally creating compensating counter pressures to prevent a rise in population will be self-defeating.

Consider the meaning of interacting attractiveness components as they affect a depressed ghetto area of a city. First, we must understand the way population density is already being controlled. A set of forces exist that determine why population density is not far higher or lower than it is. There are many possible combinations of forces that an urban area can exert. The particular combination will determine the population mix and the economic health of a city. The depressed areas of most American cities are created by a combination of forces in which there is a job shortage and a housing excess. The availability of housing draws the lowest-income group until they so far exceed the economic opportunities of the area that the low standard of living, the frustration, and the crime rate counterbalance the housing availability. Until the pool of excess housing

is reduced, little can be done to improve the economic condition of an inner city. A low-cost housing program alone moves exactly in the wrong direction. It draws more low-income people. It makes the area differentially more attractive to the poor who need jobs and less attractive to those who create jobs. In the new population equilibrium that develops, some characteristics of the social system must counterbalance the additional attractiveness created by the low-cost housing. That counterbalance is a further decline of the economic condition of the area. Unfortunately, as the area becomes more destitute, pressures rise for still more low-cost housing. The consequence is a downward spiral that draws in the low-income population, depresses their economic condition, prevents escape, and reduces hope. All of this is done with the best of intentions.

My paper, "Systems Analysis as a Tool of Urban Planning" (Forrester, 1969), from a symposium in October, 1969, at the National Academy of Engineering, suggests a reversal of present practice by simultaneously reducing the aging housing in decaying cities and allocating land to income-earning opportunities. The land shifted to industry permits the "balance of trade" of an area to be corrected by allowing labor to create and export products to generate income streams with which to buy the necessities of modern life from the outside. The concurrent reduction of excess housing is absolutely essential. It supplies the land for new job-creating structures. Equally important, the resulting housing shortage creates the population-stabilizing pressure that allows economic revival to proceed without being inundated by rising population. Revival of an urban area can be done without driving the present low-income residents out of an area. Revival policies should create upward economic mobility to convert the low income population to a self-supporting basis.

Many people, at first, believe these revival policies of less low-cost housing and conditions to favor business to create jobs will not be accepted by elected officials or residents of depressed urban areas. However, some of the strongest support has come from within those groups that are closest to the symptoms, who have lived through the failures of the past, and who must endure present conditions until lasting solutions are found.

The country has slipped into short-term policies for managing cities that have become part of the system that is generating even greater troubles. If we were malicious and wanted to create urban slums, trap low-income people in ghetto areas, and increase the number of people on welfare, we could do little better than follow present policies. The trend toward stressing income and sales taxes and away from the real estate tax encourages

old buildings to remain in place and block self-renewal. The concessions in the income tax laws to encourage low-income housing do, in the long run, actually increase the total low-income population. Highway expenditures and government loans for suburban housing have made it easier for higher-income groups to abandon urban areas than to revive them. Expanding the areas incorporated into urban government, in an effort to increase revenue base, has been more than offset by lowered

administrative efficiency, more citizen frustration, and the accelerated decline that is triggered in the annexed areas. The belief that more money will solve urban problems has taken attention away from correcting the underlying causes and has instead allowed the problems to grow to the limit of available money.

## "The Attractiveness Principle" Applied to Urban Dynamics

An example described in "Urban Dynamics -- The First Fifty Years." by Louis Alfeld, *System Dynamics Review*, Fall 1995. Experiences in Concord, MA, 1975)

One of the principal assumptions behind urban dynamics is the theory of relative attractiveness. The theory states that, **given free migration, no place can long remain more attractive than any other place**. A corollary of the theory suggests the existence of negative counterbalances. **Population growth continues until negative pressures arise to counterbalance an area's underlying attractiveness**. Perception delays can cause population to overshoot, thus exaggerating the negative impact of growth. Concord, with its many attractive qualities would surely draw in more people than it could comfortably house and, in the process, erase its rural charm.

"A second corollary of relative attractiveness is that **no two communities need suffer the same set of negative counterbalances**. All that is needed to bring a community into equilibrium with its surroundings is a set of pressures sufficient to deter further in-migration. Any mix of pressures will do so, as long as people outside the community perceive them as sufficiently negative. Yet residents may choose which pressures they prefer. People pick where to live on the basis of such tradeoffs. One community, quite distant from downtown and requiring a long and difficult commute, might offer picturesque countryside and reasonable housing prices. Another community, close by downtown, might trade lack of parking and higher housing costs for urban proximity."

"In most communities, such tradeoffs go unrecognized, much less openly debated. ... In a pluralistic society, such choices are virtually impossible to make. Each group, in seeking its own goals, unwittingly blocks others

from achieving theirs. Parents support spending for educational improvements that attract more families. Stores expand to feed and clothe the newcomers. Roads are widened to ease traffic congestion. Better automobile access opens more land for development. New houses require utility extensions, more school buses and a larger fire department. Taxes rise. Voters curtail teacher pay rises. Educational quality begins to decline and concerned parents relocate to new suburbs whose residents support spending for educational improvements. Multiply the feedback structure a hundred times to reflect the different goals and preferences of every group. A community that tries to solve every problem and meet every need eventually satisfies no one."

" Urban dynamics shows us the folly of traditional thinking, both for our cities and for our world. Human systems are too complicated for intuitive solutions. **Traditional cause-and-effect thinking does not work. Feedback, nonlinearities and hidden delays defeat most conventional policies**. Eventually we must shift the paradigm away from traditional analytical methods to the urban dynamics viewpoint -- conserve what we already have and **reinforce the counterbalances we prefer**. It is the mentality of the great cities of Europe and it is the mentality of the well-preserved American suburb. It works there and it can work worldwide."

"Urban Dynamics -- The First Fifty Years." by Louis Alfeld  
*System Dynamics Review*, Fall 1995  
On experiences in Concord, MA in 1975

An example of "The Attractiveness Principle" Applied to Urban Dynamics described in "Urban Dynamics -- The First Fifty Years." by Louis Alfeld, *System Dynamics Review*, Fall 1995. Experiences in Concord, MA, 1975)

