The Engineers and the Urban System, 1968-1974

by

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The social policy agenda of the Great Society was shaped by the recognition that if broad social improvement was to be achieved in urban America, social planning and state intervention based on systemically acquired expertise about the city would have to be developed. As a case study in the development of such expertise, in this thesis I explore the work of the Urban Systems Laboratory (USL), established in 1968 at the Massachusetts Institute of Technology (MIT) with funding from the Ford Foundation. Using computationally intensive methods, behavioral models and the latest techniques of the information sciences, research at the USL emphasized the role of rational, analytical, social scientific expertise in managing social conflict. In particular, I explore the work of Jay W. Forrester, a member of the USL whose research on the city was published in 1969 as *Urban Dynamics*. Using an IBM Systems/360 Model 67, Forrester built one of the first large-scale, interactive, computational models of a city specifically to explore the consequences of the social policies of the period and more generally the possibility of the social engineering of complex social systems in a postindustrial society. This project of the production of expertise at the USL struggled to secure legitimacy in the early 1970s as the attempt to treat the problems of urban America as phenomena to be handled by a new class of experts was overwhelmed by the sheer scale of urban turmoil.

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Chapter 1:

The Great Society and the Urban Crisis

Too often regarded as separate, the processes of postwar suburbanization were in fact deeply interrelated with those that shaped postwar urban America, including the concentration of poor African Americans in central cities, deindustrialization, disinvestment, and rapid depopulation.[1] From this perspective, these processes can be seen as a single process that produced the geography of the postwar United States. This process produced a period of prosperity for two decades following World War II. However, in the mid-1960s this process began to undermine the stability of American society.[2] The largest effort of social reform since the New Deal was designed to resolve many of the most severe social problems of urban America—primarily those surrounding the issues of poverty—and thus arrest the consequences of uneven postwar development. As President Lyndon B. Johnson stated in 1965, this massive expansion of the state was, in effect, "part of an effort to build the great cities which are at the foundation of our hopes for a Great Society."[3] Rarely recognized as such, the Great Society was the most extensive urban development program in the history of the United States.

The power of the state would reach deeply into urban America for the rest of the decade to respond to the most widespread social threat since the Great Depression. This

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[1] Jon C. Teaford, *The Metropolitan Revolution: The Rise of Post-Urban America* (New York: Columbia University Press, 2006).

[2] Robert A. Beauregard, *When America Became Suburban* (Minneapolis: University of Minnesota Press, 2006), 40-69.

[3] Lyndon B. Johnson, "Special Message to the Congress on the Nation's Cities, March 2, 1965," in *Public Papers of the Presidents of the United States: Lyndon B. Johnson, 1965, Vol. 1* (Washington: United States Government Printing Office, 1965), 240.

threat was known as "the urban crisis."[4] The urban crisis was primarily a source of fear. Indeed, as Robert A. Beauregard has argued, this period saw "the emergence of a single theme that... turned urban decline into a society wide problem. The theme was race, the problem was the concentration, misery, and rebellion of Negroes in central cities, and the reaction was one of fear and eventually panic."[5] Indeed, the "urban crisis" as a term gained currency during a period of violent social upheavals lasting from the mid-1960s until the late 1960s. These upheavals symbolized the protest of the powerless against the misery of the massive urban ghettos of America.

In this period, many African Americans came into conflict with the insufficiency of existing political institutions they challenged the inadequate responses of the state to the problems of inequality in American society. When traditional forms of institutionalized political activity failed to end racial discrimination and create equal economic opportunity in America, many young African Americans who had borne more than their share of the burden of uneven postwar development rejected this approach and sought to reassert their control of the city in a series of violent urban revolts. The imagery of a civil war breaking out in the massive urban ghettoes of America conveyed a sense of crisis that led the state to try to satisfy social discontent and hold back demands for radical political change by building a much more comprehensive welfare state than that left over from the legacy of the New Deal. Indeed, the key to understanding the Great Society is seeing how it functioned as part a larger political strategy.

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[4] Peter J. Steinberger, *Ideology and the Urban Crisis* (Albany: State University of New York Press, 1985); Michael P. Smith and Joe R. Feagin, *The Bubbling Cauldron: Race, Ethnicity, and the Urban Crisis* (Minneapolis: University of Minnesota Press, 1995).

[5] Robert A. Beauregard, *Voices of Decline: The Postwar Fate of US Cities* (Blackwell, Oxford, 1991), 169.

Technocratic Social Knowledge and Social Policy

During the development of the Great Society social scientific experts were called upon in large numbers to refine "solutions" to the "problems" of urban America. The origins of the social policies of the Great Society have been the subject of systematic historical investigations.[6] These analyses have explored how, in response to the recognition that if broad social improvement was to be achieved in urban America, social planning based on knowledge about the city had to be produced. These analyses have also explored how the activity of the state created demands for knowledge about the social problems that the state intended to address. The penetration of the state into the city, as it increased demands for knowledge about the city, which in turn increased demands for new interventions in the city, led to a desire to systematize this process. To systematize the process by which the state itself influences the production as well as the use of knowledge was, in effect, to "scientize" it, i.e., to bring in scientifically informed experts in the development and deployment of social policy. The "scientization" of social policy led to the imposition of a distinctively technocratic perspective on the vision of the Great

[6] See Sar A. Levitan and Robert Taggert, *The Promise of Greatness* (Cambridge: Harvard University Press, 1976); Henry J. Aaron, *Politics and the Professors: The Great Society in Perspective* (Washington: The Brookings Institution, 1978); Alice O'Connor, *Poverty Knowledge: Social Science, Social Policy, and the Poor in Twentieth-Century U.S. History* (Princeton: Princeton University Press, 2002), 137-210; James T. Patterson, *America's Struggle Against Poverty in the Twentieth Century* (Cambridge: Harvard University Press, 1981), 97-192; Hugh Heclo, "The Political Foundations of Antipoverty Policy," in *Fighting Poverty: What Works and What Doesn't*, ed. Sheldon H. Danziger (Cambridge: Harvard University Press, 1986); Robert H. Haverman, *Poverty Policy and Poverty Research: The Great Society and the Social Sciences* (Madison: University of Wisconsin Press, 1987); Ira Katznelson, "Was the Great Society a Lost Opportunity?" in *The Rise and Fall of the New Deal Order, 1930–1980,* ed. Steve Fraser and Gary Gerstle (Princeton: Princeton University Press, 1989), 185-211; Allan J. Matusow, *The Unraveling of America: A History of Liberalism in the 1960s* (New York: Harper & Row, 1984), 217-274; John Morton Blum, *Years of Discord: American Politics and Society, 1961–1974* (New York: Norton, 1991); Gareth Davies, *From Opportunity to Entitlement: The Transformation and Decline of Great Society Liberalism* (Lawrence: University of Kansas Press, 1998); Sean J. Savage, *JFK, LBJ, and the Democratic Party* (Albany: State University of New York Press, 2004), 91-142; G. Calvin MacKenzie and Robert Weisbrot, *The Liberal Hour: Washington and the Politics of Change in the 1960s* (New York: Penguin, 2008).

Society. The state was regarded as unitary, capable of action; the social sciences were regarded as methodologically secure, capable of providing objective knowledge; and society was regarded as organized, capable of being stabilized through the implementation of social policy designed by experts.

To understand the origins of the social policies developed in this period, it is necessary to understand what social scientific experts who designed the Great Society were interested in when forming them, which reveals both their objectives as well as their ability to reach them. Catalyzed by the sense that the city was beset by a series of crises that required state intervention, the city became an object about which an enormous about of social knowledge and expertise needed to be created for the state to properly act.[7] The urban crisis was analyzed as if it were the sum of a series of smaller, manageable crises which were identified as key "social problems" to be treated as specialized, even technical phenomena for experts to solve with a series of social policy innovations. As Ira Katznelson has noted, the "targets of these public polices were not objects of compassion, but of fear born of uncertainty."[8] Urban America came to be seen by the state as a failed social system that required social reengineering by experts.[9] As Michael Katz has explained, many of the social scientists that designed the social policies of the Great Society assumed that "dependent people were mainly helpless and passive, unable, without the help of liberal intellectuals, to break the cycle of deprivation and degradation

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[7] Mark I. Gelfand, "How Cities Arrived on the National Agenda in the United States," in *Financing Urban Government in the Welfare State*, ed., Douglas E. Ashford (New York: St. Martin's Press, 1980), 210-236.

[8] Ira Katznelson, *City Trenches: Urban Politics and the Patterning of Class in the United States* (Chicago: University of Chicago Press, 1981), 3.

[9] Francis Fox Piven and Richard A. Cloward, *Regulating the Poor: The Functions of Public Welfare* (New York: Vintage, 1971), 249.

that characterized their lives."[10] The Great Society was thus designed in a way that reinforced the ideal of the technocratic management of social relations as a solution to social problems.

This ideal was exemplified by the creation of the Department of Housing and Urban Development (HUD) on September 9, 1965, giving the United States the capacity to develop an "urban policy" for the first time in its history. The Johnson administration wanted HUD to do more than simply continue the postwar policies of large-scale urban renewal that had come to be seen as at least partially responsible for the continued decline of cities. Instead, HUD was to develop and deploy social policy innovations designed to improve the "social health" of urban America. The disillusionment with the destructiveness of urban renewal, the urgency of complex interracial tensions arising from social unrest in America's cities, and the faith that social scientific expertise would produce more effective state interventions—all of these forces shaped the activity of the state with respect to the urban crisis.

From its inception, HUD was to provide resources for accumulating appropriate, policy-relevant social knowledge based on systematic research on the city. As Robert C. Weaver, the first secretary of HUD, explained, what was needed to implement the vision of the Great Society was a "whole new order of urban experts" to assist the state in systematically acquiring the knowledge it required to effectively intervene in the dynamic environment of urban America.[11] However, to achieve these goals would have required the United States to adopt social democratic policies involving extensive state

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[10] Michael Katz, *The Undeserving Poor: From the War on Poverty to the War on Welfare*, New York: Pantheon Books, 1989), 17.

[11] Robert C. Weaver, *The Urban Opportunity: Roles for the University* (Washington: United States Government Printing Office, 1967), 11.

interventions in the market. Indeed, the most conspicuous characteristic of the Great Society was that from the beginning it conceded to the framework of the larger political economy of the period.[12] As Susan and Norman Fainstein have shown, while the problems of the city in the United States were the most severe of any advanced capitalist industrial society, it also had the most underdeveloped capacity to effectively respond to them.[13] In other words, despite the creation of HUD, the United States still lacked any strong policy instruments for dealing with the problems of the city. The capacity of the state to respond to the urban crisis was thus severely restricted. Instead of addressing the underlying causes of postwar social conflict—namely, the unequal distribution of power and resources—the social policies of the Great Society were limited to implementing temporary improvements in the social conditions of the economically marginalized populations of urban America.[14] This reflected a distinctively technocratic style of politics that focused on questions of management, yet just what the problems of management were, and how social policies should be designed in order to manage them, remained a question.[15]

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[12] In the opinion of James Tobin, a member of President John F. Kennedy's Council of Economic Advisors in the early 1960s who in collaboration with Arthur Okun, Robert Solow and Kenneth Arrow helped design the Keynesian economic policy implemented by the Kennedy administration, the success of a robust macroeconomic strategy was the foundation for the advances of liberal social policy in the Johnson administration: "With new resources unendingly provided by growth, public services could be expanded and upgraded, social insurance and income assistance extended, a war on poverty launched—all without divisive conflicts over taxes, the size of the public sector, defense spending, and the distribution of income and wealth. Stable, rapid, non-cyclical, non-inflationary growth was to be the underpinning of the Great Society." See James Tobin, "The Political Economy of the 1960s," in *Policies for Prosperity: Essays in a Keynesian Mode*, ed. Peter M. Jackson (Cambridge: MIT Press, 1987), 422.

[13] Susan S. Fainstein and Norman I. Fainstein, "National Policy and Urban Development," *Social Problems* 26 (1978): 125-46.

[14] John H. Mollenkopf, *The Contested City* (Princeton: Princeton University Press, 1983), 25-67.

[15] See Francis Fox Piven, "The Great Society as Political Strategy," in *The Politics of Turmoil*, ed., Richard A. Cloward and Frances Fox Piven (New York: Pantheon Books, 1974), 271-83.

State Strategies of Social Conflict Management

The technocratic social policy-makers of the Great Society faced fundamental questions about the capacity of the state to resolve the social conflicts arising in America's cities. In reciprocal fashion, there were indications that the growing complexity of the responsibilities of the state called for new forms expertise to achieve greater control over the effects of its actions.[16] Excitement over the new techniques of management used in the Department of Defense inspired policy makers to apply these very same technocratic planning methods to solve the problems of urban America. Many scientists and engineers transferred their wartime experience to the challenge of postwar urban problems, As Jennifer S. Light has shown.[17] Social scientific technologies such as "systems analysis," pioneered first in military affairs in the 1950s to grapple with the logistics of national security were employed to this end.

In the late 1940s and early 1950s systems analysis was developed at the RAND Corporation as a rational means of comparing the costs and risks of decision-making. In the beginning of its development, systems analysis was part of a set of techniques pioneered in the hope of creating a science of war. The word "systems" indicated that every decision should be considered in a broad context, while the word "analysis" emphasized the desire to reduce a complex problem to its most basic elements. While these efforts to create a science of war were mostly unsuccessful, systems analysis became popular in the Kennedy and Johnson administrations. The methods of systems

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[16] Sonja Michelle Amadae, *Rationalizing Capitalist Democracy* (Chicago: University of Chicago Press, 2003), 29-47.

[17] Jennifer S. Light, *From Warefare to Welfare: Defense Intellectuals and Urban Problems in Cold War America* (Baltimore: John Hopkins University Press, 2003).

analysis expanded into new fields, which synthesized knowledge from other branches of science as a strategy of solving complex governmental problems in situations of uncertainty. In David R. Jardini's analysis of the relocation of systems thinking from the "security policy" of the Department of Defense to the social policy of the Great Society, he argues "that the construction and implementation of the Great Society social welfare programs were fundamentally shaped by Cold War techniques as RAND alumni and their analytical methods can be found at the core of Great Society policy-making."[18]

Recognizing that uprisings in urban America were based in part on the discontent of urban populations with unresponsive political institutions, planners at RAND and in the federal government believed that social discontent could be managed with such techniques, thus increasing the state's power to impose social control. The usage of these techniques by the state was also seen as a way to systematize the relation of the production of social knowledge and the implementation of social policy in state interventions. New policy instruments were deployed to measure the effects of social policy interventions according to the criteria of efficiency. Individual social programs were evaluated with new scientific methodologies, experiments were conducted on alternative social policy approaches to the problems of urban America, and the socio-economic conditions of cities were carefully monitored over time. The compensation of liberal democratic participation was to be made superfluous through new state techniques of macrosociological conflict management.

The seduction of the technocratic option to liberals during the period of the Great

[18] David R. Jardini, "Out of the Blue Yonder: The Transfer of Systems Thinking from the Pentagon to the Great Society, 1961-1965," in *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After*, ed. Agatha C. Hughes and Thomas P. Hughes (Cambridge: MIT Press: 2000), 312.

Society was that it promised to take the contest out of politics—indeed, to take the politics out of politics. From this technocratic perspective, only technically trained experts had the knowledge necessary to govern, effectively rendering traditional liberal democratic politics obsolete. However, the ideal of the scientific management of social conflict was no closer to realization in the late 1960s than it was in the early 1960s when systems analysis and other techniques of rational state planning began to be used to solve the problems of urban America, the only difference being that the use of such methods had become prevalent.[19] There was beginning to be a significant political backlash against the use of these techniques. That their use had not in fact achieved this ideal was becoming increasingly clear, as the highly idealized vision of the state as an agent of positive social control that had been promoted by the social policy-makers of the Great Society was slowly undermined by the sheer scale of urban turmoil.

Further Into the Urban Crisis

One of the most brutal riots in American history broke out in Detroit, Michigan on July 23, 1967.[20] Early in the morning, police raided an illegal after-hours bar in the center of Detroit's massive urban ghetto, where people were celebrating the return of two African American soldiers from Vietnam. They were expecting to arrest a few patrons, but instead found a crowd of people inside. The police decided to arrest everyone present. While they waited for reinforcements, a crowd gathered in protest. It is still not clear

[19] Jeffrey D. Straussman, *The Limits of Technocratic Politics* (New Brunswick: Transaction Publishers, 1978), 10-15.

[20] Sidney Fine, *Violence in the Model City: The Cavanagh Administration, Race Relations, and the Detroit Riot of 1967* (Ann Arbor: Michigan State University Press, 1989).

exactly what happened next, but within the hour, a riot erupted that raged out of control. The riot was the deadliest of the 1960s.[21] By the end of 1967, riots had occurred in 164 cities across the United States. While the riot in Detroit was underway, Johnson created the National Advisory Commission on Civil Disorders.[22] The Commission was tasked with determining the causes of the riots of 1967 and with making a proposal to assist the state in preventing such events in the future.

The publication in February of 1968 of the National Advisory Commission on Civil Disorders constituted the next significant blow to the technocratic vision of the Great Society. The report argued that the riots were protests by local neighborhood residents rather than meaningless outbursts of violence and mobilized evidence on an array of social, political, and economic problems that were suffered with particular severity by African Americans. The report warned that the United States was "moving toward two societies, one black, one white—separate and unequal."[23] Their report also contained the following testimony from the sociologist, Kenneth Clark: "I must again in candor say to you the members of this Commission—it is a kind of Alice in Wonderland—with the same moving picture re-shown over and over again, the same analysis, the same recommendations and the same inaction."[24] No single solution, whether directed to housing, employment, or education would alleviate the problems that led to the riots, the report stated. Rather, all solutions must be implemented at once, and

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[21] Heather Ann Thompson, *Whose Detroit? Politics, Labor, and Race in a Modern America City* (Ithaca: Cornell University Press, 2004), 42.

