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RESEARCH DESIGN FOR INSTITUTIONAL ANALYSIS
OF HUD'S SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

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ABSTRACT

This paper is one of a series prepared under the sponsorship of DOE's Photovoltaic (PV) Program as part of the institutional analysis of housing. After an introduction describing the theory and methods of institutional analysis, the paper is organized into three sections. ABSTRACT, the first section, presents the research design used for institutional analysis of HUD's Solar Heating and Cooling Demonstration Program. It contains an hypothesized institutional arena, which describes the institutional entities in the housing arena by function and activity and then arrays them according to intensity of interaction across function. The second section of the paper describes the HUD program and describes how it serves as the perturbation prompter for institutional analysis. The third section of the paper presents the specific research design used in the study. From the first three cycles of the HUD program, 11 projects were chosen for on-site case study. A special open-ended semi-structured survey instrument was used to collect information from a set of informants identified for each project. The results of this data collection effort are reported in subsequent reports in this project.

The author gratefully acknowledges Michael Furlong, Steven Heim, Patricia McDaniel, Barbara Parker, Andrew Reamer, and Carole Swetky, all of the PV Institutional Analysis Project at MIT; Jeffrey Cruikshank, who provided editorial services; David Moore, Director of HUD's Solar Heating and Cooling Demonstration Program; and Etta Roth of Real Estate Research Corporation. Without their help and support, this paper could not have been completed.

The drawing is the architect's rendering of the Friends Community, a Cycle 3 project in North Easton, MA.

This paper is one of a series resulting from institutional analysis of photovoltaic (PV) acceptance. These studies are undertaken with sponsorship of the US Department of Energy (DOE) as part of its Photovoltaic Program. In addition to institutional questions, DOE is interested in economic, marketing, and technological issues, and is sponsoring a series of studies and field tests on these topics. Institutional analysis studies have typically been undertaken in relation to particular PV field tests, though in some cases studies have focused on comparable technologies and institutional forces influencing their acceptance.

The housing institutional arena is being investigated in relation to the PV program, in the context of the DOE-HUD Solar Heating and Cooling (SHAC) Demonstration. The SHAC demonstration program involves direct federal grants to assist project developers in incorporating solar thermal approaches into various building forms. In this context, institutional analysis is directed to understanding those forces which influence the rate and nature of innovation acceptance in the housing sector. (For a more detailed discussion of the theory of institutional analysis, see Nutt-Powell, et al., 1978.) An institutional analysis involves seven steps:

- (1) Identify the sector (i.e., economic, geographic) to be studied; determine study objectives.
- (2) Prepare a preliminary sector exploration -- i.e., an overview that could be applied to any location-specific sector.
- (3) Construct an hypothesized institutional arena.
- (4) Identify the "perturbation prompter."
- (5) Devise the specific research design.
- (6) Monitor perturbations.
- (7) Analyze the institutional arena.

This paper incorporates material relevant to the third, fourth and fifth of these steps: constructing an hypothesized institutional arena, identifying a "perturbation prompter," and devising the specific research design for an institutional analysis of the Solar Heating and Cooling Demonstration Program. Its organization follows the theoretical and methodological constructs for institutional analysis of innovation acceptance presented in an earlier paper in this series. (Nutt-Powell, et al, 1978). That paper posits six types of institutional entities -- formal and informal organizations, members, persons, collectivities, and social orders. Institutional action consists of exchanges, for which the critical datum is information. Such exchanges occur within an institutional arena. Innovation forces institutional action by disrupting existing social meaning.

This paper is preceded in the study by five others, each a background paper serving as an element of the preliminary sector exploration of the housing institutional arena. These papers deal with research and socialization (Furlong and Nutt-Powell, 1979), governmental involvement (McDaniel and Nutt-Powell, 1979), standard setting (Parker and Nutt-Powell, 1979), energy provision (Reamer, Heim, and Nutt-Powell, 1979) and housing production (Swetky and Nutt-Powell, 1979). Taken together, these papers provide the basis for constructing an hypothesized institutional arena for housing.

An hypothesized institutional arena is a means of representing institutional entities characteristically involved in a given sector, and of indicating the nature of their typical exchanges. At any point in time there is an identifiable pattern of exchanges between and among institutional entities. This is called a "resource configuration." It is possible to postulate a relative homeostasis of an institutional arena's resource

configuration in order to establish researcher perspective as well as a starting place for data collection. This postulation is the hypothesized institutional arena.

A review of the hypothesized institutional arena leads to the identification of where and how the introduction of an innovation could prompt a perturbation (that is, cause exchanges between and/or among institutional entities which are not routine). For research purposes, one can identify three types of institutional analysis, based on the time and nature of perturbation prompting. The first studies the introduction of an actual perturbation during its introduction; the second examines a perturbation after it has been introduced; and the third studies a perturbation introduced solely for research purposes. This project, which has included work in four different institutional sectors, has been based on studies using each of these approaches.

Once an hypothesized institutional arena is constructed and a perturbation prompter identified, it is possible to devise a specific research design for institutional analysis. The research design establishes how perturbations occasioned by the innovation will be monitored.

This paper has three major sections. The first presents an hypothesized institutional arena for housing; the second discusses the perturbation prompter for this study; and the third presents the specific research design devised for this study. Subsequent papers in this series will report the findings of these investigations.

AN HYPOTHESIZED INSTITUTIONAL ARENA FOR HOUSING

Institutions are defined along three planes: function, activity, and role. Function is the broadest parameter, including, for example, production and research. Activities are undertaken in support of a function; for example, assisting or analyzing. Finally, role is the particular implementation strategy adopted by an institutional entity with regard to its function and activity; for example, vendor or linking-pin. In defining an hypothesized institutional arena, the analyst focuses on function and activity as the two generalizable defining planes.

The hypothesized institutional arena for housing presented here is based on information gathered during the preliminary sector exploration stage, and is presented in the five preliminary exploration working papers of this study. The work described in these papers was initiated by taking each of the seven institutional functions (finance, research, political, regulation, production, service, socialization) as a separate starting point. Data obtained from literature and key informants established the division of institutional entities into the five topics reflected in the titles of the working papers, a clustering which is the consequence of institutional entities serving more than one function. Thus, two papers are combinations maintaining function designation -- research and socialization (Furlong and Nutt-Powell, 1979) and production (Swetky and Nutt-Powell, 1979) -- while the other three present clusters of institutional entities meeting many or even all functions -- governmental involvement (McDaniel and Nutt-Powell, 1979), energy provision (Reamer, Heim and Nutt-Powell, 1979) and standard setting (Parker and Nutt-Powell, 1979).

This paper does not repeat the extensive description and discussion of institutional entities in housing contained in these earlier papers. Most particularly, it does not present detailed definitions of these entities and the manner in which their characteristic functions and activities are manifested. Rather, each entity is defined briefly here according to the functions it fulfills, and the activities it performs in meeting those functions. These definitions are found in Tables 1-7 (one for each of the seven functions).

The definition of institutional entities by function and activity is then used to develop a series of interaction matrices, representing the exchanges characteristic of institutional entities by function, and indicating the relative intensity of this interaction. The intensity of interaction is represented by a four-level ordinary scale: none, low, medium, high. The assignment of an intensity rating was by a pooled judgement of the research team. The interaction matrices are presented as Charts 1-28.

The set of figures and charts together represent an hypothesized institutional arena for housing, with particular reference to exchanges important to solar energy innovation acceptance.

Table 1

INSTITUTIONAL ENTITIES PERFORMING THE FINANCE FUNCTION IN HOUSING

<u>ENTITIES</u>	<u>ACTIONS</u>
Veterans Administration (VA)	Insures, guarantees home loans
Federal Housing Administration (FHA)	Provides housing subsidies, loans
Department of Housing and Urban Development (HUD)	Provides loans, grants, subsidies
Farmers Home Loan Administration (FmHA)	Provides housing loans, grants
Federal National Mortgage Association (FNMA)	Trades mortgages in the secondary market
General National Mortgage Association (GNMA)	Trades mortgages in the secondary market
Federal Home Loan Mortgage Corporation (FHLMC)	Trades mortgages in the secondary market
Federal Deposit Insurance Corporation (FDIC)	Provides deposit insurance
Federal Savings and Loan Insurance Corporation (FSLIC)	Provides deposit insurance
State Housing Finance Agencies (HFAs)	Provides housing loans, insurance, grants, subsidies
State Department of Community Development (DCAs)	Provides housing loans, grants, subsidies
Congress/Internal Revenue Service (IRS)	Provides financial incentive through tax policies
States, Counties, Municipalities	Sets & collects property tax
Federal Reserve Board	Sets monetary policy
Federal Home Loan Bank Board	Sets monetary policy
State Bank Regulatory Boards	Sets monetary policy
Mortgage Companies	Provide loans
Private Mortgage Insurance Companies	Insures mortgages
Insurance Companies	Provide loans
Real Estate Investment Trusts	Provide means to accumulate and invest capital

ENTITIES

ACTIONS

Pension Funds

Provide loans

Savings & Loans

Provide mortgages

Commercial Banks

Provide construction loans

Mutual Savings Banks

Provide mortgages

Individuals

Provide loans

Equity Syndications

Provide means to accumulate capital

Finance Companies

Provide home improvement loans

Credit Unions

Provide home improvement loans

Tax Assessors

Provide financial incentives through
tax policies

Table 2

INSTITUTIONAL ENTITIES PERFORMING THE RESEARCH FUNCTION IN HOUSING

<u>ENTITIES</u>	<u>ACTIONS</u>
Congress	Conducts policy-oriented research
President	Conducts policy-oriented research
State legislatures	Conduct policy-oriented research
Governors	Conduct policy-oriented research
Municipal Planning & Budget Agencies	Conduct policy-oriented research
Federal Housing Authority (FHA)	Conducts housing market analyses
U.S. Department of HUD - Policy Development and Research (PDR)	Conducts long-term broad-based policy studies at local, regional and national levels
U.S. Bureau of the Census	Collects and analyzes demographic and housing statistics
Private research	Performs research on contract with other actors in the housing arena
Trade and professional associations	Perform subject-related research
Unions	Perform subject-related research
Universities	Perform basic and applied research related to housing on contract or grant
Banks	Research economic and fiscal trends, local housing market characteristics
Federal Reserve Board (FED)	Performs economic research
Federal Home Loan Bank Board (FHLBB)	Performs economic research
Commission/Task Force, Staff	Carry out special, highly visible studies
Cabinet Officers, Staff	Carry out focused policy and program-related research
Congressional Budget Office (CBO)	Studies economic and fiscal impacts of Congressional appropriations and policies

TABLE 2, cont'd

ENTITIESACTIONS

General Accounting Office (GAO)

Performs reviews and evaluations of existing federal programs

Office of Management and Budget (OMB)

Researches program impacts and fiscal needs

Interest Groups (Federal/State/Local;
General Special/Specific Special/
Public Interest/Specific Public
Interest)

Perform subject-related research

Banking Commissions

Research bank policies and mortgage practices

Voluntary Standard Setting Commissions
(ASTM, ANSI)

Research nature, characteristics & performance relative to standard setting

U.S. Department of Energy (DOE)