[22] Kevin Mumford, "Harvesting the Crisis: The Newark Uprising, the Kerner Commission, and Writings on Riots," in *African American Urban History Since World War II*, ed. Kenneth L. Kusmer and Joe William Trotter (Chicago: University of Chicago Press, 2009).

[23] National Advisory Committee on Civil Disorders, *Report of the National Advisory Commission on Civil Disorders* (New York: Bantam Books, 1968), 1.

[24] Ibid., 483.

only then, their report claimed, would "new patterns of behavior and social organization emerge in the central cities."[25] The report sought to refocus the discourse of the urban crisis from the superficial physical manifestations of urban violence to the problems of the structural inequalities of American society. It was agreed that something about the "system" itself had to be transformed.

Johnson was angered by their indictment of his efforts, and did not agree with his commission's findings. They were rejected and their recommendations were ignored.[26] The next blow to the Great Society was the final one. The murder of Dr. Martin Luther King Jr. on April 4, 1968, catalyzed a new wave of riots in 130 cities all over the United States—including Boston, Baltimore, Chicago, Detroit, Newark, New York City, and Washington, D.C. The worst revolts occurred in Washington, D.C.[27] The 1968 riots were the most widespread of the 1960s. By this time, the years for major social welfare legislation were over as the war in Southeast Asia assumed increased significance. This contradiction was not lost on many liberals, who believed that one war was being traded in for another, with both spiraling equally out of control. In spite of the deployment of a series of new social programs targeting urban America, cities across the nation continued to erupt in protest. The policy-makers of the Great Society were at a loss to explain these events. The escalation of violence in urban America dramatically revealed both the true

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[25] Ibid., 35.

[26] James T. Patterson, *Grand Expectations: The United States, 1945-1975* (Oxford: Oxford University Press, 1996), 668.

[27] Howard Gilette, *Between Justice And Beauty: Race, Planning, and the Failure of Urban Policy in Washington* (Baltimore: John Hopkins University Press, 1995), 27-29; Ben W. Gilbert et al., *Ten Blocks from the White House: Anatomy of the Washington Riots of 1968* (New York: Frederick A. Praeger Publishers, 1968), 45; Manfred Berg, "1968: A Turning Point in American Race Relations?" in *1968: The World Transformed*, ed. Caroline Fink, Phillip Gassert, and Detleft Junker (Cambridge: Cambridge University Press, 1998), 406.

magnitude of the urban crisis, as well as the limits of the state's capacity to properly resolve it.

Chapter 2:

The Engineers and the Urban System, 1968-1969

The Urban Systems Laboratory (USL) was established in 1968 at the Massachusetts Institute of Technology (MIT) with a sense of urgency. "The problem of the city," explained MIT President Howard W. Johnson in a letter to McGeorge Bundy, President of the Ford Foundation, "presents itself as a complex of poverty, racial strife, crime, physical and aesthetic decay, ineffective public education, and the progressive breakdown of its services in housing transportation, health, sanitation, and government."[28] "This picture," he added, "is one of social and economic disintegration that affects the vitality of democracy in serious ways."[29] In 1967 Johnson submitted a proposal to the Ford Foundation arguing that MIT's proficiency in science and technology, as well as its expertise in urban affairs, should be developed into a project of research to involve all of the resources of the Institute. It was only with such a large-scale interdisciplinary effort, Johnson argued, that MIT could begin to face the challenges of the urban crisis. However, as Charles L. Miller, the Executive Director of the USL, and the former head of the Department of Civil Engineering, indicated, the "problems faced by the USL, the problems of the city... are the broadest and most complex problems ever faced by MIT."[30]

By the late 1960s, MIT had already developed a capacity to generate urban

[28] "Letter from Howard W. Johnson to Mr. McGeorge Bundy, President of The Ford Foundation, February 24, 1967," 1, Ford Foundation — Urban Studies Proposal, MIT Corporation, Office of the Chairman, Records, 1965-1983, AC-118, Box 167, Folder 1, Massachusetts Institute of Technology, Institute Archives and Special Collections, Cambridge, Massachusetts [hereafter AC118].

[29] Ibid., 2.

[30] Charles L. Miller, "Urban Systems Laboratory," in *Massachusetts Institute of Technology Bulletin: Report of the President 1968* (December 1968), 490.

expertise through the Joint Center for Urban Studies. Established in 1959, the Center was designed to address social policy issues confronting a nation experiencing widespread economic and social transformations, with dramatic effects on urban America in particular. Martin Meyerson of Harvard Lloyd Rodwin of MIT imagined that the Center would function in a way that was analogous to scientific laboratories in other fields.[31] With support from the Ford Foundation, the research agenda of the Center was based on the premise that the resolution of the complex political issues facing urban America called for the production of expertise about the city. The idea that the production of expertise alone would solve the problems of the cities strongly reflected the interests of its patron. In the 1960s the Ford Foundation imposed a technocratic vision of social change as a question of developing appropriate social-scientific expertise and discouraging public involvement in order to minimize political resistance from below.

MIT's relationship with the Ford Foundation immersed the Institute into the network of power the Foundation rapidly established in the postwar period. The Foundation had ties with many powerful officials in government. Thus a process was established in which an exchange of interests, expertise and funding took place between MIT, the Ford Foundation and the Kennedy and Johnson administrations. The influence of the Ford Foundation was also imposed upon the USL. However, its mission differed significantly from that of the Center. By the late 1960s, the Center had come to be seen as traditional, rather than innovative. Unlike the Center, which included the humanities in its research, the USL was strictly oriented around the development of scientific and technical expertise, not only reflecting the Ford Foundation's interest in the latest

[31] Eugéne L. Birch, "Making Urban Research Intellectually Respectable: Martin Meyerson and the Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University, 1959-1964," *Journal of Planning History* 10 (2011): 219-238.

intellectual fashions of technocratic social engineering, but also MIT's desire to capitalize on the growth of techno-scientific research pursued under government and nongovernment contract. As Johnson explained to Bundy, "We anticipate a situation in five to ten years when project and fellowship funds in urban studies... will be comparable with the financing which society now provides for other fields considered to be of high national priority."[32] MIT received $3,000,000 in grants from the Ford Foundation, and $800,000 of the grant was dedicated to establishing the USL. Upon the bestowal of this grant, a Ford Foundation press release stated that "despite engagement of many talented persons, the outlay of substantial public and private funding, and the initiation of many reforms and innovations in urban affairs, the root problems of American cities remain largely unsolved, complex, and explosive."[33] This suggested a novel approach was needed which would focus systematically on the most serious of urban problems. The founders of the USL believed that, while only experts would solve these problems, these experts did not yet exist.

Urban Systems Research

The aim of the USL was to develop a broad institutional framework at MIT for interdisciplinary research on the city. This idea in itself posed a series of problems that had to be resolved before the USL could be established. While MIT had experience in organizing interdisciplinary research and large-scale project laboratories in engineering

[32] "Letter from Howard W. Johnson to Mr. McGeorge Bundy, President of The Ford Foundation, February 24, 1967," (1967), AC118, 2.
[33] "News from the Ford Foundation, November 30, 1967," (1967), AC118, 1.

and applied science—such as, for example, at the Research Laboratory of Electronics, the Lincoln Laboratory and the Instrumentation Laboratory—the USL was the first to combine architecture, urban planning, management, and the social sciences as well as engineering on a major scale. The key to the effort to encourage all of the resources of the Institute to join in the mission of the USL was the employment of the concept of "system" in defining the object that this interdisciplinary institutional framework would be built to explore. As this concept was used across the arts and sciences, it suggested that every department and discipline could contribute to the USL without sacrificing its specific area of expertise. However, the conception of the "urban," once paired with the concept of "systems," had undergone a significant conceptual transformation. The idea of "urban systems" called to mind the underlying social, political, and economic processes of the city, and not merely the physical manifestation of the city as built form. This too suggested that the USL had the potential to be a great success, insofar as no one discipline could claim the "urban system" as its own, thus requiring an effort of collaboration in order to explore a new style of research that lacked traditional disciplinary identifications.

It was obvious to the founders of the USL that urban problems could not be regarded as separate from each other and that they appeared to demand an interdisciplinary approach if they were to be tackled effectively. The style of research that arose in order to face this challenge was known as "urban systems research," and was loosely defined at the USL as the utilization of the methodology of systems theory, systems analysis, systems engineering, and related social technology as applied to the "social problems" of housing, education, transportation, environmental quality control,

health, and community development. Nevertheless, in this research the very conception of the city lost its political significance and no longer offered any precisely defined object of study, as the "urban" became identified with the "social" in general. Research at the USL emphasized not just rebuilding urban America, but planning social rehabilitation, designing systems of social service delivery, and inventing new techniques of social management requiring the management and sharing of large quantities of information with the use of a computer. As MIT Provost Jerome Wiesner explained, the computer was an ideal instrument to explore the problems of the city because of its capacity to enhance "the ability of the human brain to deal with the complexities of the molecules of life, the mysteries of the cosmos, and man's urban existence."[34]

As the USL Executive Director Charles L. Miller argued, it was the computer that brought the interdisciplinary activities of the USL together. "Access to an experimentally oriented computer" was, he explained, "essential to new research in urban information systems, urban simulation, and urban design as planned by many groups associated with U.S.L."[35] The centrality of the computer in this research, he added, "has led the USL to acquire a time-shared 360/67 IBM computer in MIT's new Information Processing Services Center"[36] **(Figures 1-13)**. By the late 1960s, MIT was known for many of the most significant technological achievements in computers, and with the establishment of the USL, was set to explore the power of the computer to establish a community of

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[34] Jerome Wiesner, "Urban Problems in the Light of Technological Opportunities," in *Federal Role in Urban Affairs: Hearings Before the Subcommittee on Executive Reorganization of the Committee on Government Operations, United States Senate, April 13, 1967*, 90th Cong. (Washington: United States Government Printing Office, 1967), 3246.

[35] "Urban Systems Lab Installs New Computer," News Release Special to The Tech, September 23, 1968, MIT Urban Systems Laboratory Records, 1968-1974, AC-366, Institute Archives and Special Collections, MIT Libraries, Cambridge, Massachusetts [hereafter AC366].

[36] "The Laboratory That Isn't," *Technology Review* 71 (1968): 92.

researchers at MIT working on urban problems collaboratively through a time-sharing computer system.

The IBM 360/System Model 67, Time-Sharing Systems, and Urban Systems Research

Upon its release in 1964, the IBM System/360 was one of the most widely sought-after computing systems in the world.[37] It was the first family of computers designed by IBM to cover a range of applications. Before the release of the IBM System/360, computers were built for special purposes and required an enormous technical staff to operate at great cost. The IBM System/360 changed all that, and was extremely successful in the market as a result.[38] However, the corporate vision of computers, exemplified in design of the IBM System/360, was still of machines that merely provided data management for large organizations. The manufacturers of these systems did not consider them to be experimental. It was left to universities like MIT to explore their experimental potential. The Model 67 version of the IBM System/360 the USL acquired in 1968 was principally the result of the research of computer scientists at MIT in the 1960s.

The Model 67 was unique in the System/360 family because it allowed users at remote computer consoles to communicate directly with the system, a capability known as "time-sharing."[39] Time-sharing systems provided a more democratic distribution of

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[37] Emerson W. Pugh, Lyle R. Johnson, and John H. Palmer, *IBM's 360 and Early 370 Systems* (Cambridge: MIT Press, 1991), 15-75.

[38] Ibid., 85.

[39] Charles T. Gibson, "Time-sharing in the IBM System/360: Model 67," in *Proceedings of the Spring Joint Computer Conference, April 26-28, 1966* (New York: Macmillan, 1966), 61-78.

computational resources to a number of users at different terminals.[40] The invention of time-sharing operating systems also catalyzed the interactive use of computers.[41] The Compatible Time-Sharing System (CTSS), developed the MIT Computation Center in the early 1960s, was one of the first time-sharing operating systems in the world.[42] In the early 1960s, there were two versions of the CTSS operating at MIT on two IBM 7094 Data Processing Systems, one at the Computation Center, and another at MIT's Project MAC (Project on Mathematics and Computation).

In the mid-1960s MIT began to look for a new time-sharing operating system. This system became Multics (Multiplexed Information and Computer Service), which was intended to be a time-sharing operating system capable of supporting hundreds of users across the Institute. In 1966, Fernando J. Corbató, the designer of the Multics project, and Robert Fano, the director of Project MAC, wrote an influential article for *Scientific American* in which they argued that time-sharing operating systems such as CTSS and Multics would have a profound impact not only on the future of the computer but on the future of society as well. "Communities will design systems," they indicated, "to perform various functions—intellectual, economic and social—and the systems in turn undoubtedly will have profound effects in shaping the patterns of human life."[43] They predicted the development of new systems of social organization arising between interactive computer systems and its users that "will create new services, new institutions,

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[40] Paul E. Ceruzzi, *A History of Modern Computing* (Cambridge: MIT Press, 1998), 155.

[41] Janet Abbate, *Inventing the Internet* (Cambridge: MIT Press, 1999), 24-27.

[42] Paul E. Ceruzzi, *A History of Modern Computer*, 157.

[43] Fernando J. Corbató and Robert M. Fano, "Time-sharing on computers," *Scientific American*, September 3, 1966, 129.

a new environment and new problems."[44]

The USL was part of an effort at MIT to lay the immense institutional infrastructure that was necessary to explore Corbató and Fano's vision. As Miller explained, "The 360/E will be to the USL what the 7094/CTSS has been to MAC, and the joint development of an experimental urban information system will be to the USL what MULTICS is to MAC."[45] "The USL," Miller indicated, echoing Corbató and Fano's 1966 article, "is an open community, open to all faculty, staff members, and students who find that they can be more effective in the field of urban systems by being active members of the community."[46] "Just as in the case of the city," he added, "the citizens of USL should have a voice in what USL should be, what it should do, and how it should operate and function."[47] That the computer was a technology to be used at the USL in its capacity to generate and share knowledge is clear. It was also a technology about which knowledge was to be generated, however. To get a sense of the role the computer played in the research at the USL, both as a subject and an object of research, we may look to a conference jointly organized by MIT and the Technische Universität of Berlin in the summer of 1968, to which a large contingent of the faculty involved in the USL was invited to present their research.

From the Complexities of Urban Existence to Urban Systems Engineering

"The computer is one of the foremost examples of technology working for man—

[44] Ibid., 132.

[45] "USL 360/E Plan, Urban Affairs — Urban Systems Lab., 1/'68-6/69," (1968) AC118.

[46] Charles L. Miller, "Urban Systems Laboratory," 491.

[47] Ibid.

expanding our ability to comprehend, to evaluate, and in many ways to control our resources and our environment," explained MIT President Johnson in his address to open the conference.[48] "It is probable," he added, "that the potential of the computer is limited only by our imagination."[49] In a session on the "Manipulation of Complex Systems by Use of the Computer," Nicholas Negroponte and Aaron Fleisher of the School of Architecture and Planning spoke about their recent experiments in computer-aided design.[50] Negroponte had founded the Architecture Machine Group in the School of Architecture and Planning at MIT in 1967 to explore the use of computers in architecture and urban planning. Negroponte used the USL to further this research.

Inspired, in part, by such sources as Ivan Sutherland's 1963 Sketchpad design program and Marvin Minsky's ideas of artificial intelligence, the research of the Architecture Machine Group was based on the idea that the architect is "an unnecessary and even detrimental middleman between individual, continuously changing needs and the continuous incorporation of those needs into the built environment."[51] The computer, they argued, inaugurated a new era of design by providing a new intellectual utility allowing people to design their own environments. They reasoned that individuals should have greater power to control their own environment, instead of being controlled by it, and envisioned the possibility of a technological utopia of architecture without architects. The idea of accessibility was central to this research, and in their talk Negroponte and Fleischer spoke of computers as the catalyst of a utopia of design that would strengthen

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[48] "Spiel mit MAC: A Berlin Conference," *Technology Review* 71 (1968), 73.

[49] Ibid.

[50] *The Computer in the University: Joint Summer Conference, Technische Universität Berlin, July 22 to August 2, 1968* (Berlin: Technische Universität, 1968), 25-26.

[51] Nicholas Negroponte, *The Architecture Machine: Toward a More Human Environment* (Cambridge: MIT Press, 1970), 6.

American democracy. Negroponte and Fleisher were interested in how computers suggested a new paradigm of agency to take back control of urban America.

Yet Negroponte and Fleischer's vision of the role of the computer in society did not go far enough in the opinion of MIT Professor of Management, Jay W. Forrester, another associate of the USL who attended the conference in Berlin **(Figure 14)**. "In the meeting so far," he stated, "most of our attention has been directed toward computer systems, toward physical systems of various kinds, toward software systems and this morning, toward architectural design systems."[52] "But it would seem," he continued, "that most of our problems today, lie not so much in the technical as they do in the areas of our social systems."[53] "There is ample evidence in every newspaper," he explained, "that man neither understands nor has mastery of his social systems."[54] "Economic crises, inflation, international conflict, failures in developing nations, price instability in world commodities, urban deterioration, student unrest, population pressures, and the stresses between the individual and the organization," he added, "all reveal our failure to master the social dynamic of our environment."[55] Forrester did not refer to any specific event, but he did not have to. The year of 1968 received its singular historical significance, at least for Americans at this time, through the convergence of a series of events that marked a unique period of social instability—the Tet Offensive, President Johnson's withdrawal from the 1968 campaign, Martin Luther King, Jr.'s assassination and the riots that followed, Robert F. Kennedy's assassination, the mayhem of the Democratic

[52] "Transcript of Lecture, "Complex Social Systems," July 31, 1968," p. 1, MIT – TUB Berlin Conference, July 22, 1968 – August 8, 1968, Jay W. Forrester Papers, MC-439, Box 17, Massachusetts Institute of Technology, Institute Archives and Special Collections, Cambridge, Massachusetts [hereafter MC439].

[53] Ibid., 3.

[54] Ibid., 21.

[55] Ibid., 26.

Convention in Chicago, student protests, and above all, the most violent period of the war in Southeast Asia.

Forrester presented research that would be published in 1969 as *Urban Dynamics*. Using the IBM Systems/360 Model 67 installed at the USL in 1968, Forrester had built a large-scale, interactive, computational model of a hypothetical urban environment. He used this model of a city like a laboratory for the study of urban social structures, processes, and systems. He argued in his presentation that, unlike methods of analysis that rely on the limited cognitive capacity of a human, with the use of the computer he was able explore the real consequences of the engineering of complex social systems. Forrester argued that social policies can be mathematically tested by experimenting with interactive computer models to calculate their effects, intended and unintended. In this way, he argued, one could reach politically neutral, systematic, and scientific conclusions and avoid the inconsistent, inefficient, and ineffective results of mere intuition. His specific aim was to offer a new policy instrument for analyzing the social policies of the Great Society. The complexity of urban America, he suggested, was a kind of complexity that only an urban policy-maker armed with a computer could master. Forester held that the city could be seen as a system that could be reengineered to reverse the social entropy he identified with urban America.

Forrester argued that if a state of the art information processing system reliably processed a vast quantity of data rapidly enough to analyze and design other complex technological systems—such as, for example, in the Apollo Program—then such a system might also be used to tackle problems of much greater complexity, such as the city. To Forrester, the computer opened up an epistemological space free of the political

polarizations of the period, a space in which to analyze the social, economic and political complexities of urban existence while simultaneously being insulated from it. More than any other research at the USL, Forrester's work was haunted by the specter—as well as the seduction—of a cybernetic self-organization of society, i.e., a technological utopia of social control incorporating rationalized planning techniques for identifying social problems, inventing policy strategies to solve them, stimulating the consequences of these policies, then sending back this information to centers of centralized decision making—a process made possible by the integration of the system, the computer, and the expert. The way Forrester looked at the city was shaped by his work following World War II.

The Genealogy of an Engineer: From Project Whirlwind to *Industrial Dynamics*

Forrester emerged as a major computer pioneer in the MIT Servomechanism Laboratory immediately following World War II where he managed the design of a high-speed digital computer named "Project Whirlwind."[56] In the late 1940s, the threat of Soviet bombers forced military officials to consider the construction of an air defense system for North America. In response, the MIT Lincoln Laboratory was established in 1951, and Project Whirlwind was transferred to the Lincoln Laboratory.[57] Forrester became the director of Division 6 at the Lincoln Laboratory, where he continued work on Project Whirlwind. By the mid-1950s, the Lincoln Laboratory had in operation a the prototype of

[56] Kent C. Redmond and Thomas M. Smith, *From Whirlwind to Mitre: The R&D Story of the Sage Air Defense Computer* (Cambridge: MIT Press, 2000), 181-222.

[57] Ibid., 151.

the computer that eventually ran the Semi-Automated Ground Environment (SAGE) land-based air defense system in the early 1950s, a computerized air defense system for all of North America. This system was the first interactive application of computers in the world. Though SAGE was strictly an air defense system, as Thomas Parke Hughes has explained, "it can also be described as an information-processing and real-time control system."[58] It is hard to exaggerate the extent of its influence on the development of the computer. Even before the system was deployed in 1958, the SAGE project had begun to train an entire generation of computer engineers, computer programmers, and cognitive scientists. In retrospect, it has come to symbolize cold war technocracy.[59]

On the advice of MIT President James R. Killian, Forrester left his post as the leader of Division 6 at the Lincoln Laboratory to join the MIT Sloan School of Management in 1956. Forrester was a perfect match for Sloan. His experiences as the manager of Project Whirlwind and the largest division of the Lincoln Laboratory led him to conclude that the biggest impediment to greater levels of efficiency in large-scale technocratic endeavors was not due to the engineering side of "industrial problems," but from the management side of "human problems." This was due to the fact that, as he explained, "social systems are much harder to control than are physical systems."[60] At Sloan, Forrester became interested in the mathematical modeling of complex social systems with the use of a computer, an area of research he referred to as "systems dynamics." Forrester employed the engineering term "dynamics" to indicate that his models provided the ability to study situations of complexity as they evolved over time.

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[58] Thomas Parke Hughes, *Rescuing Prometheus* (New York: Vintage, 1988), 87.

[59] Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge: MIT Press, 1996), 75-112.

[60] Jay W. Forrester, *Industrial Dynamics* (Cambridge: MIT Press, 1961), 5.

In particular, systems dynamics was created for the analysis and the design of "policy," by which Forrester meant the rules by which decisions are made.[61]

This method of analysis led to the creation of a special computer language called DYNAMO (DYNAmic Models), written by Phyllis Fox and Alexander Pugh, which was both a simulation language and a graphical notation system[62] **(Figure 15)**. This program allowed Forrester not only to quickly build computer models of great complexity, but to visualize them as well. Forrester began his systems dynamics research by modeling the process of decision-making in a corporation to gauge how such unruly forces as the interrelation of flows of information, labor, money, and materials—when manipulated in the model—could be redesigned to increase the efficiency of these processes. His goal was to provide a model of a corporation to allow managers to make better decisions **(Figure 16)**. This research was published in 1961 as *Industrial Dynamics* **(Figures 17-18)**.

The underlying implication of *Industrial Dynamics* was that managers of large industrial corporations could use computers to give more consideration to recursive processes of interaction in complex social systems. Inspired by the research behind *Industrial Dynamics*, Forrester began to see the computer as providing answers to some of the most perplexing problems facing society, namely, the problems of control in highly organized social systems. Forrester began to reconceptualize the computer as a technology of social control just as the systems sciences were beginning to flourish. These sciences were united by a shared concern with the problems of control in highly organized social systems. Forrester's system dynamics became a major area of research

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[61] Ibid., 15.

[62] Alexander L. Pugh, *DYNAMO User's Manual* (Cambridge: MIT Press, 1963), 15.

at Sloan in the 1960s, where it was applied almost exclusively to managerial problems of corporate America. In 1968, however, a new friendship compelled Forrester to broaden his expertise beyond corporate modeling, and face the "dynamics" of urban America.

The Mayor's Expertise in Urban Machine Politics

On January 2, 1968, the former Mayor of Boston, John F. Collins became a Visiting Professor of Urban Affairs at MIT in three different departments: Political Science, the Alfred P. Sloan School of Management, and Civil Engineering. It was the day after the end of his second term as Mayor[63] **(Figure 19)**. In the 1950s, Collins had been stricken with polio, and at MIT he required an office in a building with disability access. By chance, Forrester's office was located in such a building and the office next to his was vacant. The two began to engage in regular conversations about the problems of urban America and how Forrester's research might be used to address these problems. The chemistry of their collaboration catalyzed for each of them the sense of their own prestige. Each recognized that the other brought a set of skills to bear in their conversations that reinforced their respective areas of expertise, scientific and political. In particular, they shared a managerial vision of the city. Forrester was inclined to view everything he studied as a problem of management, and Collins viewed his former role as Mayor as a managerial one. As MIT President Howard W. Johnson stated, "the appointment of Mayor Collins represents an important step in developing a broadened program of study and research in urban affairs at MIT. He will bring to the Institute a

[63] "MIT Names Mayor Collins Professor of Urban Affairs," *Boston Herald Traveler*, Tuesday, July 11, 1967, 1.

keen knowledge of urban problems and the complexities of managing a city."[64]

Johnson's statement contained no mention of the controversy that Collins' administration had generated over the previous decade. The administration of Mayor Collins had focused upon the revitalization of the downtown business district, on maximizing private sector investment, and on rehabilitating selected neighborhoods to attract the upper classes back to Boston at the expense of the rest of the city. From 1960 to 1968, he mobilized the powerful Boston Redevelopment Authority (BRA), established by his predecessor John B. Hynes in 1957, and pushed forward a series of large urban redevelopment projects in an effort to build a "New Boston."[65] In 1960 Collins hired New Haven city planner Edward J. Logue as director of the BRA. Together they instigated what Logue later claimed was "the largest urban renewal program seriously put forward anywhere up to that time."[66] According to Lawrence W. Kennedy, "Nearly 50 percent of the population and one quarter of the city's land were located within the designated renewal areas."[67] Under Collins and Logue, Scollay Square was replaced with Government Center and the new City Hall, Faneuil Hall and Quincy Market were developed into commercial centers, and the Prudential Center was built as a major commercial property **(Figure 19)**. These projects not were regarded as universally successful, however.[68]

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[64] "Statement by Howard W. Johnson, President, Massachusetts Institute of Technology," (1968), AC118.

[65] Lawrence W. Kennedy, *Planning the City Upon a Hill: Boston since 1630* (Amherst: University of Massachusetts Press, 1992), 160; Mark I Gelfand, "Back to the Politics of the Future," in *Snowbelt Cities: Metropolitan Politics in the Northeast and Midwest since World War II*, ed. Richard M. Bernard (Bloomington: Indiana University Press, 1990), 40-62.

[66] Edward J. Logue, "Boston, 1960-1967—Seven Years of Plenty," *Proceedings of the Massachusetts Historical Society* 84 (1972): 82-96.

[67] Lawrence W. Kennedy, *Planning the City upon a Hill,* 173.

[68] Jon C. Teaford, *The Rough Road to Renaissance: Urban Revitalization in America, 1940-1985* (Baltimore: John Hopkins University Press, 1990), 7-8.

The political economy of postwar urban development in Boston produced a greater chasm than before between the central downtown area and outer neighborhoods. Amidst the riots and uprisings in America's urban areas during the 1960s, Boston was no exception.[69] For example, on June 2, 1967, members of Mothers for Adequate Welfare (MAW), a local political organization, went to a welfare office in Roxbury to voice their concern about the long waits to see social workers, and the insults and harassment they received when they did get to see them. They demanded to speak with the local welfare commissioner, and protested that the state welfare bureaucracy was being used malevolently against them as an instrument of social control.[70] The women locked themselves into the office and prevented welfare workers from leaving the building. Mayor Collins called their peaceful political demonstration "the worst manifestation of disrespect for the rights of others that this city has ever seen."[71] He called in police, who charged through the windows. The brutality of the police angered the sympathizers of the protesters picketing outside. They heard the women scream, and very quickly a riot erupted. Nearly 200 people were arrested. A few weeks later, Collins was offered the job at MIT.

The Mayor and the Engineer

In February of 1968, Forrester began work at the USL on building a computer model of a

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[69] William E. Nelson, Jr., *Black Atlantic Politics: Dilemmas of Political Empowerment in Boston and Liverpool* (Albany: State University of New York Press, 2000), 67.

[70] Jack Tager, *Boston Riots: Three Centuries of Social Violence* (Boston: Northeastern University Press, 2001), 169.

[71] Ibid., 180.

hypothetical American city. In order to create this model, Forrester synthesized his technical expertise with the expertise of a committee of real-estate developers and businessmen who had helped Collins in the 1960s to realize his vision of a New Boston.[72] Forrester was impressed by their idea of the city as a product of managerial and administrative decision-making. He was also deeply influenced by the idea that the most important goal of a city was to drive economic growth. This idea was, after all, the principle idea behind the urban development projects of the Collins administration. The role of urban policy-makers, such as the Mayor, they argued, was to do everything in their power to sustain economic growth. They had a poor opinion of the Great Society, and specifically the so-called War on Poverty, which they saw as hindering postwar economic growth and interfering with the governance of Boston. Forrester was particularly impressed with Collins, who had shown that he was able to successfully reestablish control of the city during a period of tremendous social turmoil. In a reciprocal fashion, Collins was impressed by Forrester's research, as well as with the research of the USL as a whole.

In an article published in 1968 entitled "Technology and the Urban Crisis," Collins rhetorically asked, "How can we as a nation contemplate such sophisticated scientific and industrial goals as the conquest of space and yet make such a relatively insignificant contribution to the improvement of the environment in which we live?"[73] Echoing the rhetoric of the USL, he argued that to solve the urban crisis, "a systems analysis of urban problems on a collective basis and an interdisciplinary assault by every element of the nation, public and private, academicians, business, labor, civil rights—all

[72] Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), ix.

[73] John F. Collins, "Technology for the Urban Crisis," *Technology Review* 70 (1968): 19.

of these are required."[74] Based on the conservations he had with Collins about the perils of managing a large American city, armed with his research from *Industrial Dynamics*, and utilizing the USL's IBM System/360 Model 67, Forrester bravely attempted a foray into the dynamics of the urban crisis.

Into the Dynamics of the Urban Crisis

Forrester argued that he wanted to build a model that represented a "typical" central city in the United States, with a particular emphasis on the plight of the so-called "decaying inner-city."[75] Forrester considered the city to be a "closed social system" located within a "limitless environment"[76] **(Figure 20)**. As Forrester argued, "a city, while acted upon by exogenous impulses from outside, can be treated as a system unto itself."[77] Thus the process of suburbanization, for example, was implicitly excluded from the model. He argued that everything within the model would be generated through interactions with other processes within this closed social system[78] **(Figure 21)**. In addition, no empirical evidence was used in building the model. It was the former Mayor's job to verify its accuracy. Nevertheless, Forrester believed that if the model was designed accurately enough, he could demonstrate the behavior of growth and stability that was observable in an actual city, and not merely in an abstract one.

First, Forrester utilized the latest version of the computer program DYNAMO he

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[74] Ibid., 20.

[75] Jay W. Forrester, *Urban Dynamics*, 12.

[76] Ibid., 15.

[77] Ibid., ix.

[78] Ibid., 17.

developed in his work from *Industrial Dynamics*, once it was adapted by his assistants to work on the Model 67 computer at the USL. He isolated variables that he believed reasonably described the social and economic composition of an American city, as he had done with corporations. The basic variables were chosen primarily with an eye to the urban crisis: the existence of "slums," the unemployment caused by capital flight from the city, and insufficient tax revenue due to rapid depopulation. Thus the structure of the model consisted of a hierarchy of three subsystems that comprised the total "urban system," namely industry, housing, and population. These subsystems interacted through nine so-called "state" and twenty-two "rate" variables, such as "labor" and "unemployment"[79] **(Figure 22)**. These variables structured the parameters of every possible interaction within Forrester's hypothetical urban system. The interrelationships among the variables took the form of so-called "structural parameters, rate equations, level equations, and auxiliary equations," which described the feed-back-like interactions of industry, housing, and population with other variables and established in the form of an abstract, analytical representation the structure of the urban system as a whole. Forrester was then prepared to see what kind of behavior his hypothetical urban system produced as it grew and evolved over time[80] **(Figures 23-26)**.

Beginning with a fixed area of undeveloped land, the model generated a cycle of development leading to full land use, which Forrester identified as a condition of social and economic "equilibrium." His model of a hypothetical urban system generated a visualization of the behavior of this system over a 250-year life cycle. This illustrated the "growth and decay of the city," with "stagnation" setting in around the 150th year

[79] Ibid., 17.
[80] Ibid., 24.

(Figures 27-29). Forrester's model generally produced a cycle of development in which, after a long period of systematic urban development, eventually the beginnings of a "crisis" set in. Using this model, Forrester then examined the effect of a range of social policy options in order to analyze their performance in "real-time." He modeled many of the social policies of the Great Society, and specifically those of the War on Poverty, which were introduced into the model as modifications to the original equations. He then produced a series of models that resulted from combinations of these policies. He met frequently with the former Mayor to seek his advice on the ideal city, and tweaked the model until he was satisfied that he had discovered the precise combination of policies to produce this ideal. He then proposed a series of recommendations to urban policy-makers to reach this ideal.

Even though Forrester noted the preliminary nature of his research in the introduction to *Urban Dynamics*, he proposed dismantling virtually all of the major social policies of the period. He specifically rejected as harmful the policies of the War on Poverty. He discouraged these policies, arguing instead that without them the "natural" development of the city would return to a condition of economic and social equilibrium. He proposed what was, in effect, an anti-poverty program of his own, which was simply to destroy every institution meant to help the poor. In this way, he reasoned, once the social policies aimed at the poor were dismantled, there would be no incentive for the poor to remain in the city, and thus the city would no longer have a poverty problem. His vision of the city was grim indeed. In Forrester's hypothetical urban system, the poor merely give birth to further poverty and remain imprisoned in the welfare system; the unemployed appear to never escape unemployment; and the wealthy, identified as the

"managerial class" in his model, struggle to reap the fruit from the downward social spiral of the urban crisis. The policy-makers of the city are also trapped within this spiral, introducing measures to solve social problems that only make them exponentially worse. "This model of an urban system," he stated, "suggests that many past and present urban programs may actually worsen the conditions they are intended to improve. Promising alternative programs, addressed to the underlying *causes* of urban decay rather than to *symptoms*, suggest different approaches."[81]

More controversial than these ideas, however, was Forrester's explanation of why the social policies of the Great society "may well be making matters worse...while policy changes in exactly the opposite direction from present trends are needed if the decaying inner city is to be revived."[82] According to Forrester, the social policies of the Great Society merely applied intuitive reasoning to the complex social system of urban America. Forrester argued that the "interactions between economic and social activity are so complex that intuition alone can not devise policies that prevent decay."[83] "With a high degree of confidence," Forrester argued, "we can say that the intuitive solutions to the problems of complex social systems will be wrong most of the time. Here lies much of the explanation for...troubles of urban area."[84] The idea underlying Forrester's arguments was that the urban crisis had been exacerbated by the state's attempt to resolve it by social planning. With Forrester's *Urban Dynamics* we can see how, with the national sense of urgency at its height, what would eventually crystallize into a conservative vision of the urban crisis began to emerge.