Performs energy-related research

Table 3

INSTITUTIONAL ENTITIES PERFORMING THE POLITICAL FUNCTION IN HOUSING

<u>ENTITIES</u>	<u>ACTIONS</u>
Congress	Determines policy
President	Proposes/approves/administers policy
U.S. Cabinet departments/officers	Propose /debate /administer policy; determine policy at a lesser level
General Accounting Office (GAO)	Proposes policy; determines minor policy regarding reporting requirements
U.S. Office of Management & Budget (OMB)	Determines federal budget and management practices
State legislatures	Determine policy
Governors	Propose/approve/administer policy
State cabinet departments/officers	Propose /debate /administer policy; determine policy at a lesser level
Local governing councils	Determine policy
Local chief executives	Propose/approve/administer policy
Local cabinet departments/officers	Propose/approve/administer policy
Voluntary standard commissions (e.g., ASTM, ANSI)	Determine standards

Table 4

INSTITUTIONAL ENTITIES PERFORMING THE REGULATION FUNCTION IN HOUSING

<u>ENTITIES</u>	<u>ACTIONS</u>
Building Inspectors	Inspect construction regarding structural standards
Housing Inspectors	Inspect housing regarding health and safety standards
Federal Home Loan Bank Board (FHLBB)	Sets and administers regulations for savings & loans
Federal Reserve Board (FED)	Sets and administers regulations for commercial banks
U.S. Department of the Treasury	Sets and administers broad financial, tax, and fiscal regulations
State Banking Commissions	Set and administer regulations regarding state-chartered banks
U.S. Department of Housing and Urban Development (HUD) -- Office of Interstate Land Sales	Regulates interstate land sales
HUD -- Secretary	Regulates secondary mortgage market
Securities Exchange Commission (SEC)	Oversees interstate corporation financial practices
Internal Revenue Service (IRS)	Sets and administers tax regulations
Environmental Protection Agency (EPA)	Enforces anti-pollution laws
Council on Environmental Quality (CEQ)	Oversees the environmental impact statement process
Office of Coastal Zone Management (CZM)	Regulates permissible uses within designated coastal zones
Occupational Safety and Health Administration (OSHA)	Regulates worker health and safety conditions
Fire Departments	Enforce fire regulations
Design Review	Regulates construction to meet aesthetic standards
Courts	Adjudicate disputes in the housing arena

TABLE 4, cont'd

ENTITIES

Interstate Commerce Commission (ICC)
 Unions
 Insurance Commissions
 National Labor Relations Board (NLRB)
 State Realtor Regulatory Boards
 Professional Registration Boards
 Trade and Professional Associations
 Federal Energy Regulatory Commission (FERC)
 State Public Utilities Commissions
 Department of Justice
 Nuclear Regulatory Commission (NRC)
 State Facility Siting Boards
 Fair Housing/Equal Opportunity Employment
 (EEO) Agencies

ACTIONS

Regulates materials transportation
 Regulate member behavior
 Regulate insurance company behavior
 Arbitrates labor disputes
 Regulate realtor behavior
 Regulate entry to professions
 Regulate member behavior
 Sets interstate energy prices
 Regulates local utility behavior
 Enforces antitrust laws
 Regulates construction and operation
 of nuclear power plants
 Determines where energy facilities
 may be sited
 Enforce fair housing and equal
 opportunity laws

Table 5

INSTITUTIONAL ENTITIES PERFORMING THE PRODUCTION FUNCTION IN HOUSING

<u>ENTITIES</u>	<u>ACTIONS</u>
Developers	Initiate, coordinate, oversee the production process
Architects	Design housing product
Consulting Engineers	Advise
Lawyers	Design corporate structure
Surveyors	Determine site specifications
Real Estate Brokers	Facilitate site acquisition
Trade Unions	Provide labor for construction
Contractors	Build, manage, organize
Subcontractors	Build
Materials Manufacturers	Manufacture housing components, whole structures
Materials Distributors	Distribute housing components
Public Housing Authorities	Develop public housing
State Developers	Develop
Community Development Corporations (CDCs)	Develop
Energy Companies	Supply energy in production process
Public Service	Provide roads, infrastructure to facilitate production

Table 6

INSTITUTIONAL ENTITIES PERFORMING THE SERVICE FUNCTION IN HOUSING

<u>ENTITIES</u>	<u>ACTIONS</u>
Consulting Engineers	Advise
Planners	Assess alternatives and market need
Lawyers	Advise on legal options
Title Companies	Guarantee title
Real Estate Brokers	Facilitate sales, assess market demand
Materials Distributors	Advise on product use
Welcome Wagon	Does direct advertising for local merchants
Insurance Companies	Insure property of owner and/or occupant
Repair Personnel	Advise on, assist in maintenance
Energy Companies	Supply energy, service lines, advise on energy use
Utilities gas, electric	
Oil	
Solar	
Municipal	
Police	Provide security re: crime
Fire	Provide security re: fire
Sewer	Provide continued use of sewer system
Water	Provide continued use of water system
Security Companies	Provide security for structures and occupants
Maintenance Firms	Provide building & grounds maintenance
Property Management	Oversees operation, management and maintenance
Equal Employment Opportunity (EEO)/Fair Housing Agencies (Federal, State, City)	Investigate and adjudicate complaints
Consumer Protection Agencies	Investigate and adjudicate complaints
Mortgage Financers	Arrange debt structure
Tenants Organizations	Advocate constituent interests

TABLE 6, cont'd

ENTITIES

Neighborhood Associations

Trade Associations

Professional Societies

Unions

Standards

ASTM

ANSI

NBS

HUD National Flood Insurance Act

Materials Manufacturers

ACTIONS

Advocate constituent interests

Provide advice and information

Provide advice and information

Provide advice and information

Organizes standards setting process

Legitimizes standards

Investigates standards

Provides flood insurance

Provide advice on product use

Table 7

INSTITUTIONAL ENTITIES PERFORMING THE SOCIALIZATION FUNCTION IN HOUSING

<u>ENTITIES</u>	<u>ACTIONS</u>
Designers	Set construction parameters through design preferences
Trade Associations	Socialize members, government, and the public through newsletters, advertising, and lobbying
Professional Associations	Socialize members, the government, and the public through newsletters, advertising, and lobbying
Unions	Socialize members, the government, and the public through newsletters, advertising, and lobbying
Educational Institutions	Directly socialize students; indirectly socialize the public, government officials
Standard Setting Bodies	Socialize manufacturers and users of building components
Lending Institutions	Set construction parameters through lending preferences
Congress	Sets parameters for housing preferences through choice of legislative issues
President	Sets parameters for housing preferences through public statements, legislative programs, and administrative directives
State Legislatures	Set parameters for housing preferences through choice of legislative issues
Governors	Set parameters for housing preferences through public statements, legislative programs, and administrative directives
Commissions	Legitimate new directions and ideas
Cabinet Officers	Set parameters for housing preferences through public statements, legislative programs, and administrative directives
Interest Groups	Advocate the acceptability of particularized views on housing

TABLE 7, cont'd

<u>ENTITIES</u>	<u>ACTIONS</u>
Historical Form	Establishes the familiar as a parameter
Public Services	Establish existing service forms as parameters
Tax Assessors	Set construction parameters through assessment practices
Developers	Influence construction practices through financial risk-taking preferences
Real Estate Brokers	Establish housing parameters through broker preferences
Welcome Wagons	Convey community norms
Property Management Firms	Socialize owners and occupants through management practices
Materials Distributors and Manufacturers	Set construction parameters through advertising, offering, and endorsement of products
Insurance Companies	Set construction and market parameters through insuring preferences
Fair Housing/Equal Opportunity Employment (EEO) Agencies	Set market parameters through public pronouncements
Energy Companies	Set construction and market parameters through range and cost of services offered
Neighborhood/Tenant Associations	Exert influence on property owners, government agencies
Media -- print	Reflect and formulate taste in the residential market
-- journals	Socialize professional and trade association members
-- visual	Reflect and formulate taste in the residential market
State Energy Offices	Set construction parameters through public pronouncements on energy

CHART 1
Institutional Entity Interaction in the Housing Arena: Finance and Finance Functions