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[81] Ibid., 2.

[82] Ibid., 109.

[83] Ibid., 110.

[84] Ibid., 115.

Chapter 3:

The Anarchy of Expertise and the Rise of a Neoconservative Urbanism, 1969-1974

The publication of *Urban Dynamics* in 1969 generated a controversy. In the 1960s there were numerous attempts to increase the effectiveness of the social policies aimed at urban America, yet there were hardly any works of urbanism that proceeded from the opposite perspective. Forrester's contribution to the debate on the urban crisis investigated the social policies of the Great Society from the perspective of why they had been so ineffective. This was due, he argued, to the fact that such strategies are systematically restricted by the cognitive capacity of the designers of social policy. He also argued that such efforts led to an excess of systemic planning failures. *Urban Dynamics* represented a profound skepticism in the capacity of society to influence itself and its future development by liberal democratic means of planning, intervention, and control. These ideas by themselves might have generated a controversy, but they were not why *Urban Dynamics* became the subject of a scandal.

The reason *Urban Dynamics* was so controversial was because of its implicitly undemocratic premise that only experts should have the power to make decisions about the future of the city. Forrester recommended that not just any kind of expert should have this power, however, but only the kind of expert who knew how to utilize his highly idiosyncratic program of research. To many, this was a ridiculous suggestion.[85] To others,

[85] Harvey A. Garn and Robert H. Wilson, "A Look at Urban Dynamics: The Forrester Model and Public Policy," review of *Urban Dynamics*, by Jay W. Forrester, *IEEE Transactions on Systems, Man and Cybernetics* 2 (April 1972): 150-55; Gregory K. Ingram, review of *Urban Dynamics*, by Jay W. Forrester, *Journal of the American Institute of Planners* 36 (May 1970): 206-208.

it was a frightening one.[86] It was this claim that instigated an overwhelming number of negative reviews of *Urban Dynamics*.[87] In *Systems Analysis in Public Policy: A Critique*, the political scientist Ida R. Hoos ridiculed *Urban Dynamics* for its pretentions to scientific rigor. "The procedures used by Forrester to compare alternative policies were," she argued, "contrary to the systematic and methodological pretensions of the exercise, intuitive, insofar as policy was being judged desirable or undesirable without any explanation as to the basis for such evaluations."[88] Reviewers were shocked by the absence of evidence supporting his controversial assumptions. Aaron Flesicher, Professor of Urban Planning at MIT, argued that *Urban Dynamics* "neither records nor cities one datum in support of the qualities of the interactions attributed to the components. Purveying no such evidence, it can lay no claim to history past or future."[89] He added that, "*Urban Dynamics* is, in its present state, entirely groundless."[90] In another review,

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[86] Martin T. Jaeckel, "Forrester's Urban Dynamics: A Sociologist's Inductive Critique," review of *Urban Dynamics*, by Jay W. Forrester, *IEEE Transactions on Systems, Man and Cybernetics* 2 (April 1972): 200-216.

[87] For a sample of these reviews, see Park Dixon Goist, review of *Urban Dynamics,* by Jay W. Forrester, *Technology and Culture* 11 (January 1970): 109-111; Allan G. Feldt, review of *Urban Dynamics,* by Jay W. Forrester, *American Sociological Review* 35 (April 1970): 364-365; Eugene E. Kaczka, review of *Urban Dynamics,* by Jay W. Forrester, *Administrative Science Quarterly* 15 (June 1970): 262-264; Edgar S. Dunn, Jr., review of *Urban Dynamics,* by Jay W. Forrester, *Urban Studies* 7 (June 1970): 215-217; Bruce E. Newling, review of *Urban Dynamics,* by Jay W. Forrester, *Geographical Review* 60 (July 1970): 455-457; Herbert Weinblatt, "*Urban Dynamics*: A Critical Examination," review of *Urban Dynamics*, by Jay W. Forrester, *Policy Sciences* 1 (Autumn 1970): 377-383; Harold T. Moody, "Urban Dynamics: A Review of Forrester's Model of an Urban Area," review of *Urban Dynamics*, by Jay W. Forrester, *Economic Geography* 46 (October 1970): 620-626; Brian J. L. Berry, review of *Urban Dynamics*, by Jay W. Forrester, *The Journal of Business* 43 (October 1970): 487-489; R. T. M. Whipple, review of *Urban Dynamics*, by Jay W. Forrester, *Australian Geographer* 11 (March 1971): 539-540; Philip Bartow and Thomas A. Reiner, review of *Urban Dynamics*, by Jay W. Forrester, *Economic Geography* 49 (July 1973): 275-280; Jerome Rothenberg, "Problems in the Modeling of Urban Development," review of *Urban Dynamics*, by Jay W. Forrester, *Journal of Urban Economics* 1 (1974): 1-20.

[88] Ida R. Hoos, *Systems Analysis in Public Policy: A Critique* (Berkley: University of California Press, 1972), 236.

[89] Aaron Fleischer, review of *Urban Dynamics,* by Jay W. Forrester, *Journal of the American Institute of Planners* 37 (1971): 54.

[90] Ibid.

Forrester was ironically compared to Howard Scott, one of the founders of the Technocracy movement in the 1930s.[91] In a less hostile review, it was noted that his research recalled "an early scientific treatise on chemistry or physics," such as Robert Boyle's inquiry into the properties of gases in the late seventeenth century.[92] For another, it carried "the ordinary systems analytic hunger for the general to a point of virtually Baroque splendor."[93]

Opposition to *Urban Dynamics* arose even within the USL, where Forrester's ideas met fierce resistance. In a report entitled "Systems Models of Urban Development," James Hester, Jr. set out to study "the role of formal analytic models of urban growth in understanding the processes of urban growth, stagnation and decay in an environment of rapid technological change in production, transportation and communication."[94] Hester argued that the results of his own research "invalidate the specific policy conclusions reached by Forrester."[95] Not everyone criticized *Urban Dynamics*, however. Forrester's stress on the inability of any individual to really understand urban phenomenon with any certainty because of its complexity proved to be of interest to those who sought to refute the legitimacy of the social policies of the Great Society.[96] The refutation of the Great Society was based on a series of social scientific analyses alleging to demonstrate the failures of its social policy, such as Forrester's. The exaggerated expectations of the

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[91] Harvey Simmons, "Systems Dynamics and Technocracy," review of *Urban Dynamics,* by Jay W. Forrester, *Futures 5* (April, 1973): 212-228.

[92] Alexander H. Christake, review of *Urban Dynamics,* by Jay W. Forrester, *Technological Forecasting* 1 (Spring, 1970): 427-432.

[93] David Berlinski, "Systems Analysis," review of Urban Dynamics, by Jay W. Forrester, *Urban Affairs Quarterly* 7 (September 1970): 117.

[94] James Hester, Jr., *Systems Models of Urban Development* (Cambridge: MIT Press, 1969), 3.

[95] Ibid., 5.

[96] Carol A. Horton, *Race and the Making of American Liberalism* (Oxford: Oxford University Press, 2005), 191-222.

Great Society led to exaggerated assertions of its failure.[97] In these quarters, *Urban Dynamics* was celebrated.

Neoconservative Urbanism

"I have been reading *Urban Dynamics* with the utmost interest," Daniel P. Moynihan remarked to Forrester in a letter dated February 14, 1969.[98] "You really have done something exceedingly important," he wrote, and added that, "I wonder if there would be any chance of your coming down to talk with our staff on your findings and what the Federal government might do in response."[99] After Moynihan read *Urban Dynamics*, he circulated it throughout the Nixon White House. Moynihan, the former director of the Joint Center for Urban Studies at MIT and Harvard, was at the time President Richard M. Nixon's Special Assistant for Urban Affairs and the chair of the Urban Affairs Council (UAC). Nixon's first act as President of the United States was the establishment of the UAC on January 23, 1969, which was supposed to be the domestic policy equivalent of the National Security Council in foreign affairs. At the helm of the UAC, Moynihan helped the Nixon administration pursue a policy of repressing, infiltrating, and disrupting militant political organizations that Nixon believed to be personally responsible for the urban crisis, as if it had been the work of an organized political conspiracy, an idea that

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[97] Albert O. Hirschman, *The Rhetoric of Reaction: Perversity, Futility, Jeopardy* (Cambridge: Harvard University Press, 1991), 33.

[98] "Letter from Daniel P. Moynihan to Jay W. Forrester, February 14, 1969," Moynihan – Washington, Mar. 20, 1969, Jay W. Forrester Papers, MC-439, Box 17, Massachusetts Institute of Technology, Institute Archives and Special Collections, Cambridge, Massachusetts.

[99] Ibid.

had been discredited by the Kerner Commission's report of 1968.[100] In a speech given on October 22, 1969 at the symposium, "The Engineer and the City," sponsored by the National Academy of Engineering, Moynihan referred to the significance of Forrester's research as follows: "Cities are complex social systems...Most federal urban problems have assumed fairly simple cause-and-effect relationships that do not exist in the complex real world. Moreover, they have typically been based on "common sense" rather than research in an area where common sense can be notoriously misleading."[101] It appears that what interested Moynihan was not how Forrester reached his conclusions, but the conclusions themselves. The Nixon administration was desperately looking for ways to undermine the legitimacy of the Great Society. Perhaps Moynihan was also attached to Forrester's research because of the controversy that it caused. Moynihan was not a stranger to controversy.

He had raised a considerable stir himself in 1965 when, while serving as assistant secretary of labor in the Kennedy administration, he produced a report concluding that African American families were trapped in a "tangle of pathology."[102] Two years later, he published a scathing critique of the Community Action Program, an important component of the War on Poverty.[103] Like Forrester, Moynihan came to believe that government social programs were incapable of revitalizing the city, and eagerly joined the Nixon

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[100] Michael W. Flamm, *Law and Order: Street Crime, Civil Unrest, and The Crisis of Liberalism in the 1960s* (New York: Columbia University Press, 2005), 15-36.

[101] Daniel Patrick Moynihan, "Toward a National Urban Policy," in *The Engineer and the City* (Washington: National Academy of Engineering, 1969), 12.

[102] Daniel Patrick Moynihan, *The Negro Family: The Case for National Action*, reprinted in Lee Rainwater and William L. Yancey, *The Moynihan Report and the Politics of Controversy* (Cambridge: MIT Press, 1967).

[103] Daniel Patrick Moynihan, *Maximum Feasible Misunderstanding: Community Action in the War on Poverty* (New York: Free Press, 1969).

administration when he was offered a position.[104] Forrester and Moynihan clearly sympathized with the direction of the new administration. Citing the continued deterioration and violence in American cities, Nixon argued in 1969 that "a third of a century of social experimentation has left us a legacy of entrenched programs that have outlived their time or outgrown their purposes."[105]

The Pathology of Urban America

In the late 1960s and early 1970s, Moynihan was part of a group of former liberal intellectuals who played an unduly large role in redefining the discourse of the urban crisis. Urban America came to symbolize all that was wrong, not only with the Great Society, but also more broadly with New Deal liberalism itself. They argued that the expansion of the welfare state from the 1930s to the 1960s generated social conflict by fostering too much democratic participation. In this sense, they argued, social conflict erupted because the expansion of the social welfare state led sectors of the population to make demands on the state and to expect more than the state could provide.

Therefore, to limit social conflict, they called for cutting back social programs. In particular, they came to argue for what the sociologist Nathan Glazer, influenced by Forrester, called the "limits of social policy." This idea implied that no matter how the state tried to tackle the social problems of urban America, there was very little such state

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[104] On Moynihan, see Godfrey Hodgson, *The Gentleman from New York: Daniel Patrick Moynihan: A Biography* (Boston: Houghton Mifflin, 2000).

[105] Richard M. Nixon, "Address to the Nation on Domestic Programs, August 8, 1969," *Public Papers of the Presidents, Richard Nixon, 1969, Vol. 1* (Washington: United States Government Printing Office, 1969), 637-638.

interventions could do to address the problems of inequality in American society.[106] Like Forrester, Edward C. Banfield in *The Unheavenly City* explained that "urban decay" was merely part of an evolutionary process that he referred to as "the logic of metropolitan growth."[107] In short, Banfield's *The Unheavenly City*, like Forrester's *Urban Dynamics*, provided the justification for the abandonment of urban America to the forces of the market.[108] The social policy implications of their interpretation of the urban crisis were clear: comprehensive social policies were to be systematically disempowered and dismantled at the local, state, and national scale.

The Social Policy of Urban Decay

Despite plenty of evidence to the contrary, on March 4, 1973, President Nixon declared that the urban crisis was over. This was clearly a political strategy to remove the problems of urban America simultaneously from the sphere of the activity of the state and the sphere of debate. In relation to the recession that began this year, this decision only deepened the urban crisis. The emergence of the most severe economic recession since the Great Depression catalyzed a further retrenchment of the state from urban America. It was widely acknowledged that the long period of economic expansion that the United States had enjoyed in the aftermath of World War II, due in no small part to the processes of suburbanization, was beginning to come to a halt. These economic difficulties

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[106] Nathan Glazer, "The Limits of Social Policy," *Commentary* 53 (September 1971): 51-58.

[107] Banfield, Edward C. *The Unheavenly City* (Boston: Little Brown, 1970).

[108] Harvey Averch and Robert A. Levine, "Two Models of the Urban Crisis: An Analytical Essay on Banfield and Forrester," *Policy Sciences* 2 (June, 1971): 143-158; Allan Schick, "Five Theories in Search of an Urban Crisis," *Public Administration Review* 32 (September 1972): 546-52.

strengthened the neoconservative agenda, and in the mid 1970s, they successfully remove the state from active involvement in the implementation of comprehensive social policy targeting cities, signaling the end of the effort to involve the state in the systematic social reorganization of urban America. The processes of the postwar period were intensified, and deindustrialization, disinvestment, and depopulation continued to erode urban America for the rest of the decade.

In 1974, the USL was closed for lack of funding. As the urban crisis left the stage of national political debate as the most critical issue of American society, money for the production of urban expertise also ran dry. In an article published in *The Tech* on May 17, 1974, Charles L. Miller was quoted as saying that in 1968, when the USL was founded, "there was the anticipation that urban problems would be approached on the basis of large scale, mission-oriented projects, as in the space program." "These large scale projects never came about because of funding limitations," he explained, because "HUD never became the research equivalent of the Defense Department."[109] This was a striking admission, for it indicated the degree to which the vision of the USL as laboratory for a new urban expertise was in fact dependent upon a larger vision of what the Great Society might have been. This was not the only reason that the search for expertise at the USL had come to an end, however. The idea that the development of expertise would be enough to solve the problems of urban America had become suspect even to those like Miller who had been committed to it. "There is room for the expert," Miller admitted, "but these are not the kinds of problems that will be solved by the experts."[110] Indeed, the attempt to domesticate urban problems by treating them as specialized, even technical,

[109] Greg Saltzman, "Urban Systems Lab: Social Work Since '68," *The Tech*, May 17, 1974, 3.

[110] Ibid.

phenomena to be handled by experts had been overwhelmed by the sheer scale of urban turmoil.

Appendix:

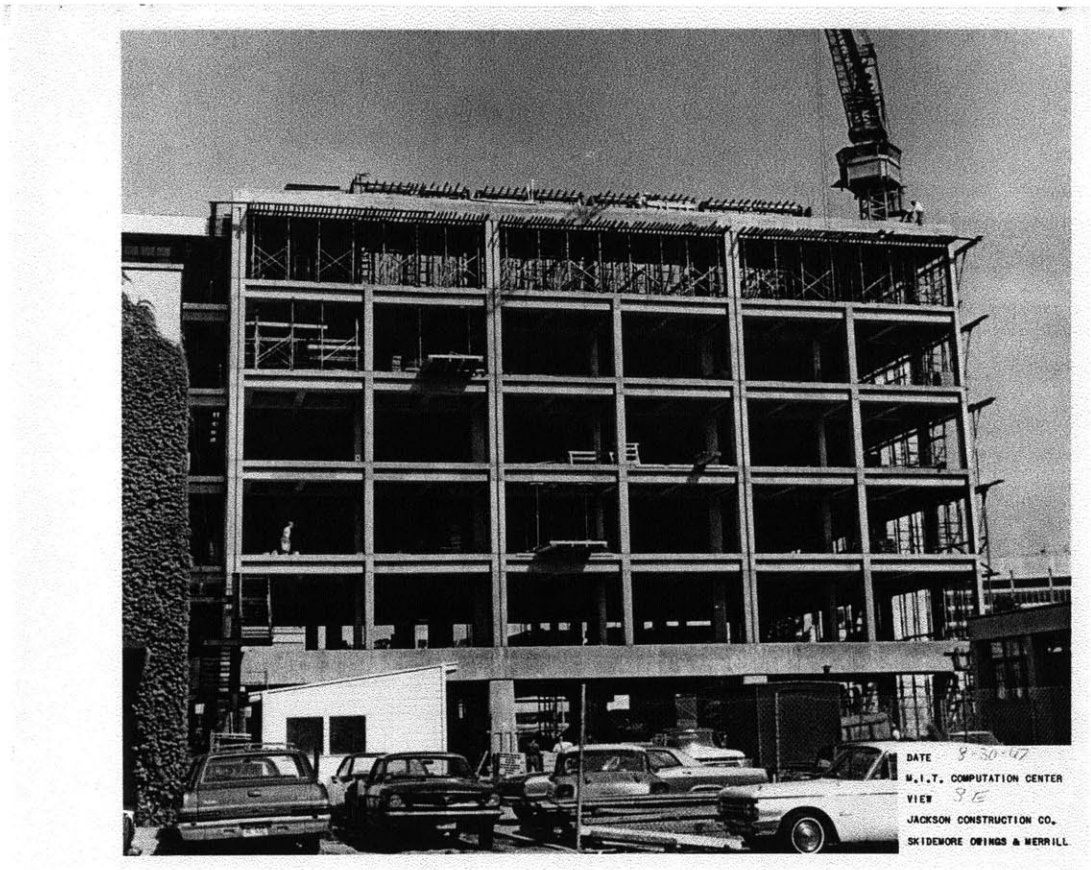

Figure 1: Building 39 under construction, location of MIT Computation Center and the Information Processing Services Center, 1967. Courtesy MIT Museum.

Figure 2: Building 39 under construction, location of MIT Computation Center and Information Processing Services Center, 1967. Courtesy MIT Museum.

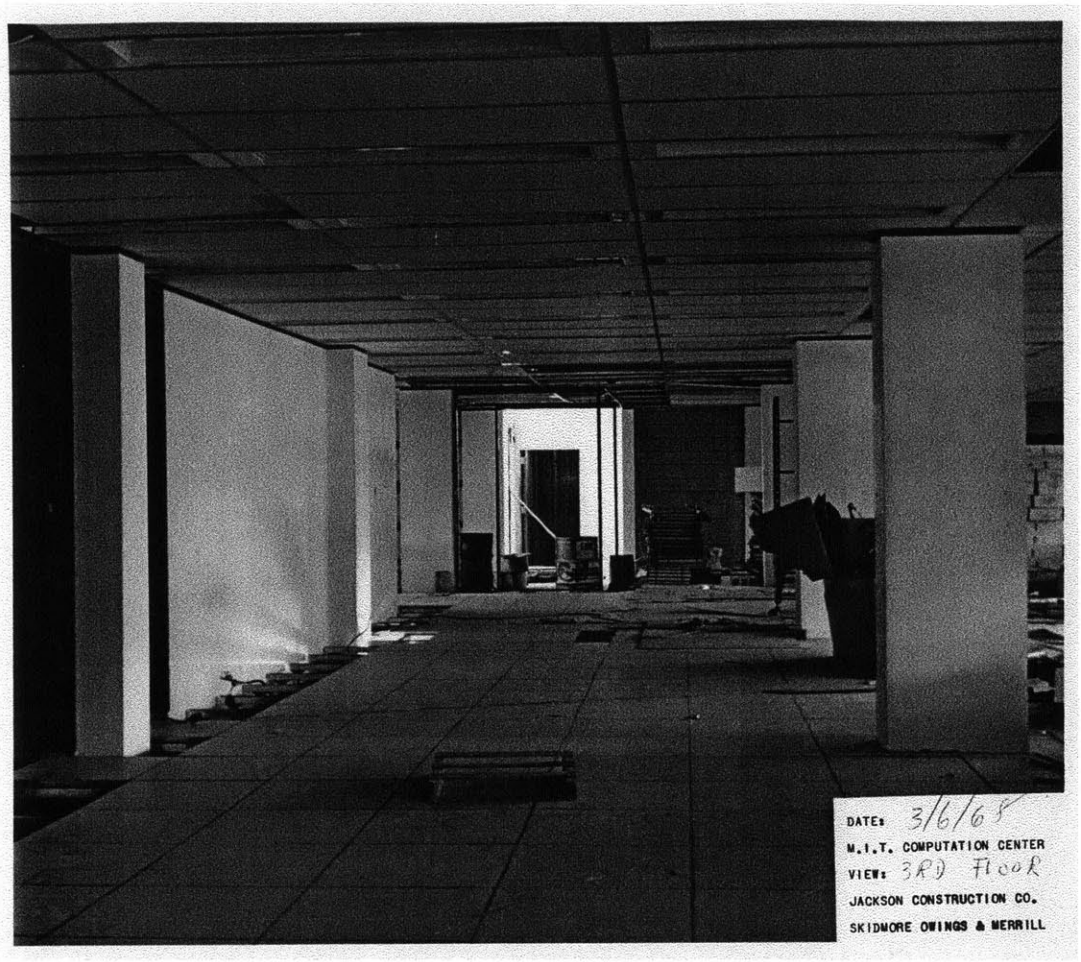

Figure 3: Building 39 under construction, location of MIT Computation Center and the Information Processing Services Center, 1967. Courtesy MIT Museum.

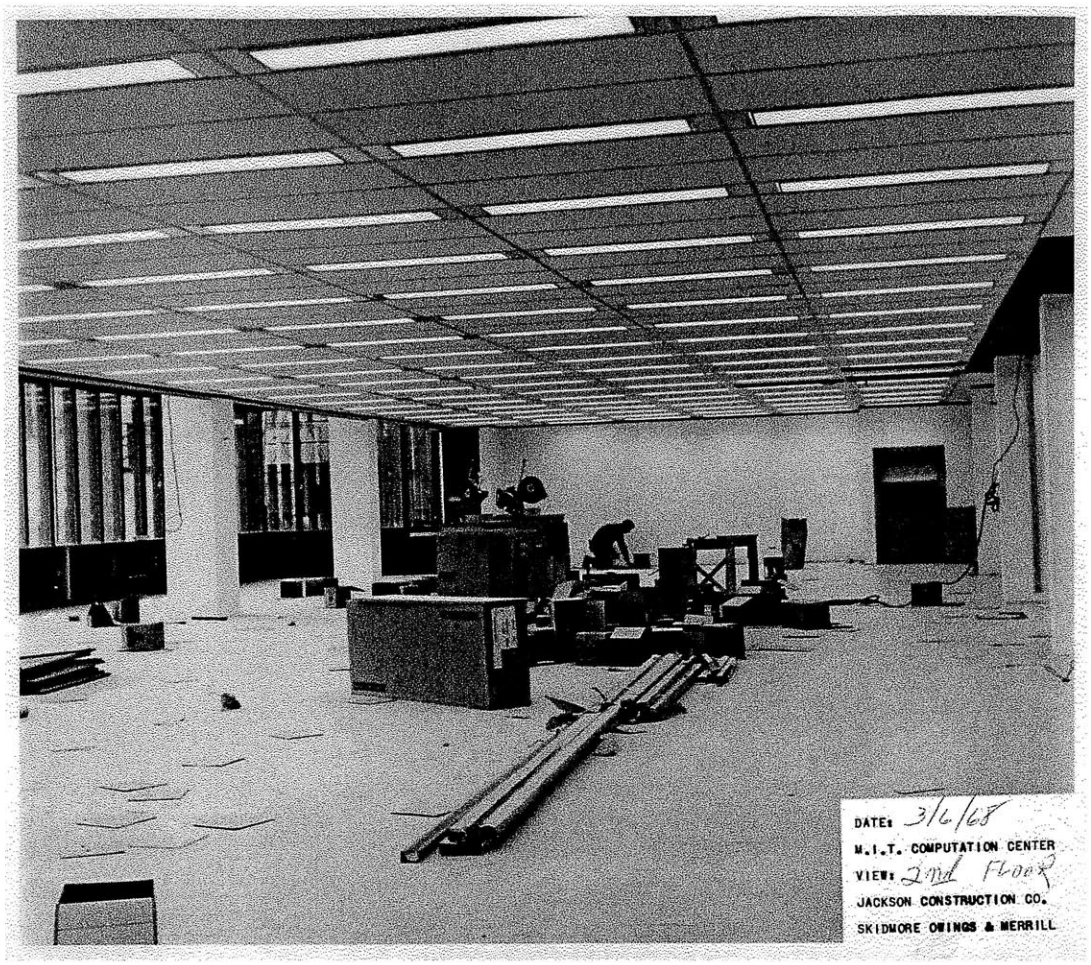

Figure 4: Building 39 under construction, location of MIT Computation Center and the Information Processing Services Center, 1968. Courtesy MIT Museum.

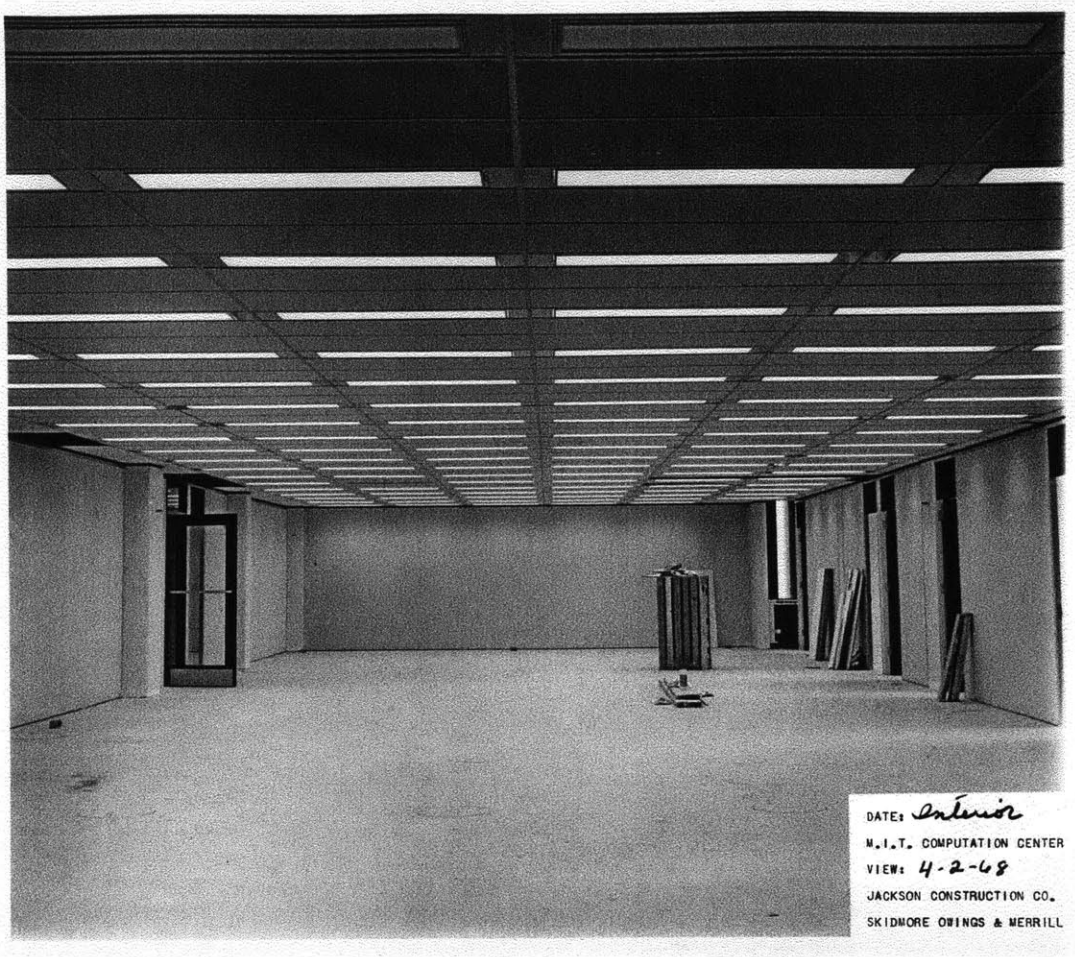

Figure 5: Building 39 under construction, location of MIT Computation Center and the Information Processing Services Center, 1968. Courtesy MIT Museum.

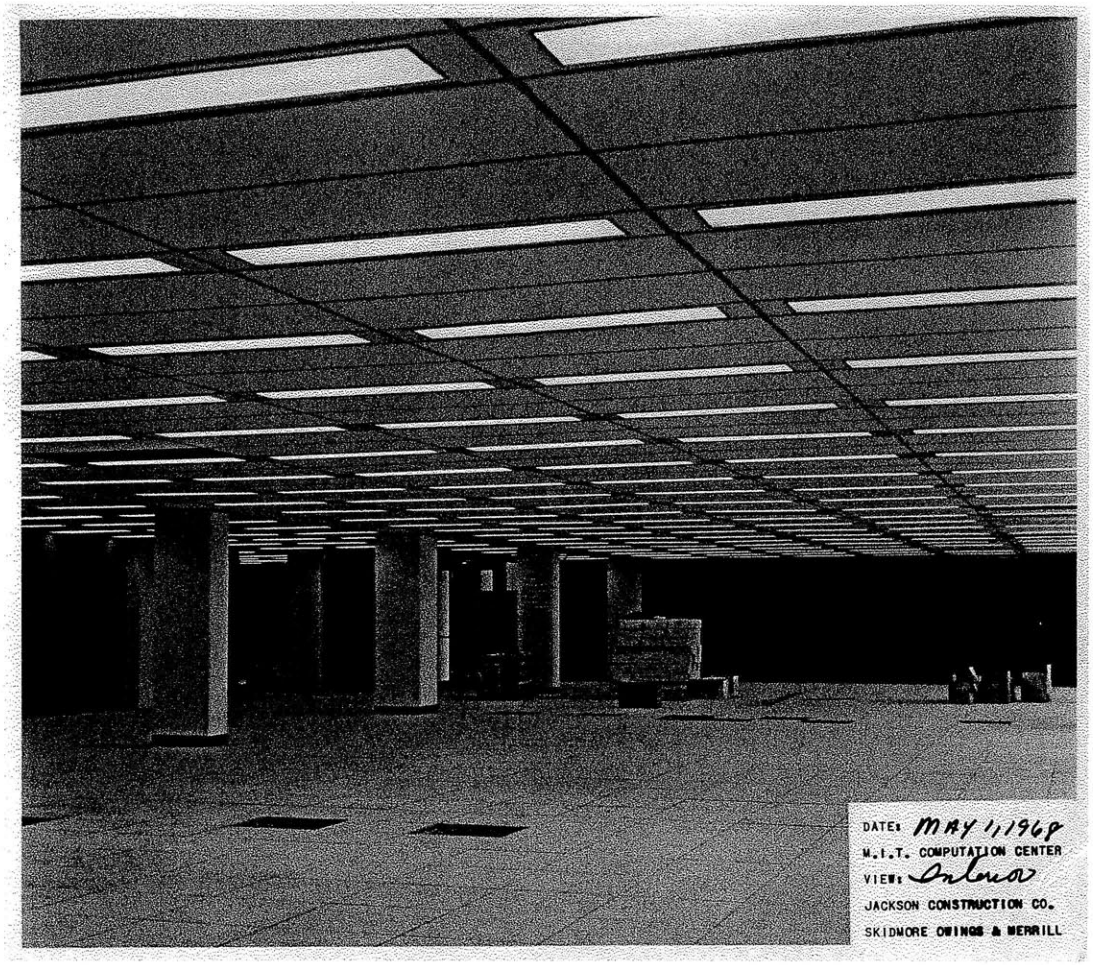

Figure 6: Building 39 under construction, location of MIT Computation Center and the Information Processing Services Center, 1968. Courtesy MIT Museum.

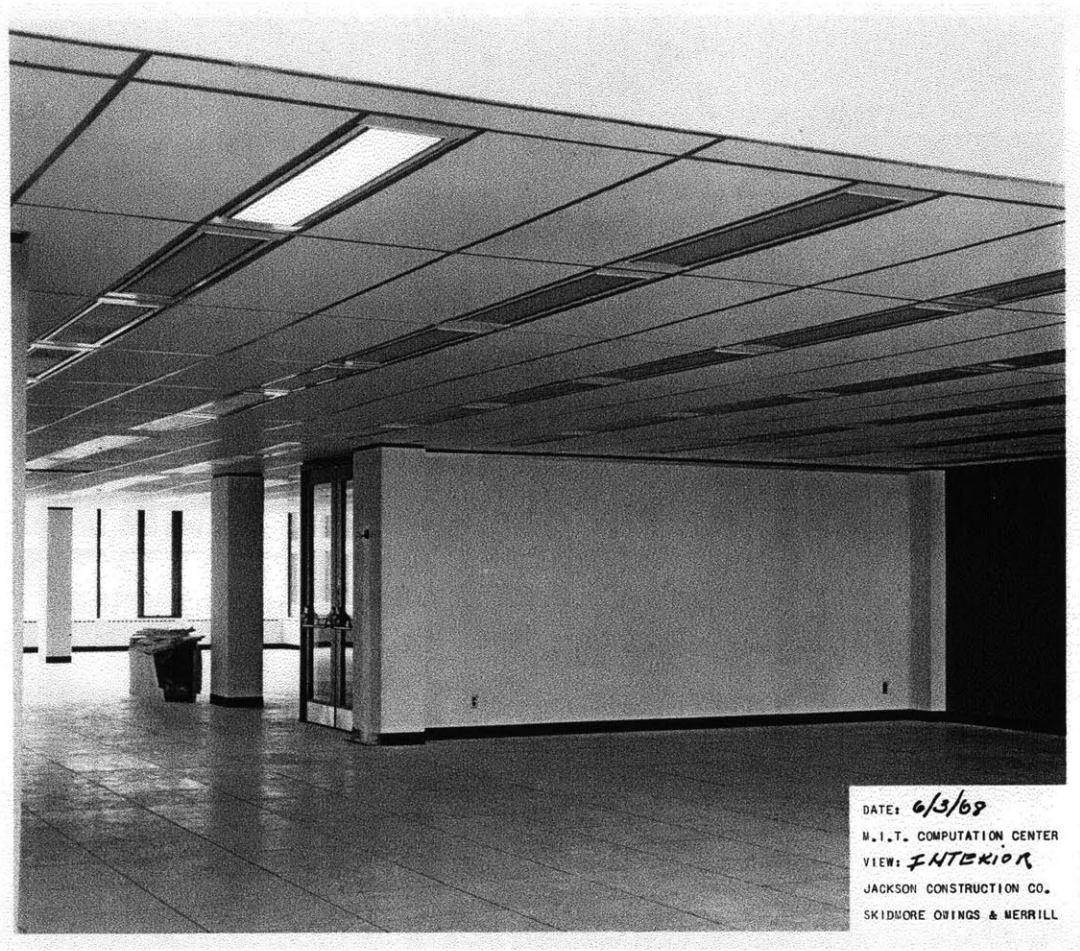

Figure 7: Building 39 under construction, location of MIT Computation Center and the Information Processing Services Center, 1968. Courtesy MIT Museum.