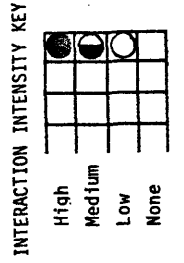
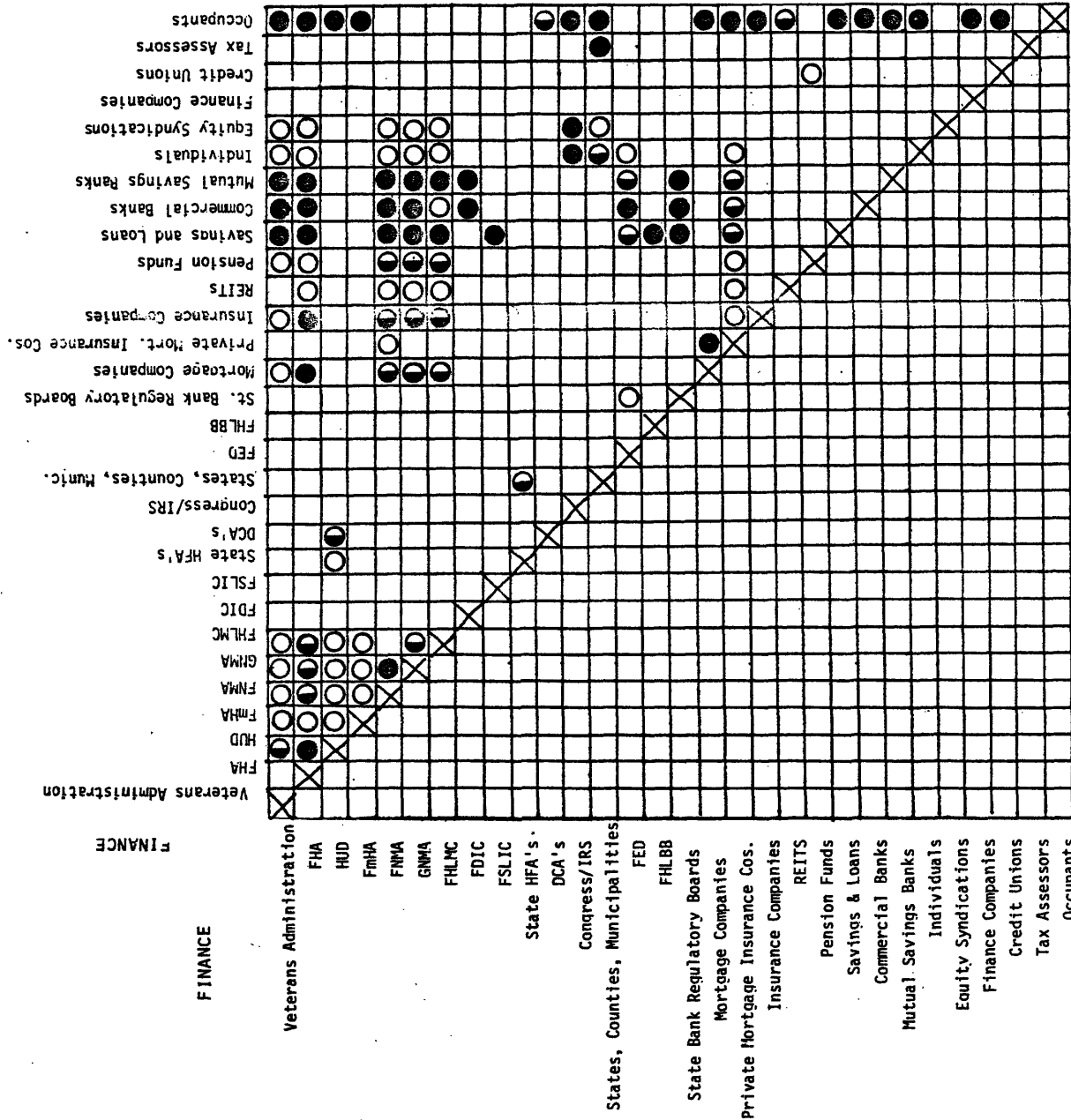
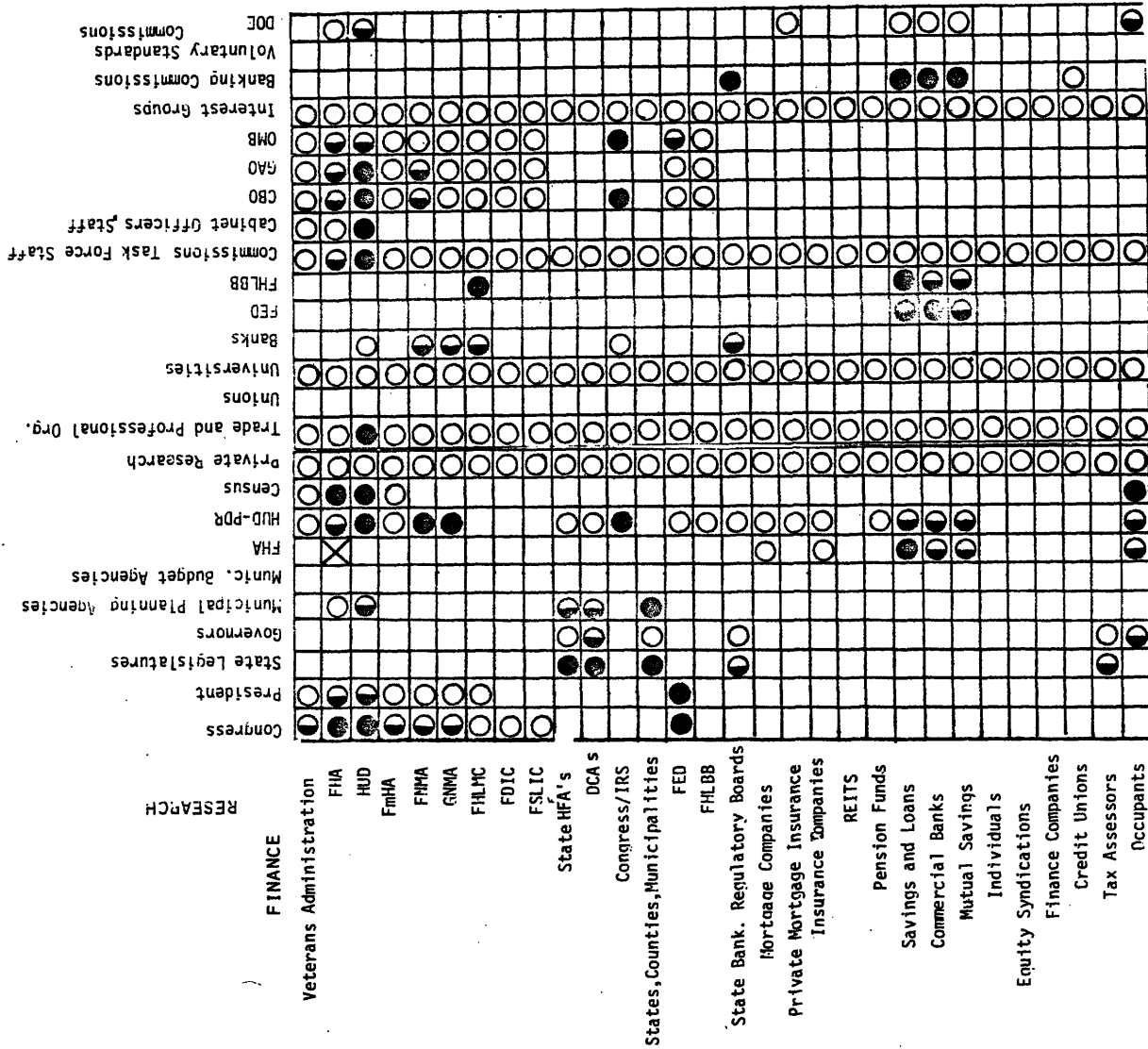


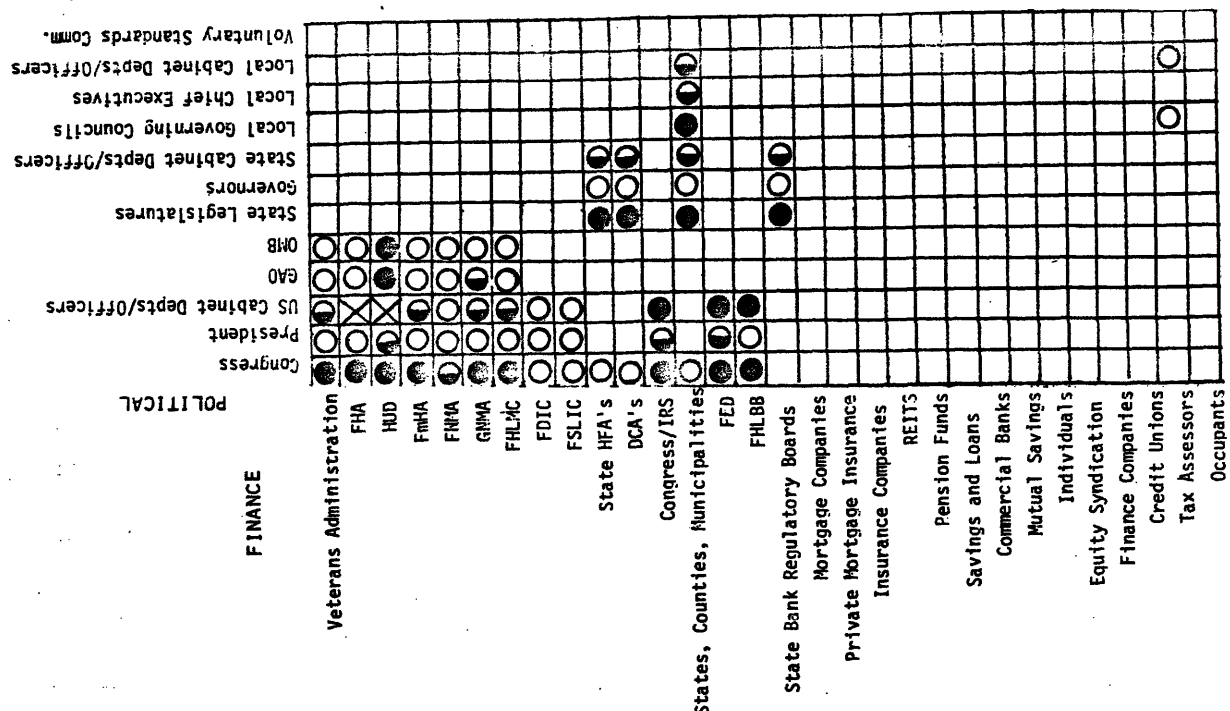
CHART 2 Institutional Entity Interaction in the Housing Arena: Finance and Research Functions



INTERACTION INTENSITY KEY

High	Medium	Low	None
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CHART 3
Institutional Entity Interaction in the Housing Arena: Finance and Political Functions



INTERACTION INTENSITY KEY

High	●
Medium	◐
Low	○

CHART 4
Institutional Entity Interaction in the Housing Arena: Finance and Regulation Functions