Figure 8: Building 39, location of MIT Computation Center and the Information Processing Services Center, 1968. Courtesy MIT Museum.

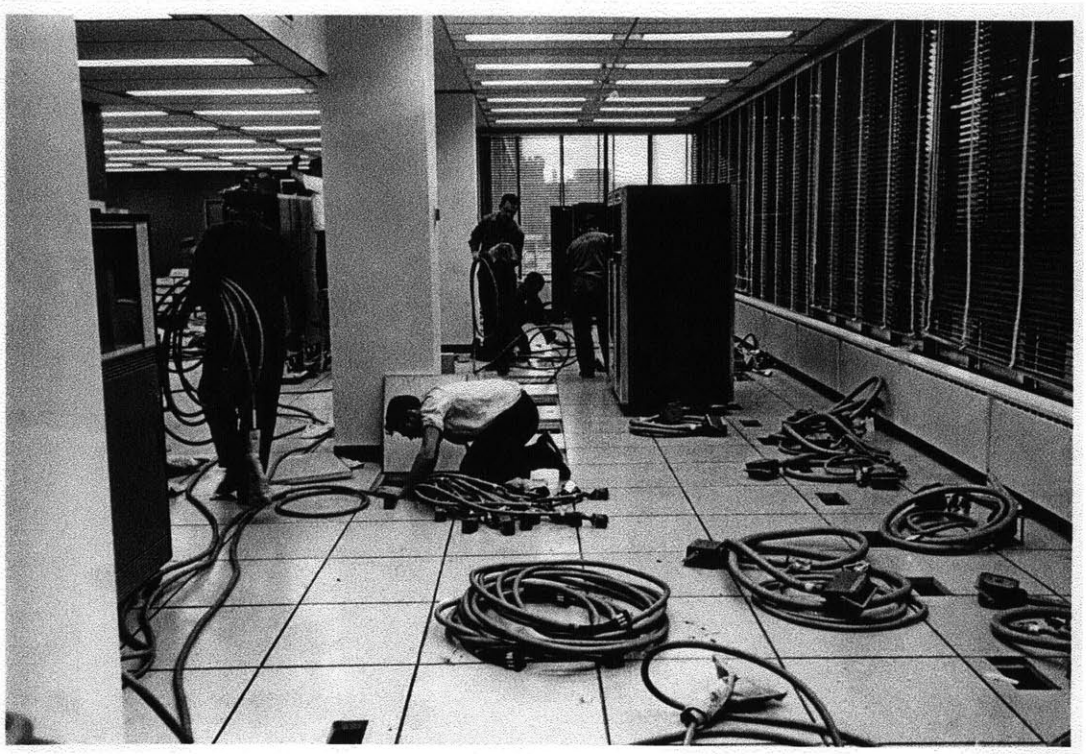

Figure 9: Installation of IBM 360/System, Model 67, MIT Information Processing Services Center, 1968. Courtesy MIT Museum.

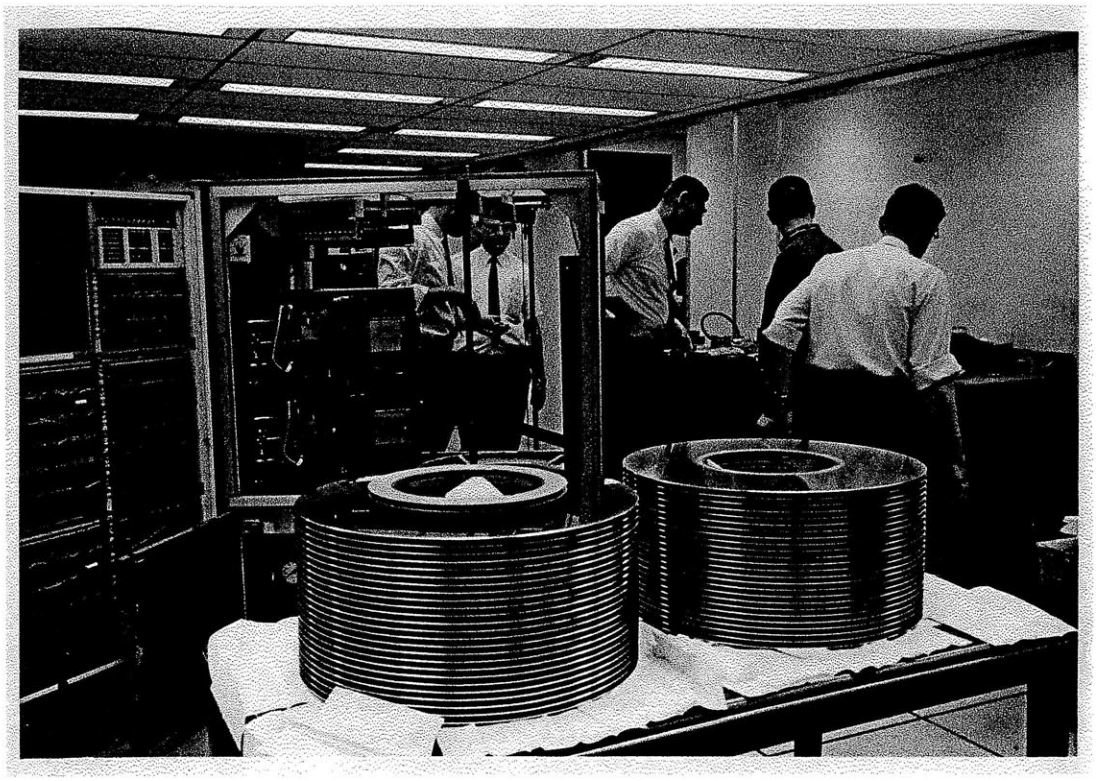

Figure 10: Installation of IBM 360/System, Model 67, MIT Information Processing Services Center, 1968. Courtesy MIT Museum.

Figure 11: IBM 360/System, Model 67, MIT Information Processing Services Center, 1968. Courtesy MIT Museum.

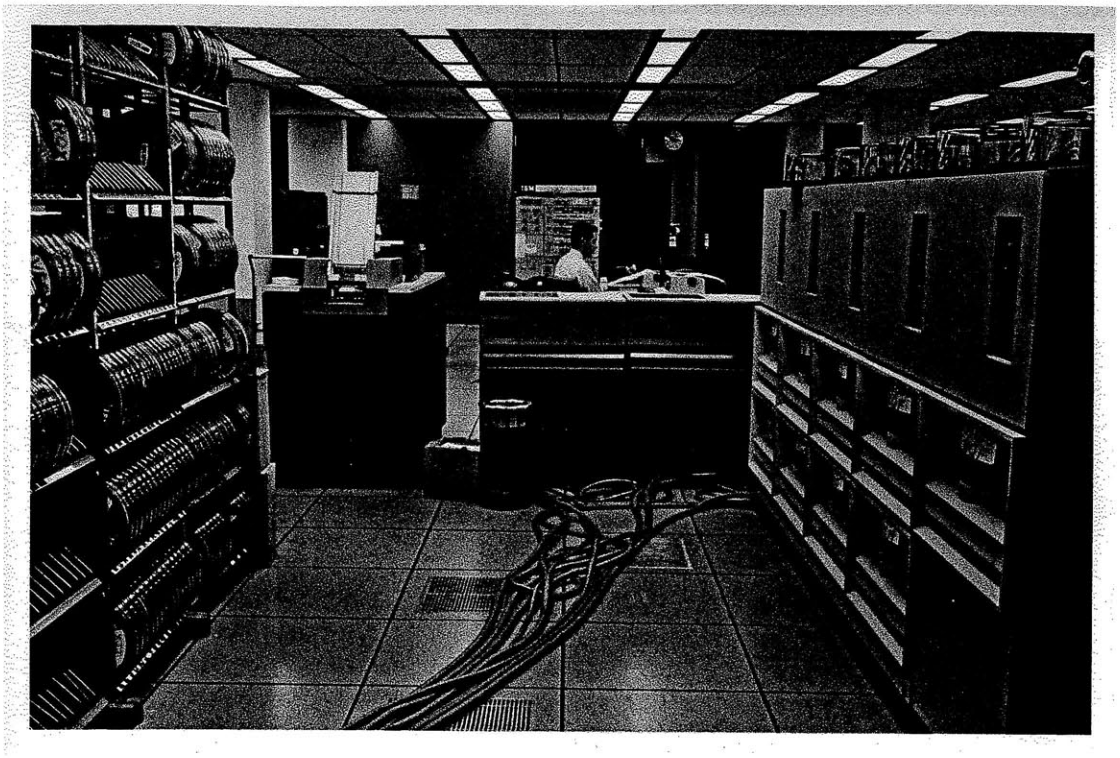

Figure 12: IBM 360/System, Model 67, MIT Information Processing Services Center, 1968. Courtesy MIT Museum.

Figure 13: IBM 360/System, Model 67, MIT Information Processing Services Center, 1968. Courtesy MIT Museum.

Figure 14: Jay W. Forrester, 1968. Courtesy MIT Museum.

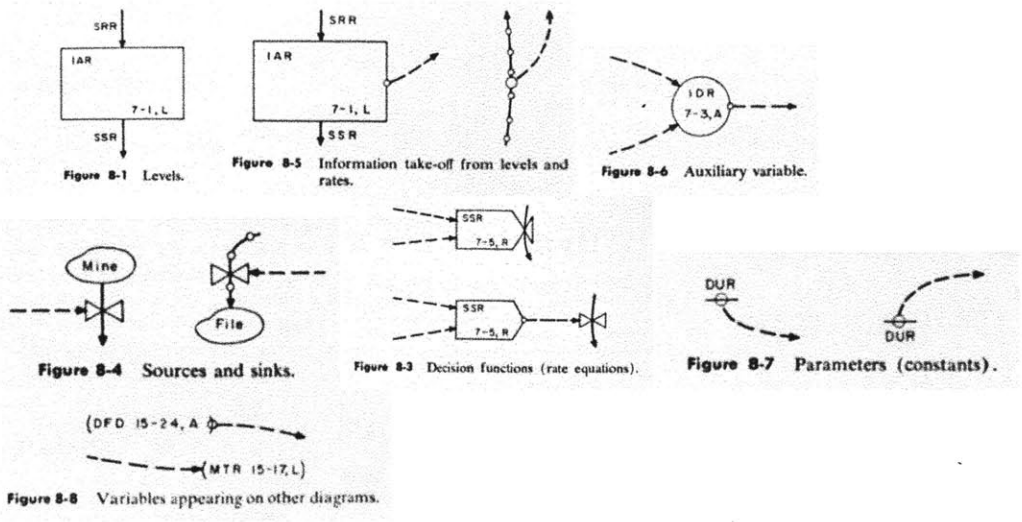

Figure 15: Diagrammatic elements generated from the computer program DYNAMO, from Jay W. Forrester, *Industrial Dynamics* (Cambridge: MIT Press, 1961), 7-11.

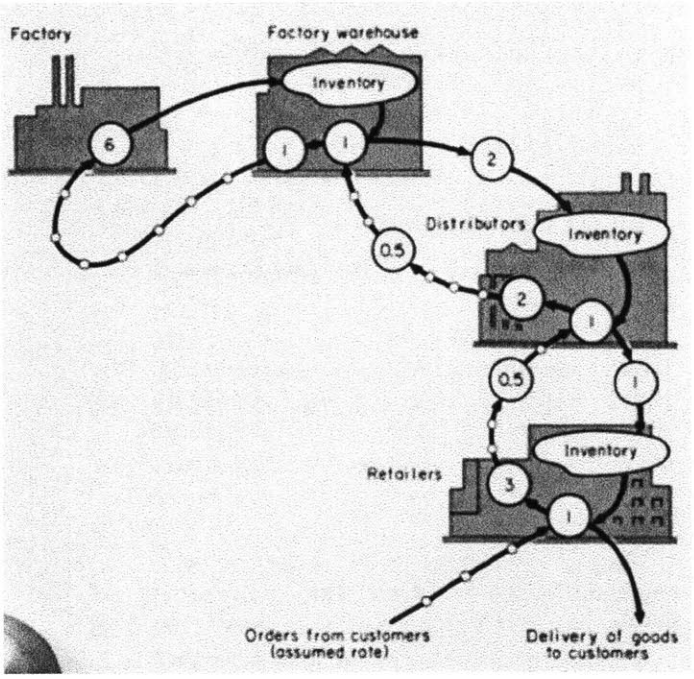

Figure 16: Diagram of "Organization of Production-Distribution System," from Jay W. Forrester, *Industrial Dynamics* (Cambridge: MIT Press, 1961), 22.

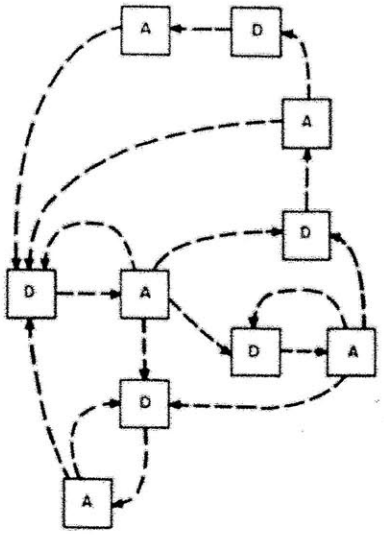

Figure 17: Diagram of "Multiloop Decision-Making System,"
from Jay W. Forrester, *Industrial Dynamics* (Cambridge: MIT Press, 1961), 24.

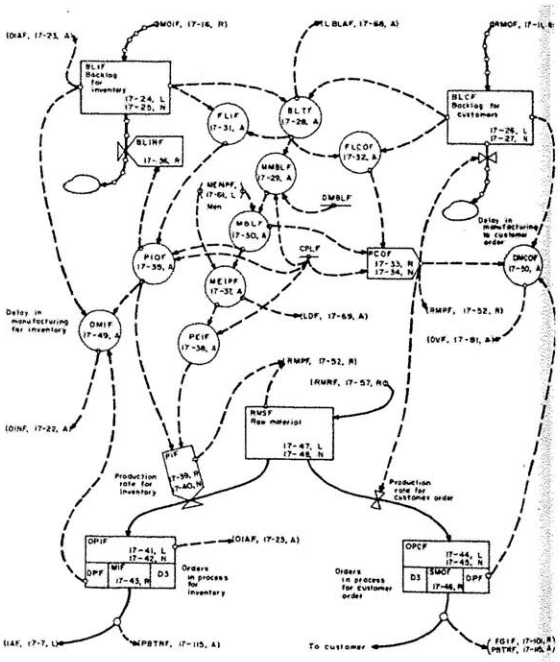

Figure 18: Diagram of "Corporate Decision-Making System,"
from Jay W. Forrester, *Industrial Dynamics* (Cambridge: MIT Press, 1961), 224.