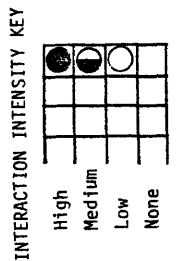
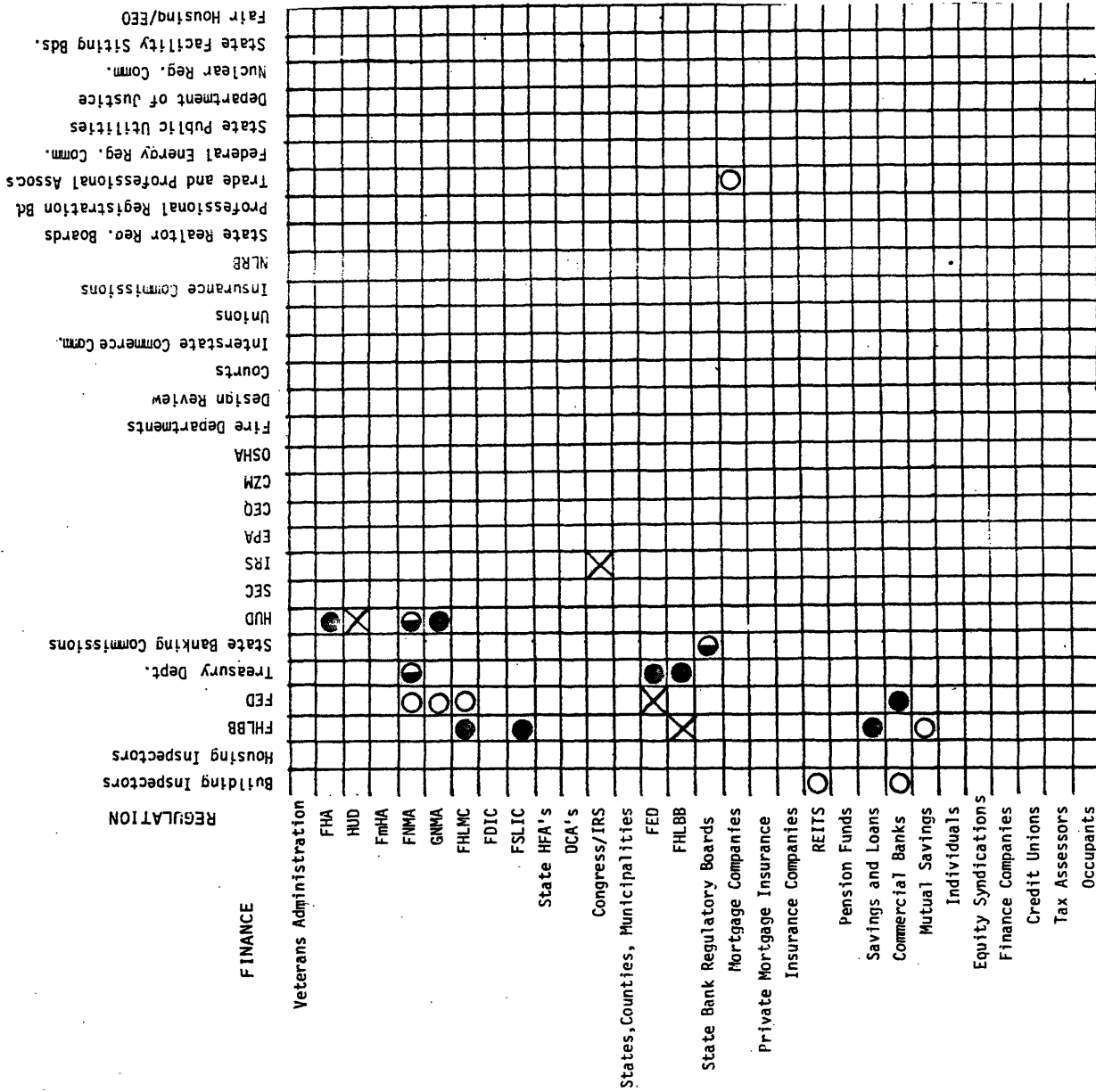
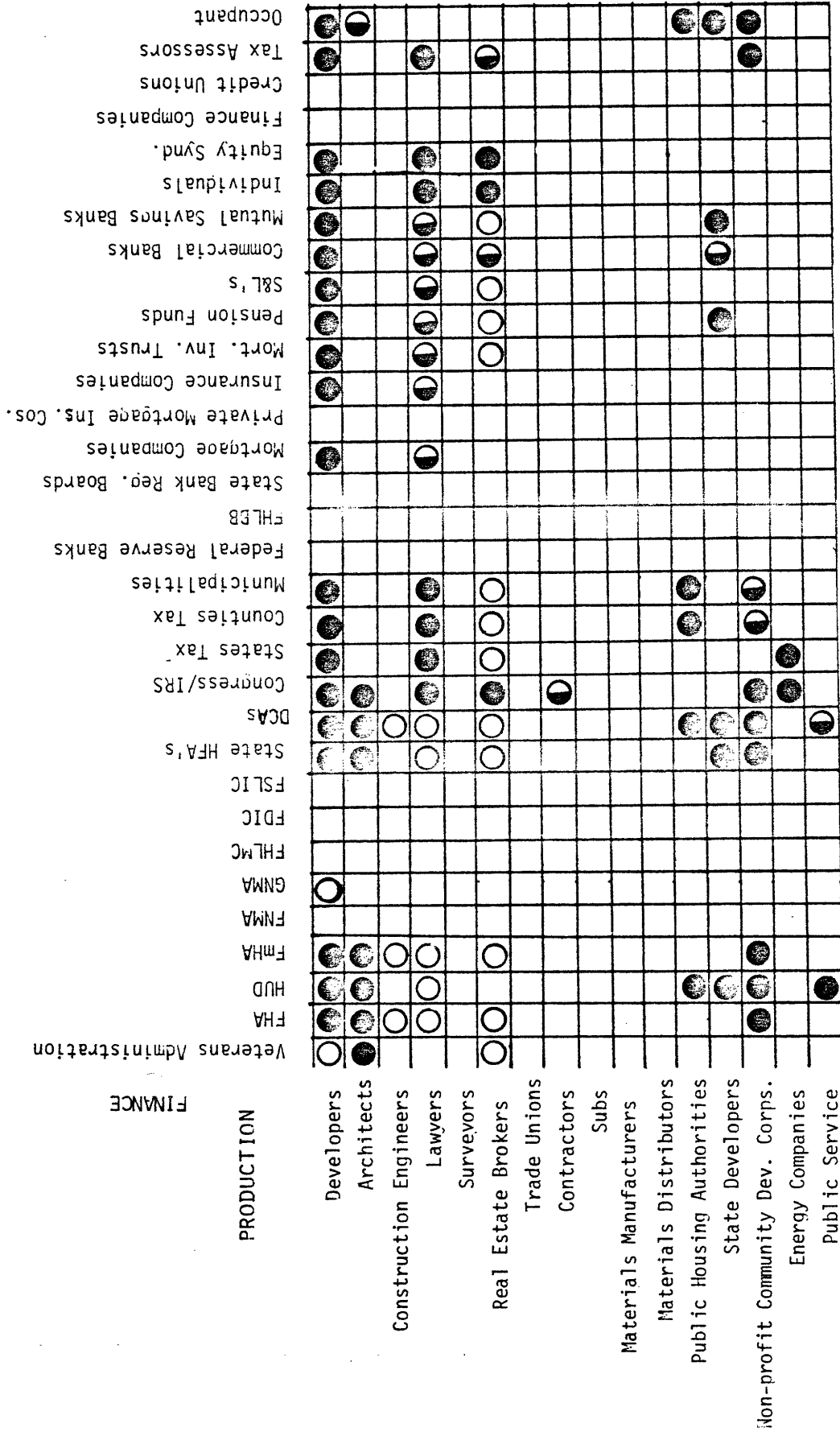


CHART 5
Institutional Entity Interaction in the Housing Arena: Finance and Production Functions



INTERACTION INTENSITY KEY

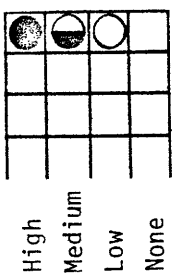


CHART 6
 Institutional Entity Interaction in the Housing Arena: Finance and Service Functions

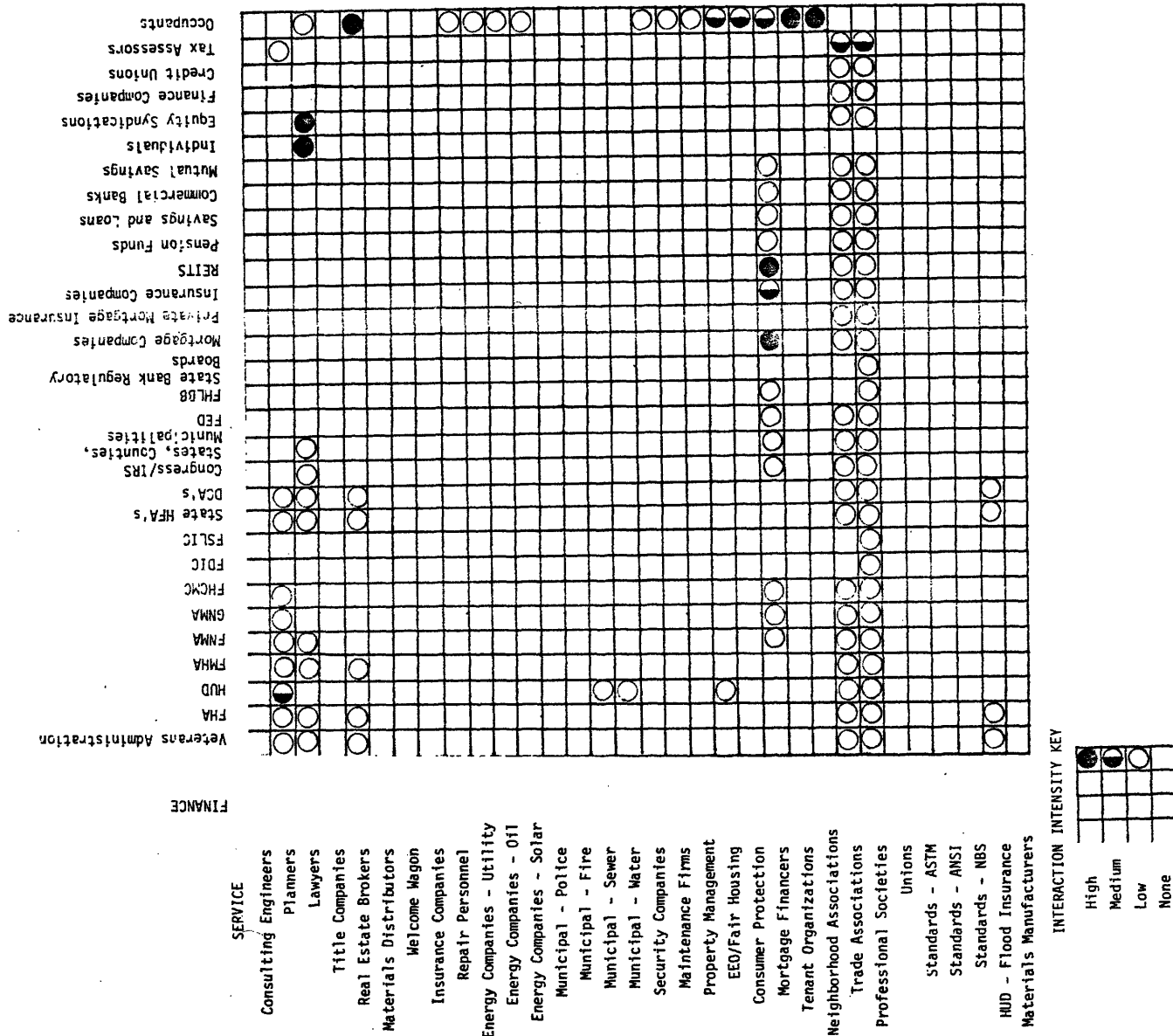


CHART 7 Institutional Entity Interaction in the Housing Arena: Finance and Socialization Functions

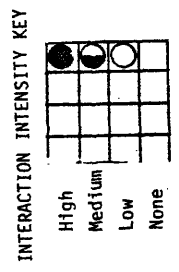
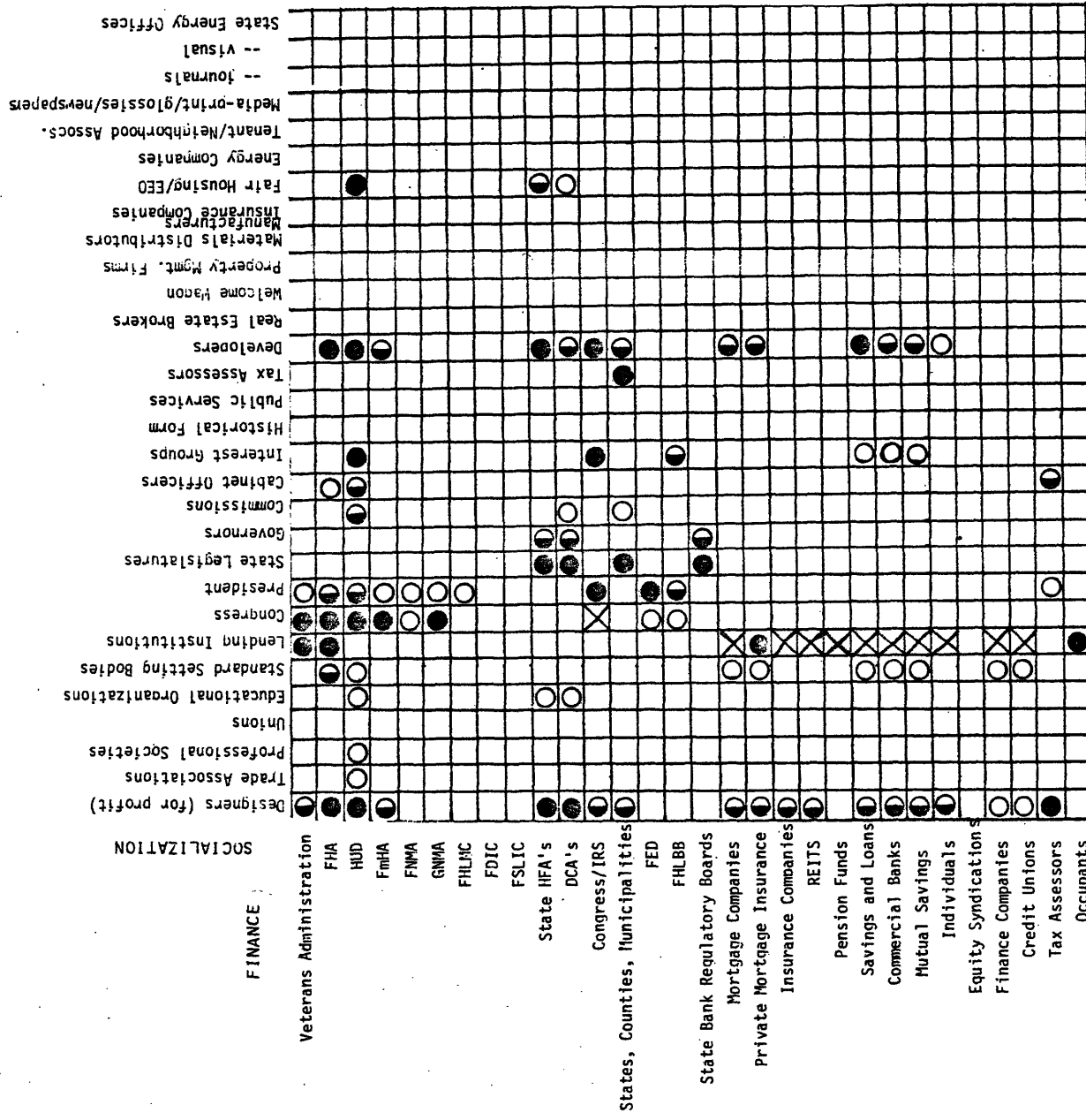


CHART 8 Institutional Entity Interaction in the Housing Arena: Research and Research Functions

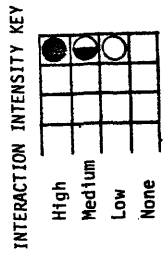
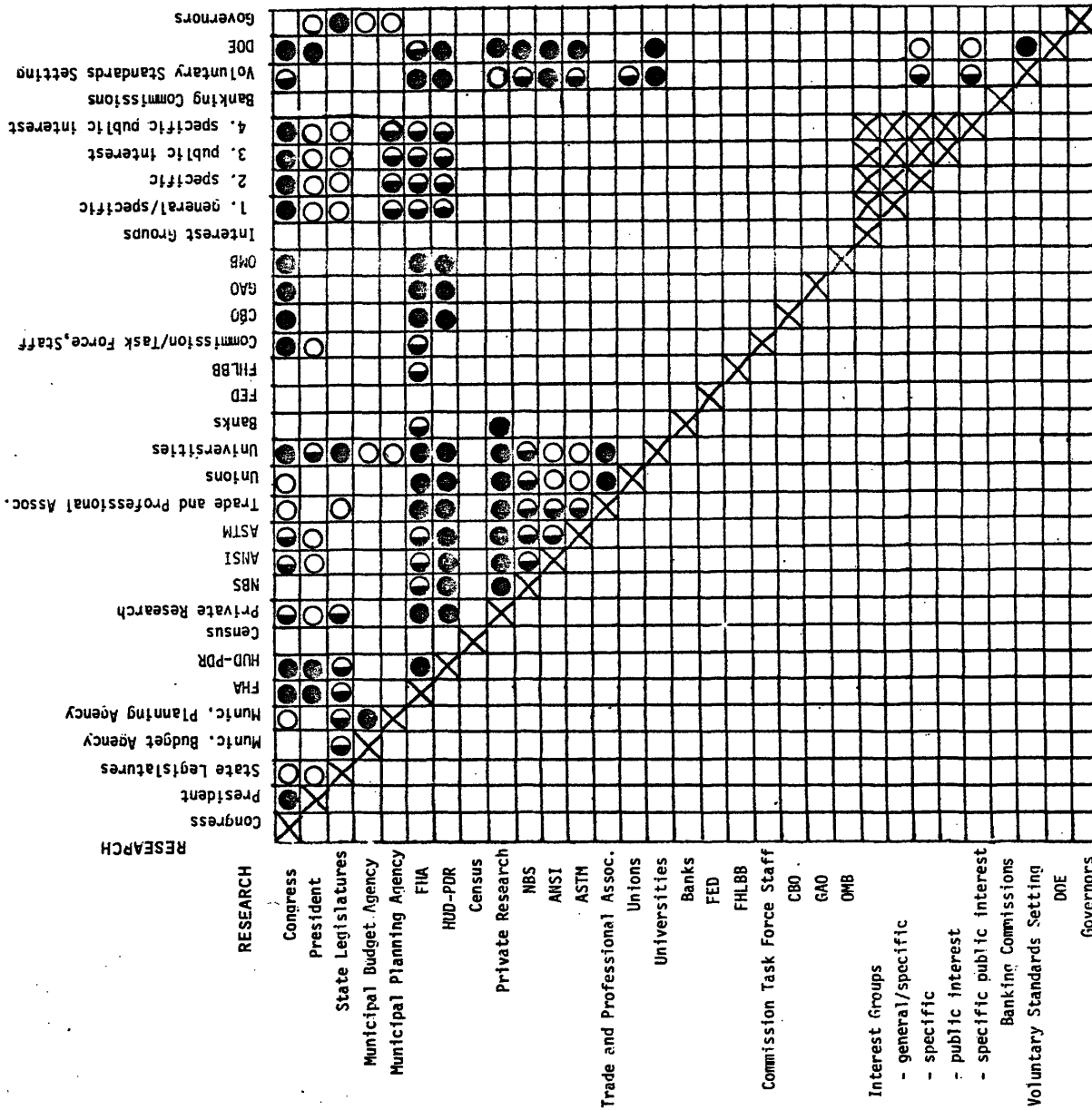


CHART 9
 Institutional Entity Interaction in the Housing Arena: Research and Political Functions

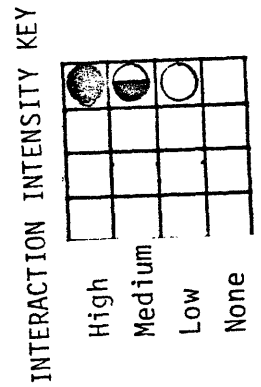
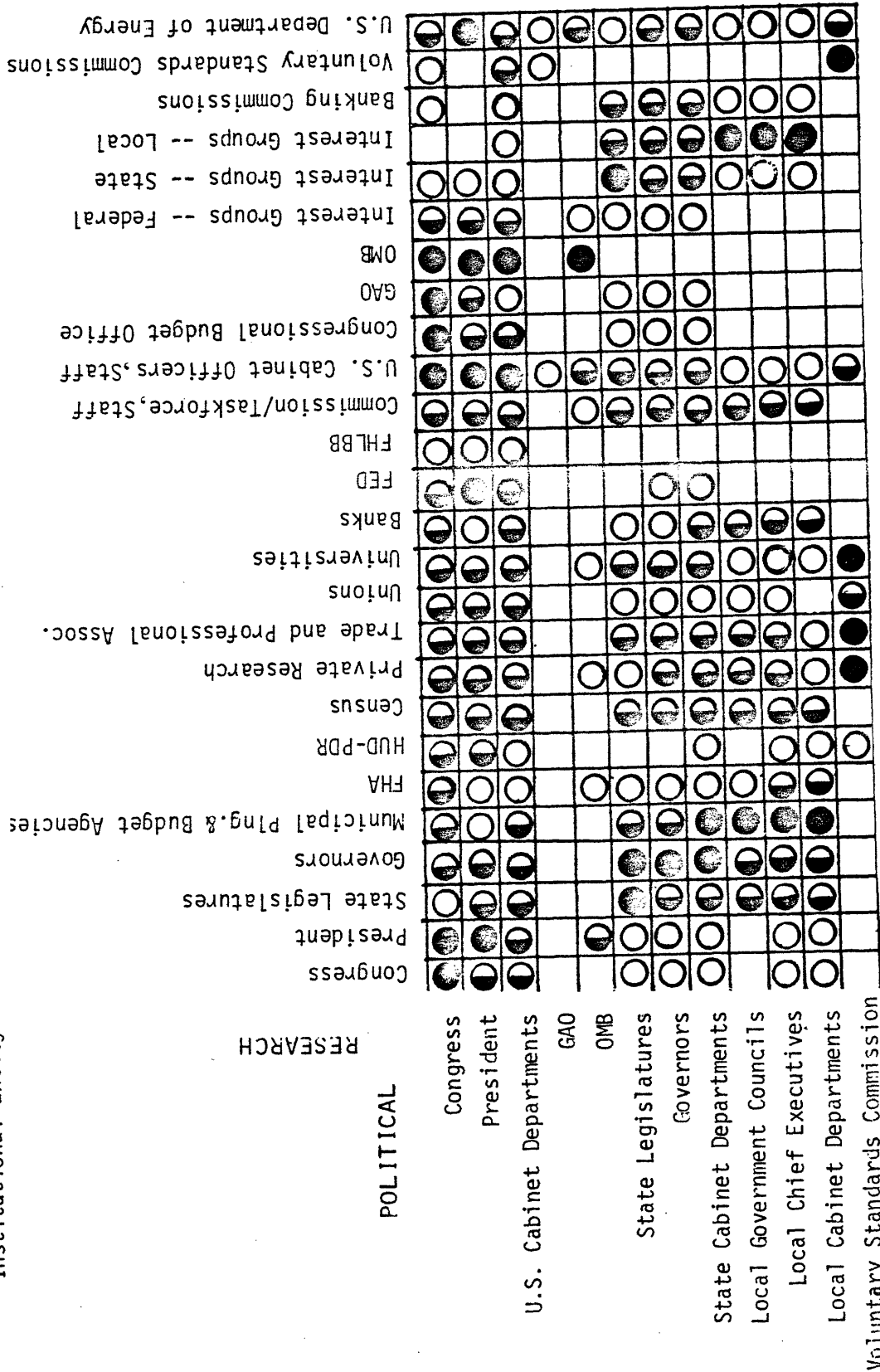


CHART 10
 Institutional Entity Interaction in the Housing Arena: Research and Regulation Functions