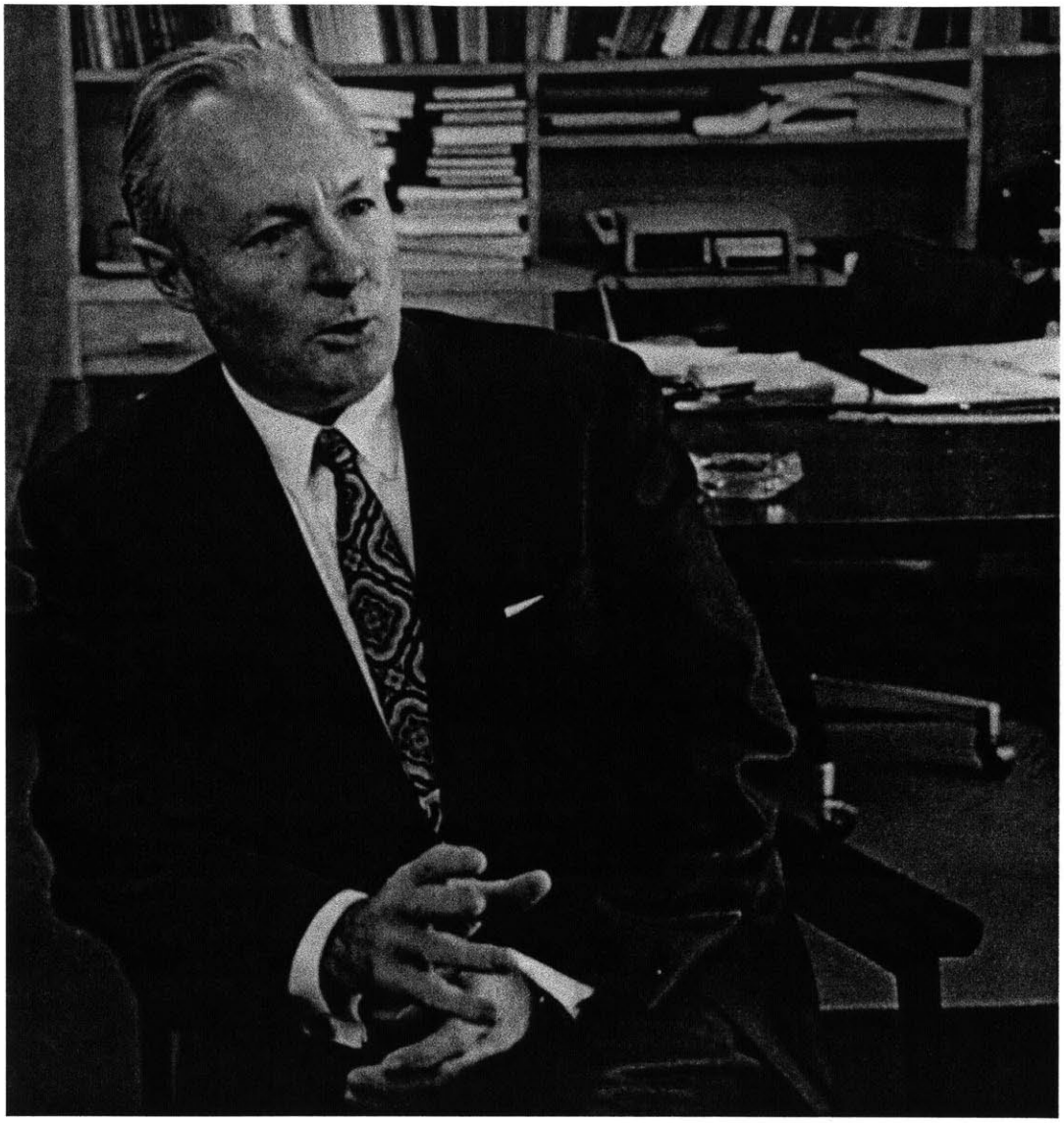

Figure 18: John F. Collins, 1968. Courtesy of MIT Museum.

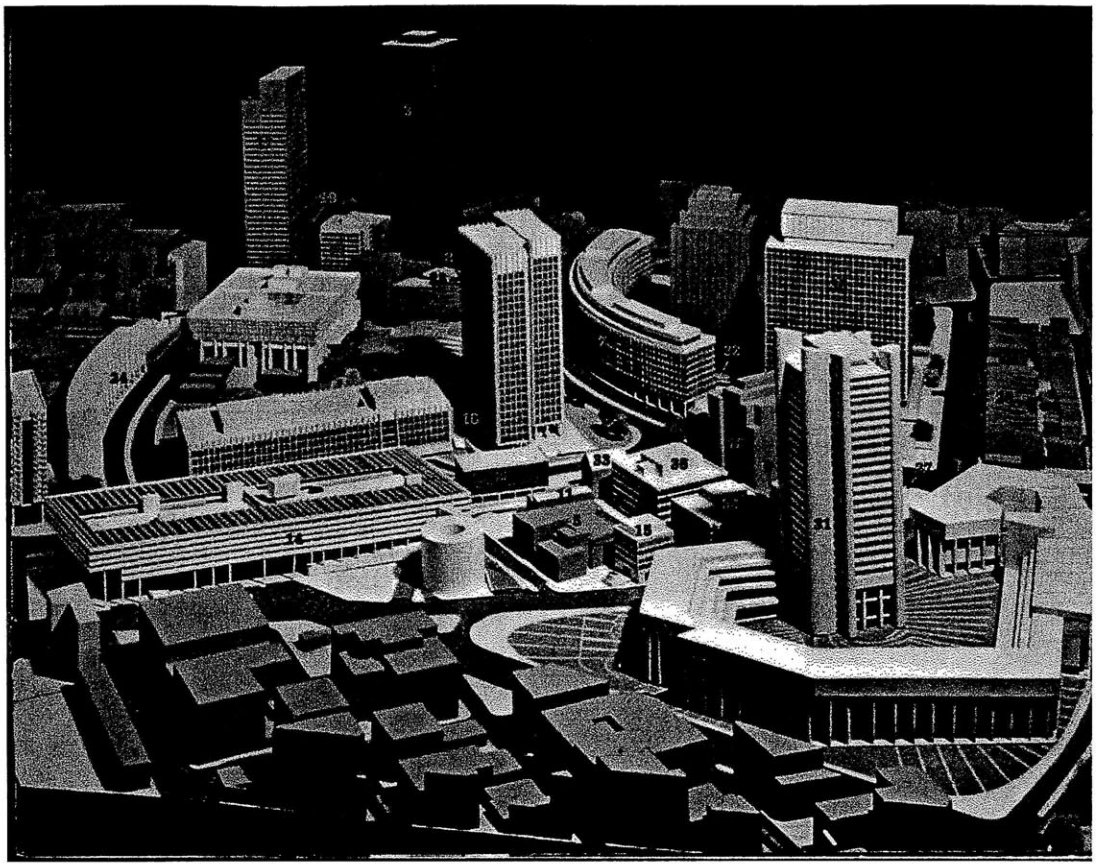

Figure 19: Model of the Government Center, Boston, 1968.

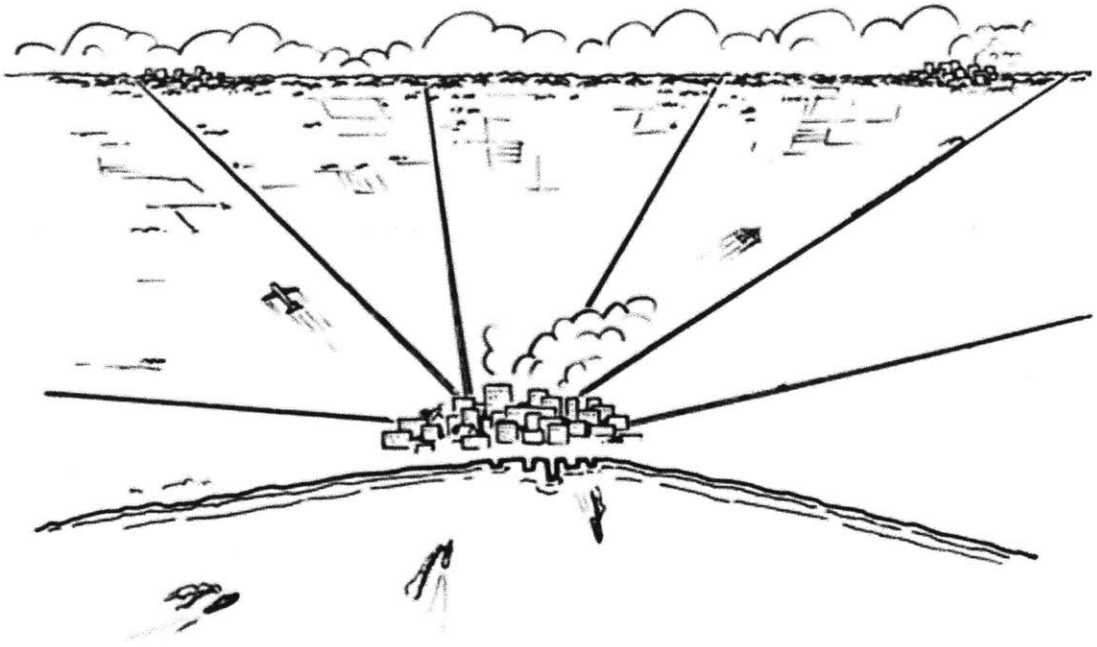

Figure 20: Diagram of the "urban area in limitless environment," from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 15.

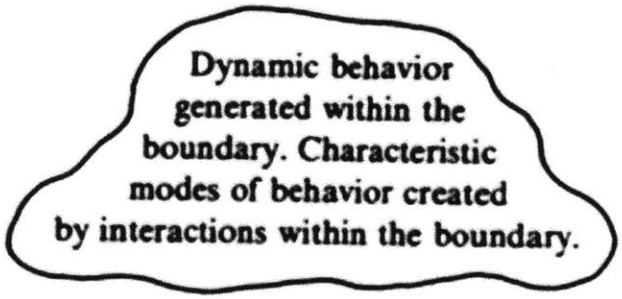

Figure 21: Diagram of the "closed social system" of the city, from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 15.

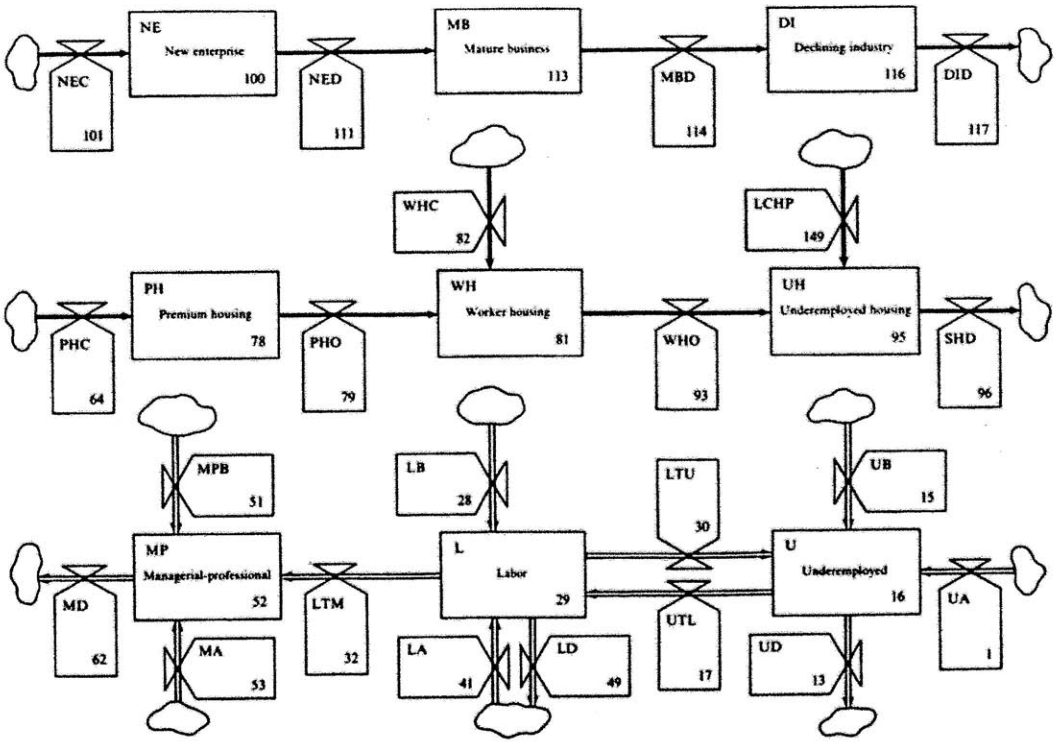

Figure 22: Diagram of the nine "state variables," from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 16.

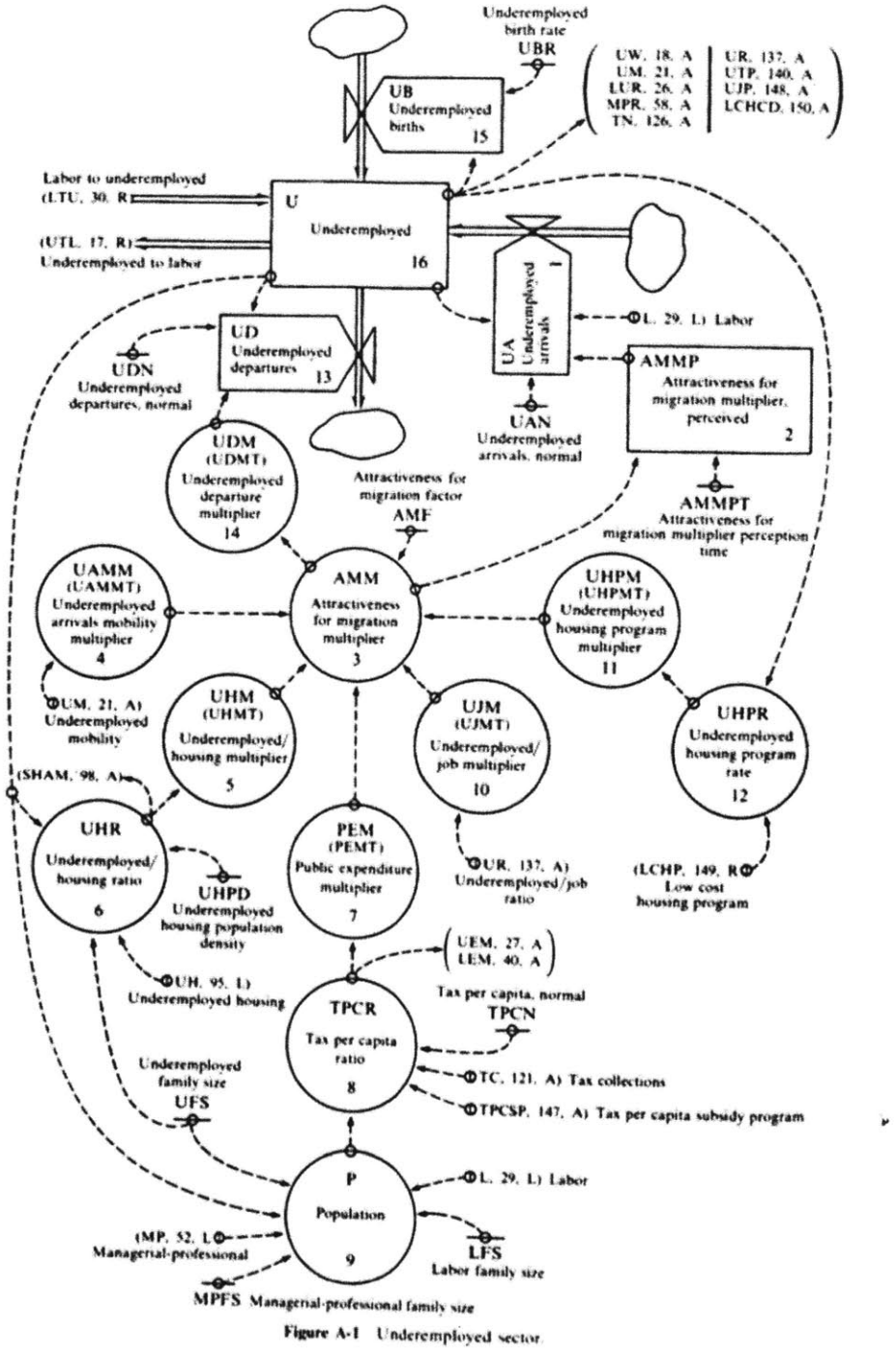

Figure A-1 Underemployed sector.

Figure 23: Diagram of the "Underemployed sector," from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 40.

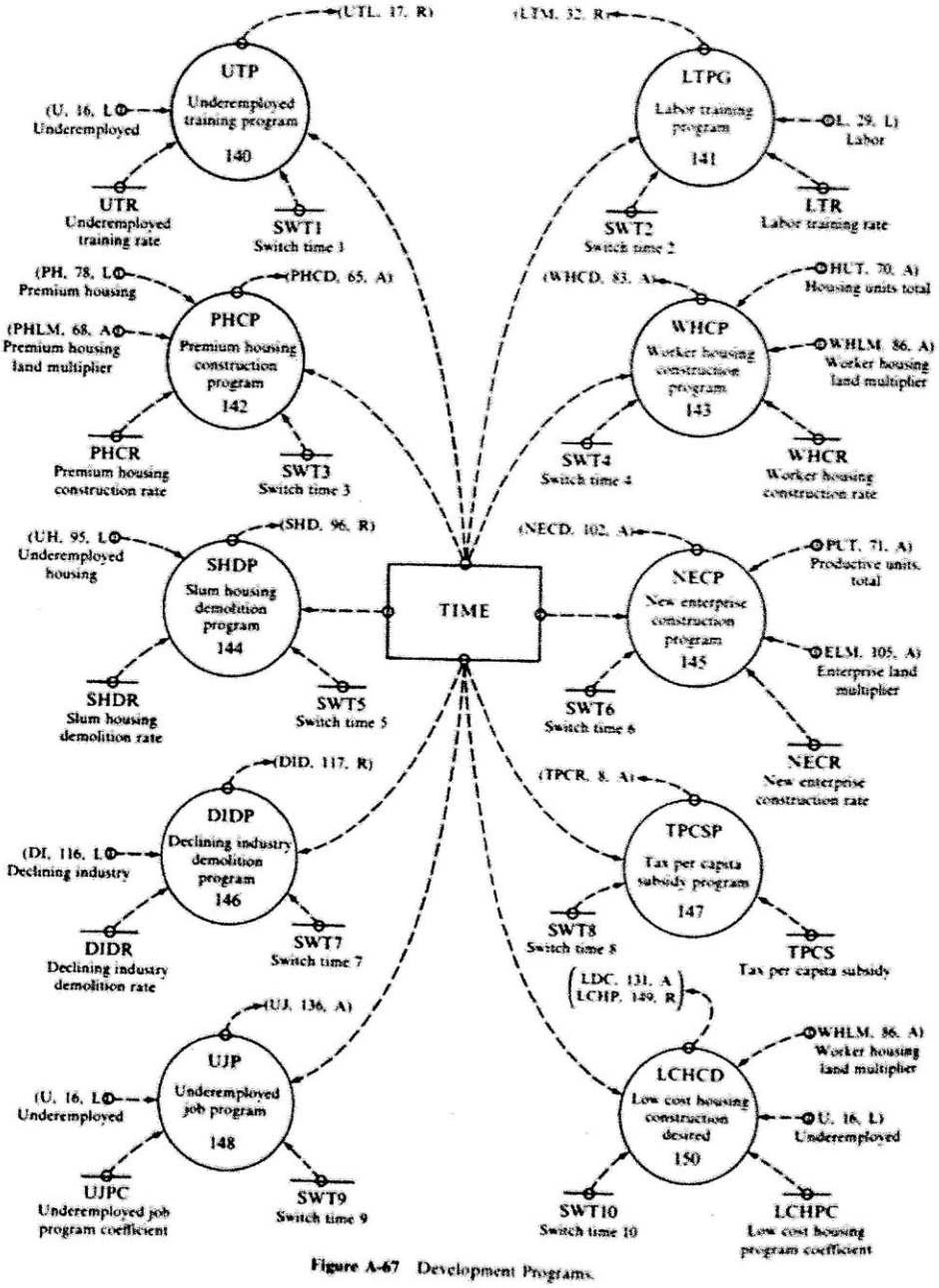

Figure A-67 Development Programs.