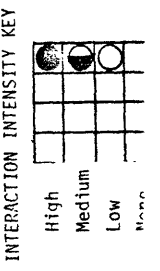
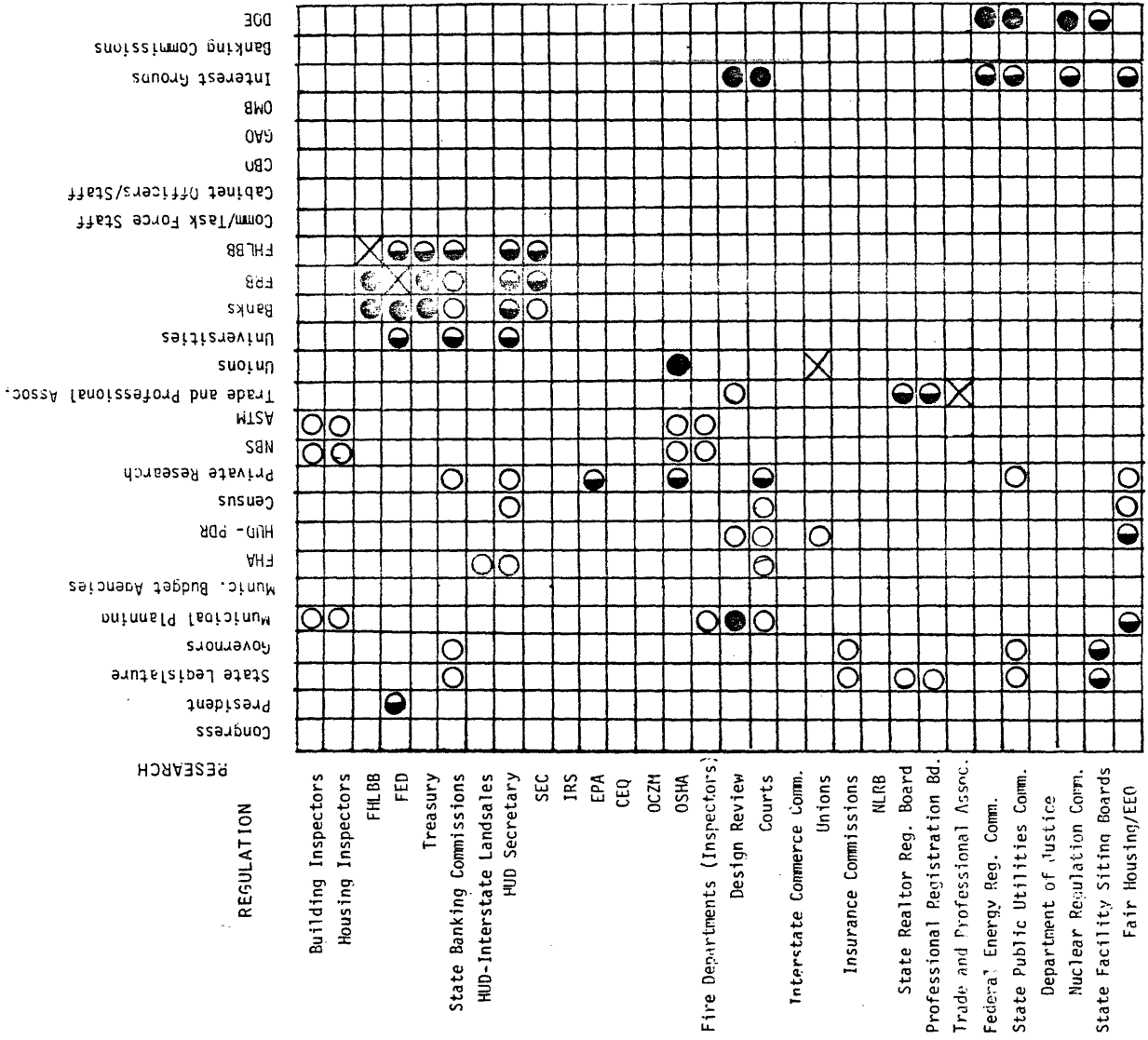


CHART 11
 Institutional Entity Interaction in the Housing Arena: Research and Production Functions

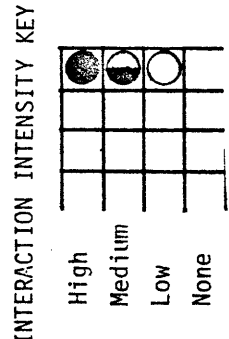
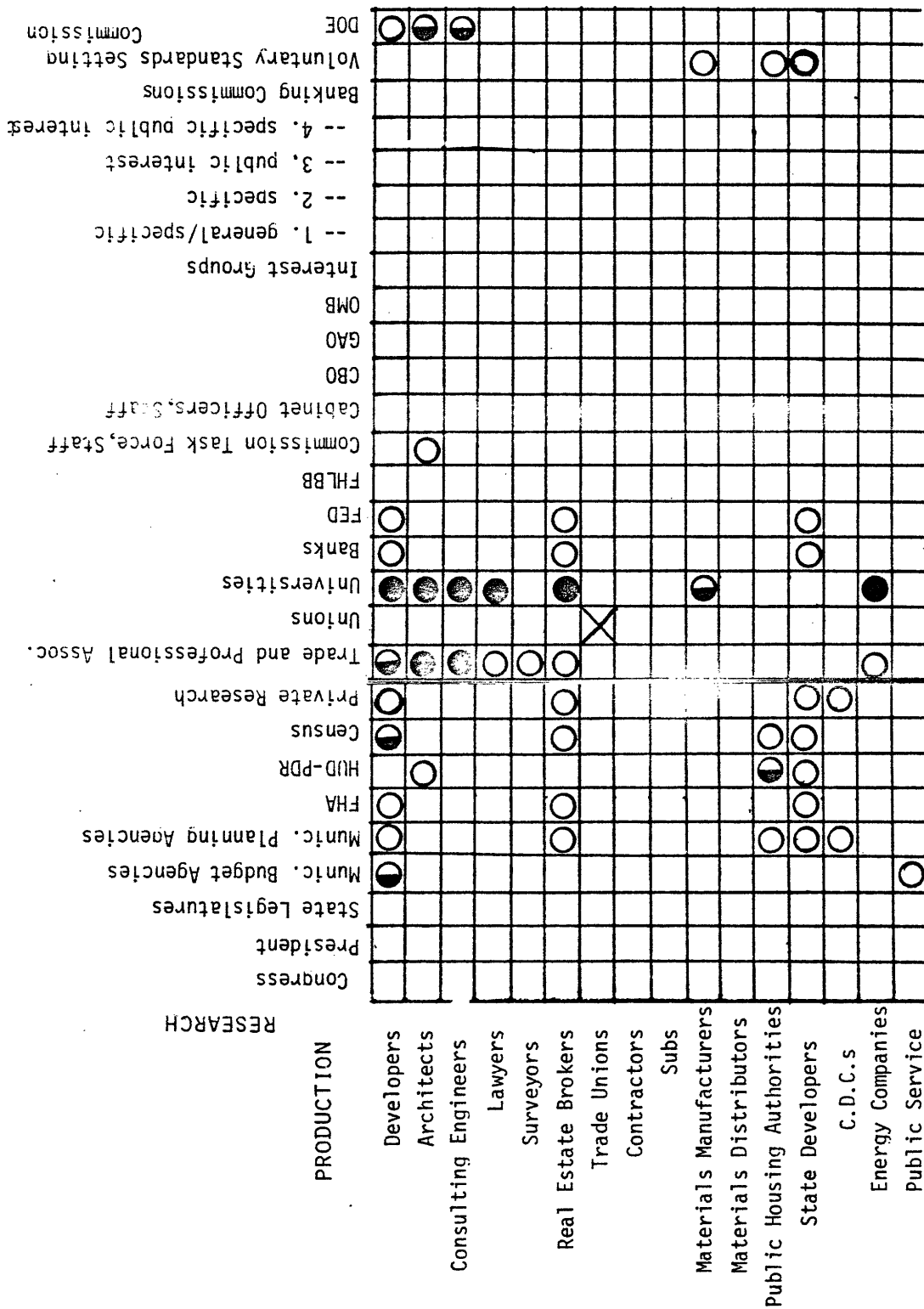
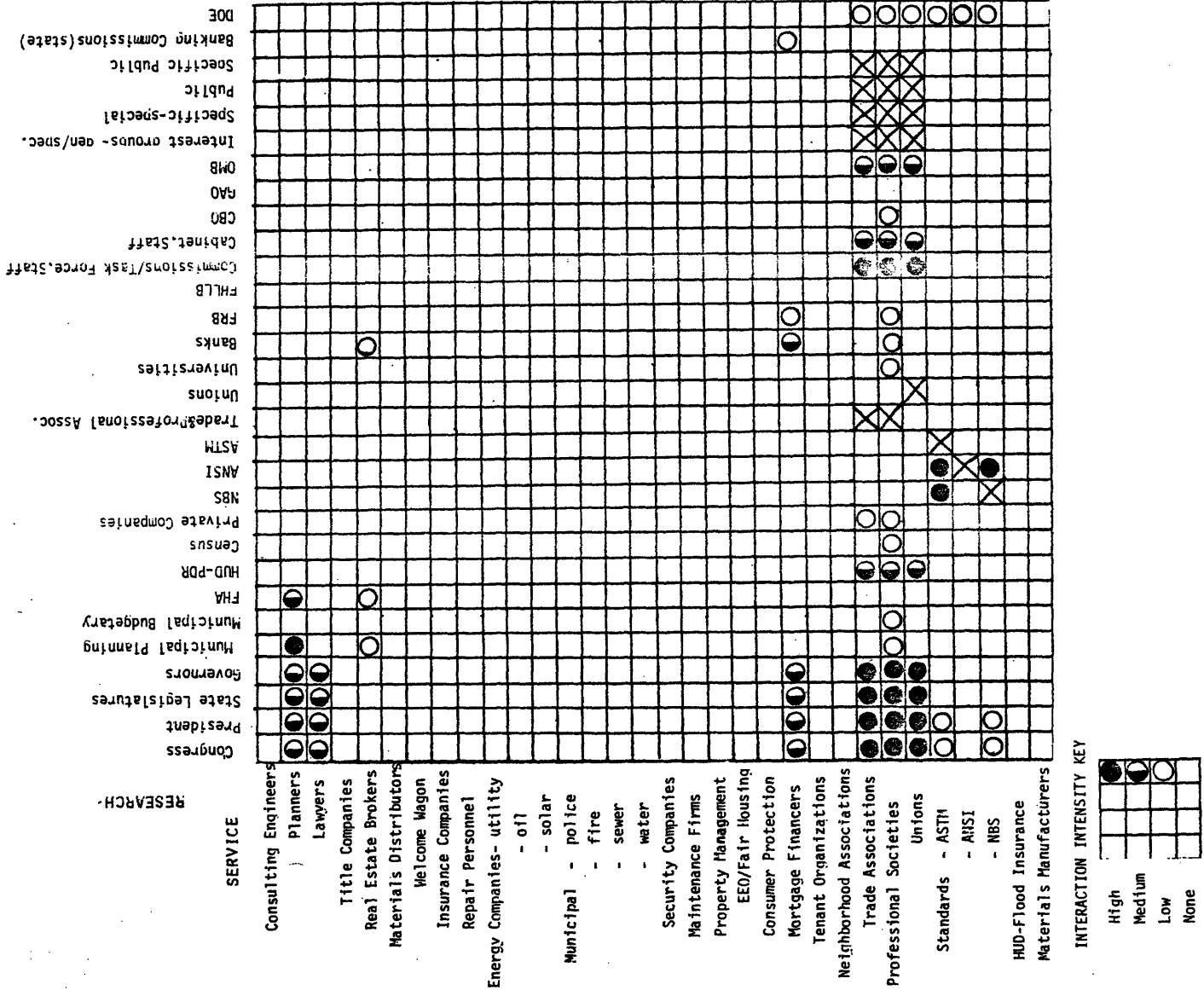


CHART 12 Institutional Entity Interaction in the Housing Arena: Research and Service Functions



INTERACTION INTENSITY KEY

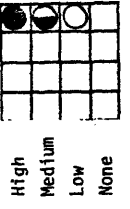


CHART 13 Institutional Entity Interaction in the Housing Arena: Research and Socialization Functions

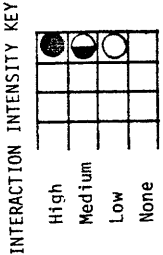
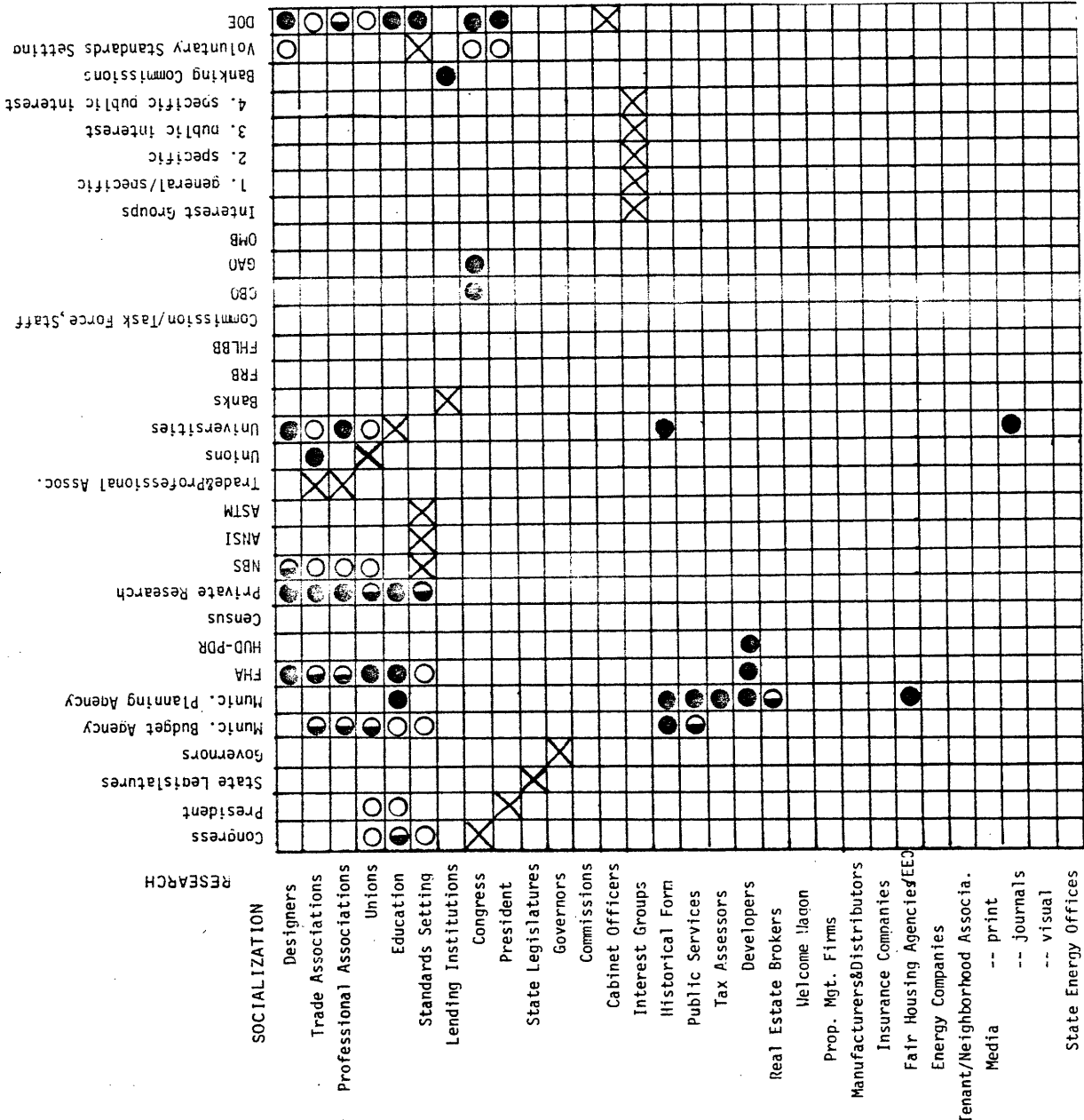
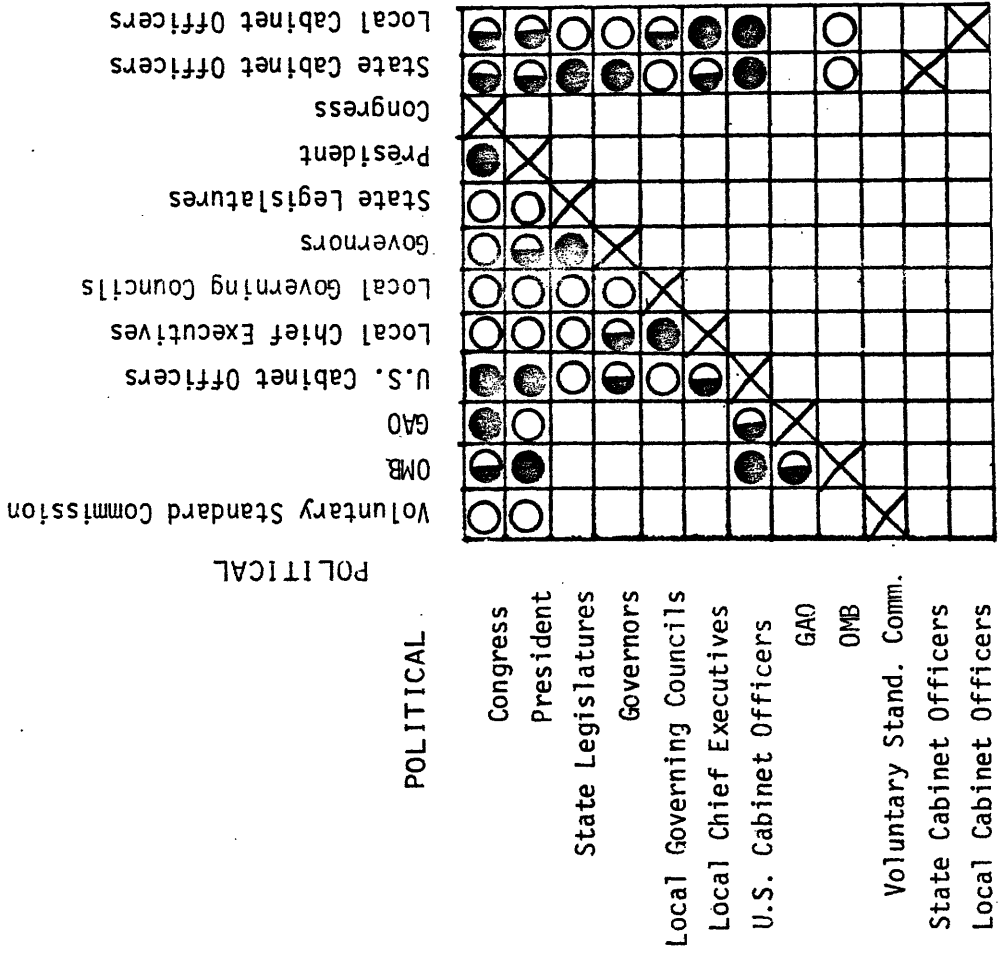


CHART 14
 Institutional Entity Interaction in the Housing Arena: Political and Political Functions



INTERACTION INTENSITY KEY

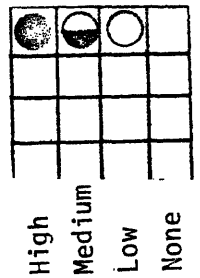
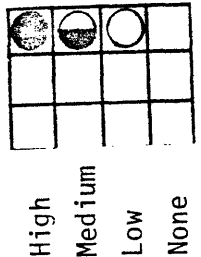


CHART 15
 Institutional Entity Interaction in the Housing Arena: Political and Regulation Functions

REGULATION	POLITICAL											
	Congress	President	U.S. Cabinet Departments	GAO	OMB	State Legislatures	Governors	State Cabinet Departments	Local Governing Councils	Local Chief Executives	Local Cabinet Departments	Voluntary Standards Commission
Building Inspectors												
Housing Inspectors												
FHLBB												
FED												
Treasury												
State Banking Commissions												
HUD												
SEC												
IRS												
EPA												
CEQ												
OZM												
OSHA												
Fire Departments												
Design Review												
Courts												
ICC												
Unions												
Insurance Commissions												
NLRB												
State Realtor Reg. Boards												
Prof. Registration Boards												
Trade/Professional Assoc.												
FERC												
State PUCs												
Department of Justice												
Nuclear Reg. Commission												
State Facility Siting												
Fair Housing/EEO												

INTERACTION INTENSITY KEY



Institutional Entity Interaction in the Operating Arena: Political and Production Functions

ART 16

POLITICAL		PRODUCTION															
		Developers	Architects	Consulting Engineers	Lawyers	Surveyors	Real Estate Brokers	Trade Unions	Contractors	Subs	Materials Manufacturers	Materials Distributors	Public Housing Authorities	State Developers	C. D. C.'s	Energy Companies	Public Service
Congress																	
Executive/President																	
State Legislatures																	
Governors																	
Local Governing Council		●	●									○					
Local Chief Executive													●				
Cabinet and Officers																	
GAO													○				
OMB														○			
Voluntary Standards Commission																	

INTERACTION INTENSITY KEY

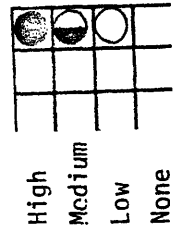
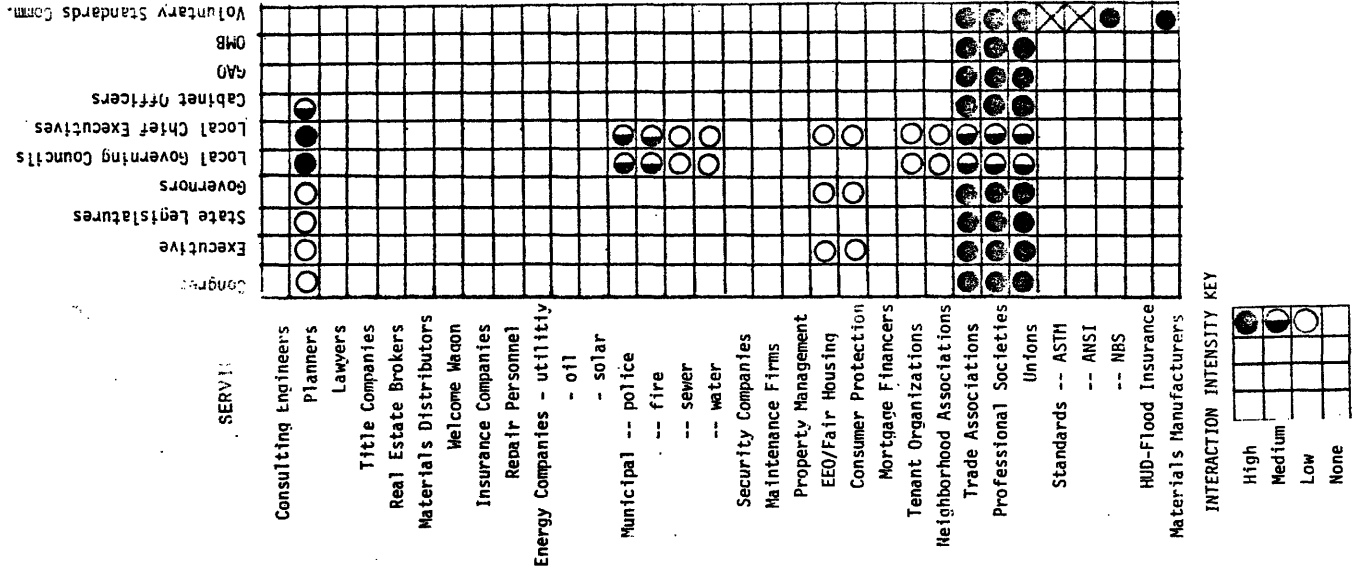