Figure 24: Diagram of "Development Programs," from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 212.

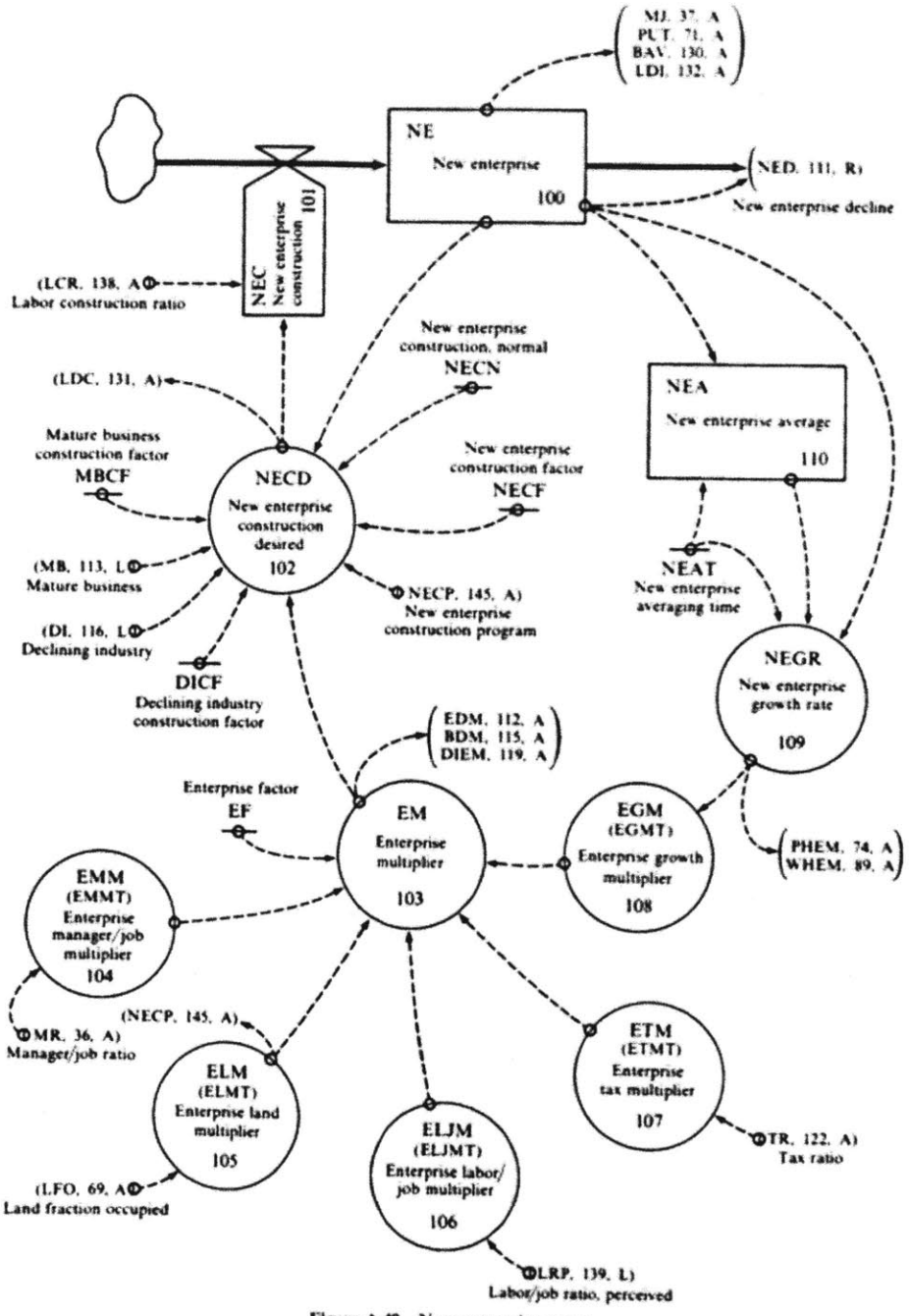

Figure A-49 New-enterprise sector.

Figure 25: Diagram of the "New-enterprise sector," from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 190.

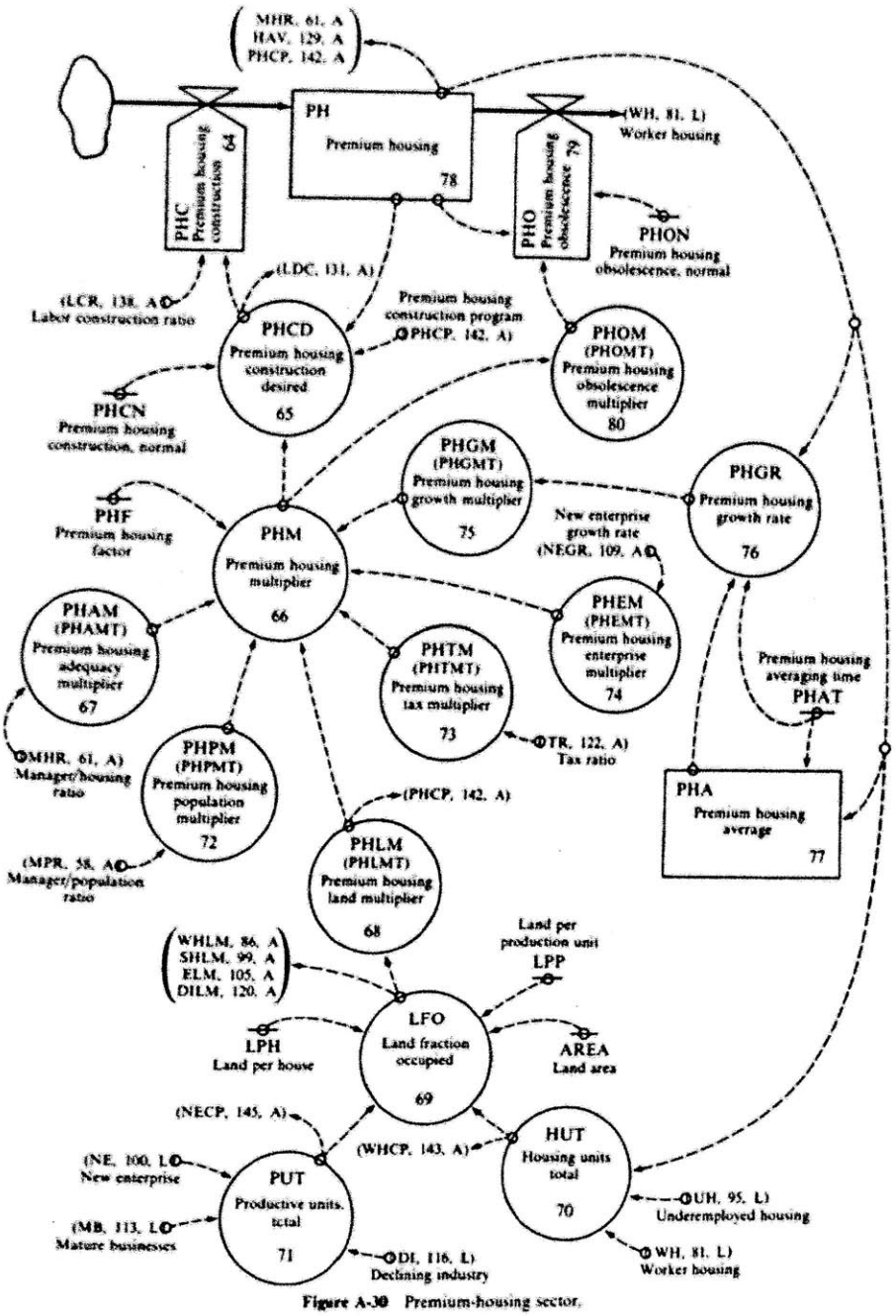

Figure A-30 Premium-housing sector.

Figure 26: Diagram of the "Premium-housing sector," from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 171.

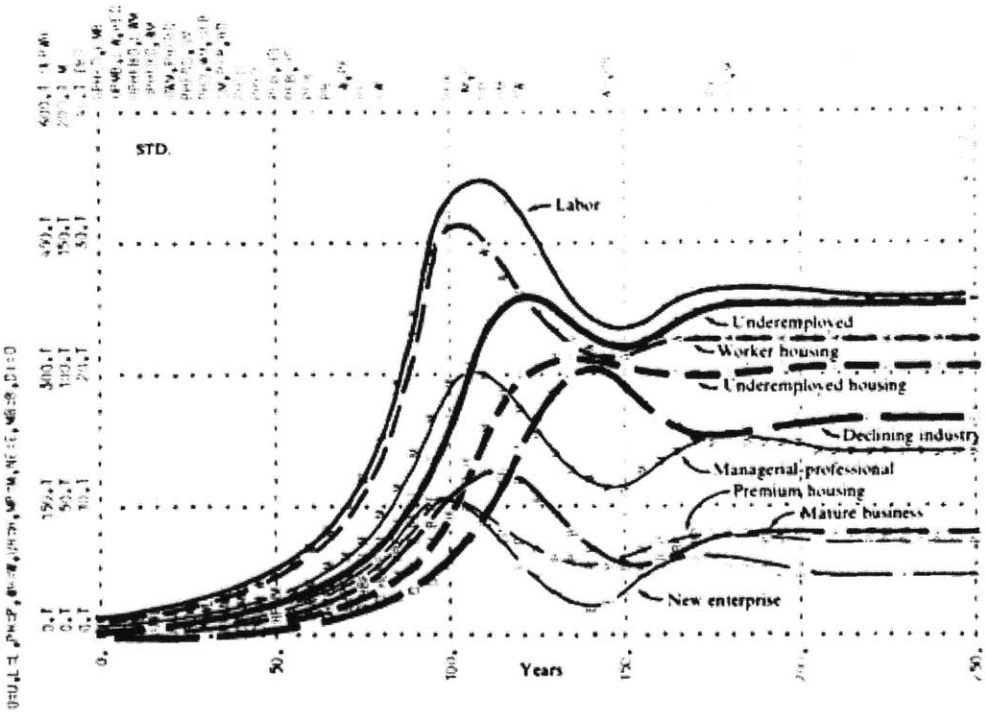

Figure 27: Plotted graph showing the behavior of the urban system over a 250 year period, from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 40.

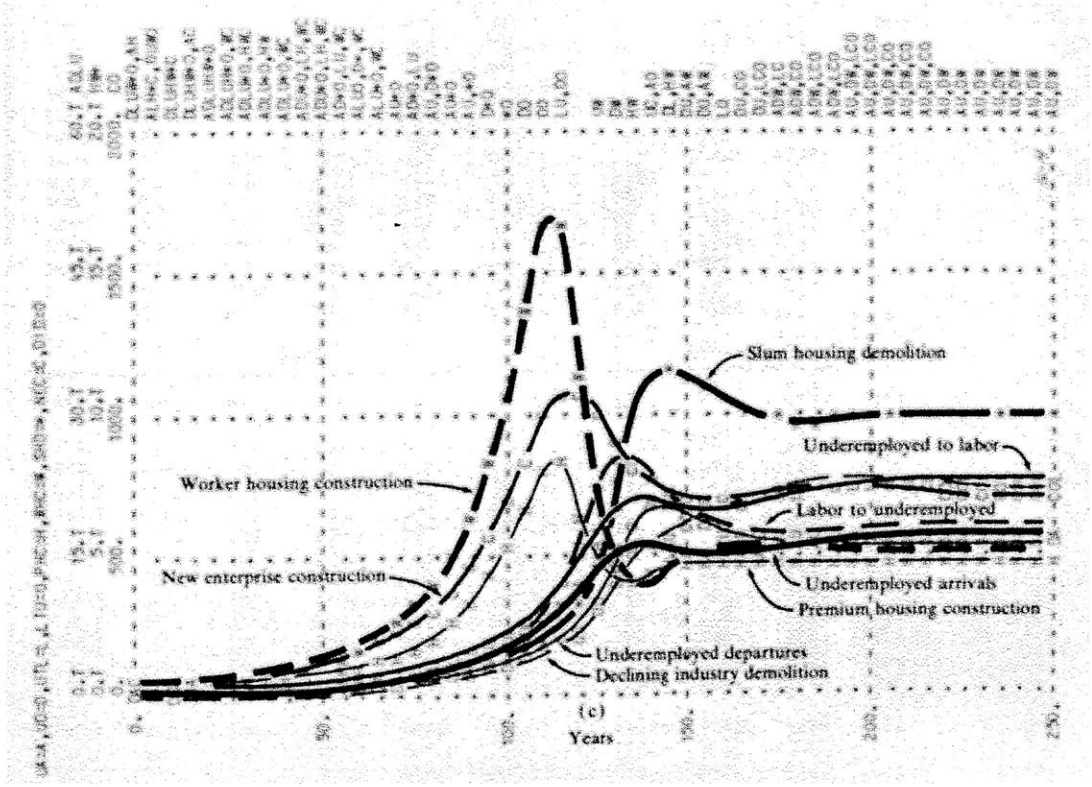

Figure 28: Plotted graph showing the behavior of the urban system over a 250 year period, from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 41.

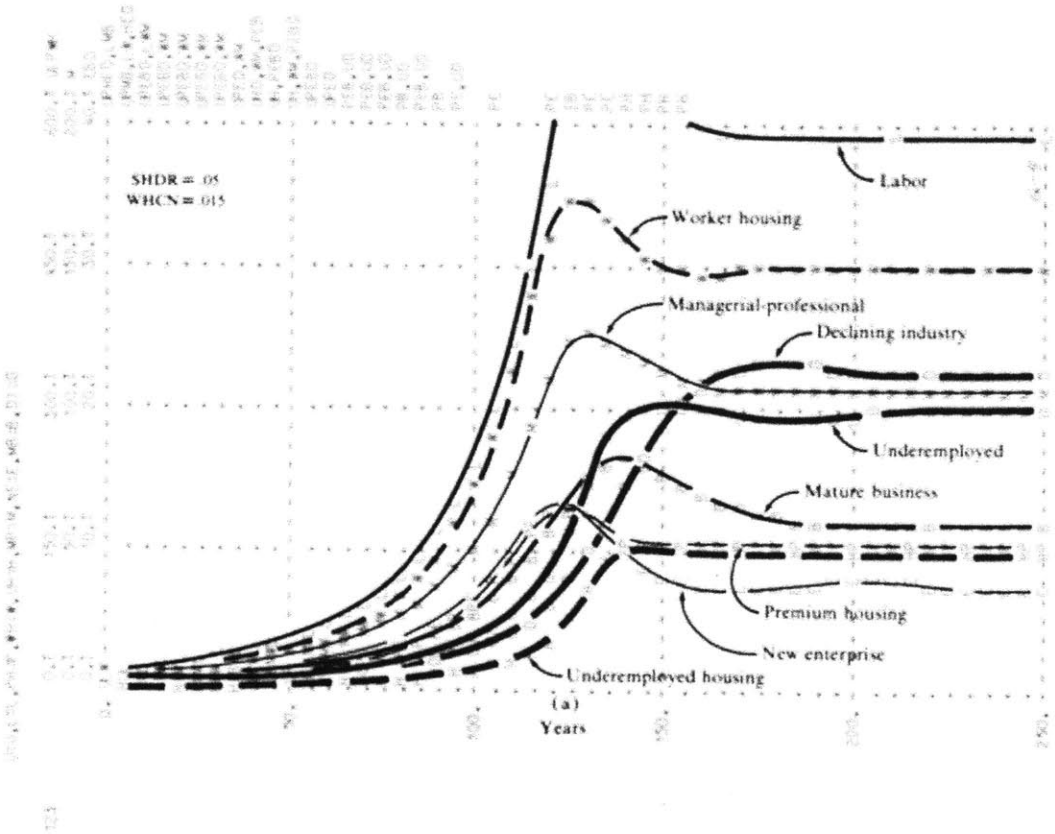

Figure 29: Plotted graph showing the behavior of the urban system over a 250 year period, from Jay W. Forrester, *Urban Dynamics* (Cambridge: MIT Press, 1969), 108.

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