CHART 17
 Institutional Entity Interaction in the Housing Arena: Political and Service Functions



INTERACTION INTENSITY KEY

High	●
Medium	○
Low	○
None	○

CHART 18 Institutional Entity Interaction in the Housing Arena: Political and Socialization Functions

SOCIALIZATION		Designers	Trade Organizations	Professional Associations	Unions	Universities/Educa. Institu	Standard Setting Bodies	Lending Institutions	Congress	President	State Legislatures	Governors	Commissions	Cabinet Officers	Interest Groups	Historical Form	Public Services	Tax Assessors	Developers	Real Estate Brokers	Welcome Wagon	Property Management Firms	Materials Distributors & Mfgs.	Insurance Companies	Fair Housing/EEO	Energy Companies	Neighborhood/Tenant/Assoc.	Media -- Print	Media -- Visual	State Energy Offices			
POLITICAL																																	
Congress																																	
President																																	
U.S. Cabinet Departments																																	
GAO																																	
OMB																																	
State Legislatures																																	
Governors																																	
State Cabinet Departments																																	
Local Government Councils																																	
Local Chief Executives																																	
Local Cabinet Officers																																	
Voluntary Standard Commissions																																	

INTERACTION INTENSITY KEY

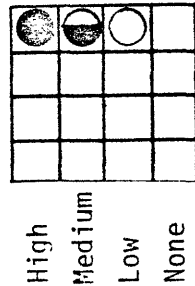
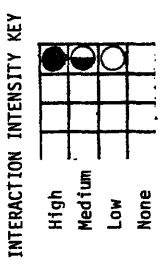
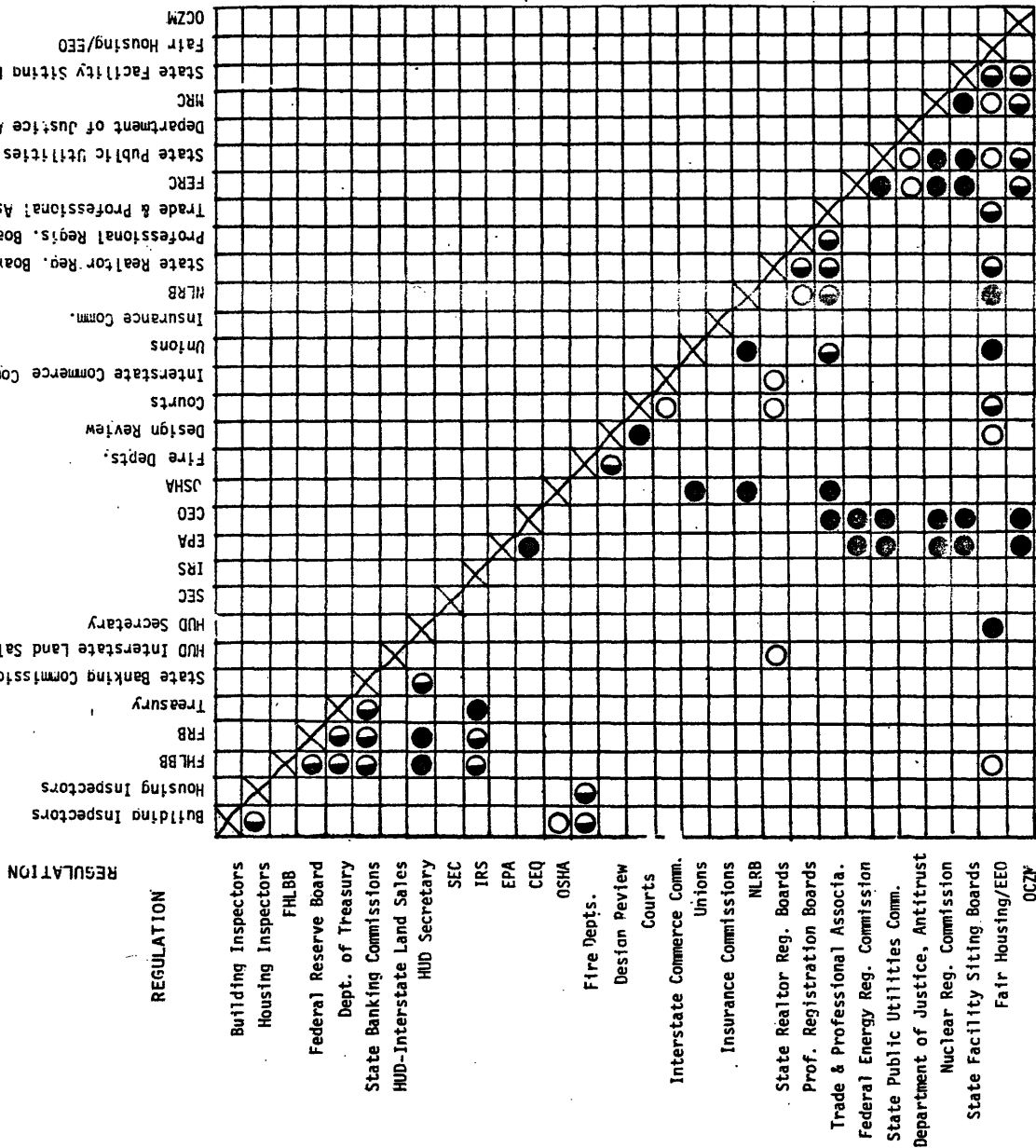


CHART 19 Institutional Entity Interaction in the Housing Arena: Regulation and Regulation Functions



PT 20
 Institutional Entity Interaction in the Housing Arena: Regulation and Production Functions

REGULATION	PRODUCTION																
	Developers	Architects	Consulting Engineers	Lawyers	Surveyors	Real Estate Brokers	Trade Unions	Contractors	Sub-Contractors	Materials Manufacturers	Materials Distributors	Public Housing Authorities	State Developers	Community Dev. Corps. (non-profit)	Energy Companies	Public Service	
Building Inspectors	○	●	●					○	●	●							
Housing Inspectors																	
FHLBB																	
FED																	
Treasury																	
State Banking Commissions	○											●					
HUD				○													
SEC																	
IRS	●			●		○								○			
EPA	○		●									○	○	○			
CEQ	○		●									●	●	●			
CZM	●	●	●	●		○						●	●	●	●	●	
OSHA	○							●	●	●			○	○	○	●	●
Fire Departments	○	●	○					●	●			○	○	○			
Design Review	●	●										●	●	●			
Courts				●													
Interstate Commerce Comm.									●	●							
Unions							×	●	●								●
Insurance Commissions								●	●								
NLRB								●	●								
State Realtor Reg. Boards							●										
Professional Regs. Boards		●	●														
Trade Professional Assocs.		○	○	○	○												
Federal Energy Reg. Comm.															○	○	
State Public Utilities Comm.																	○
Department of Justice																	
Nuclear Reg. Comm.																	
State Facility Siting Boards																	
Fair Housing/EEO	○																

INTERACTION INTENSITY KEY

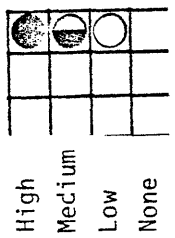


CHART 21
Institutional Entity Interaction in the Housing Arena: Regulation and Service Functions

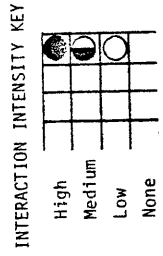
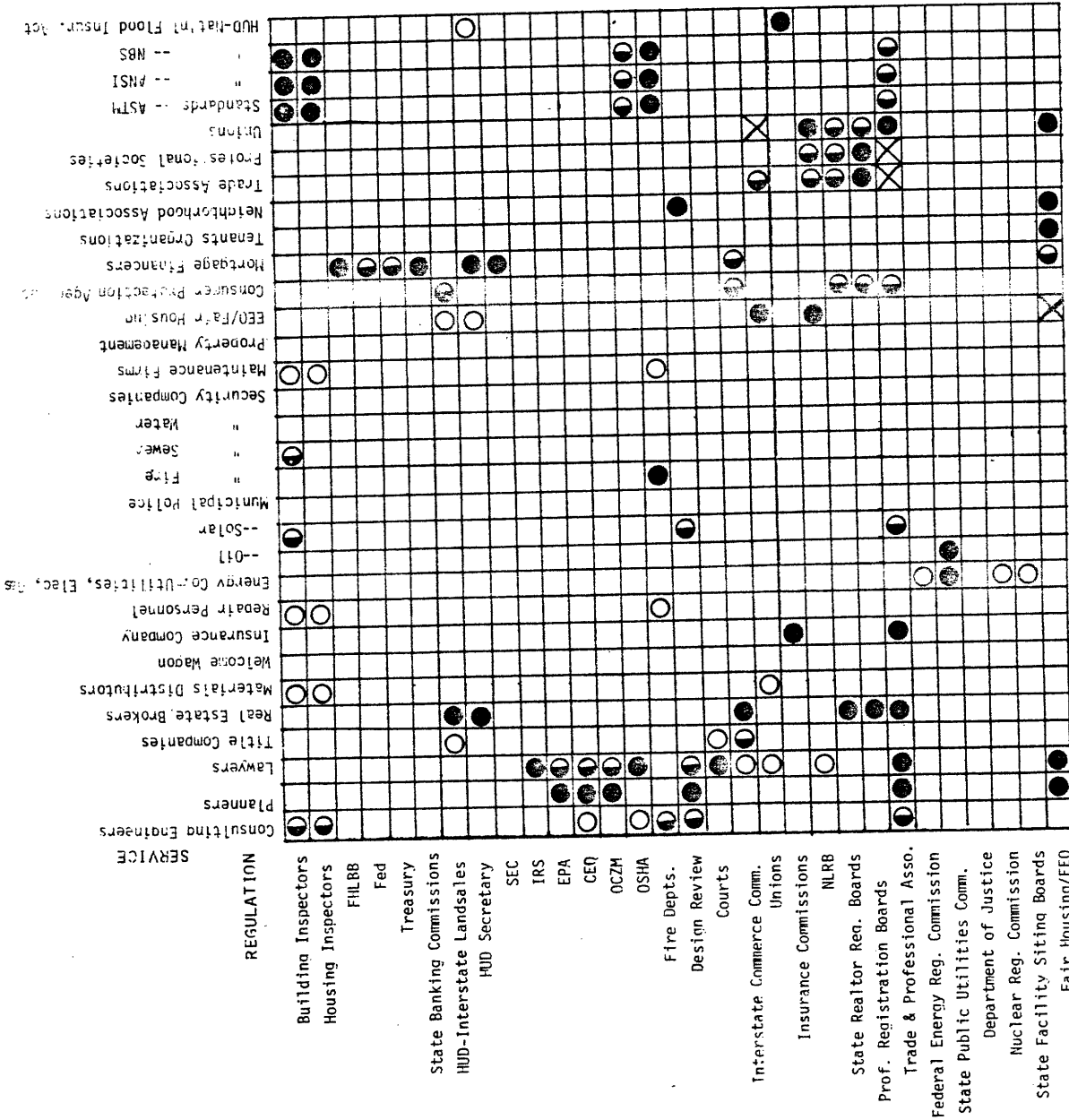
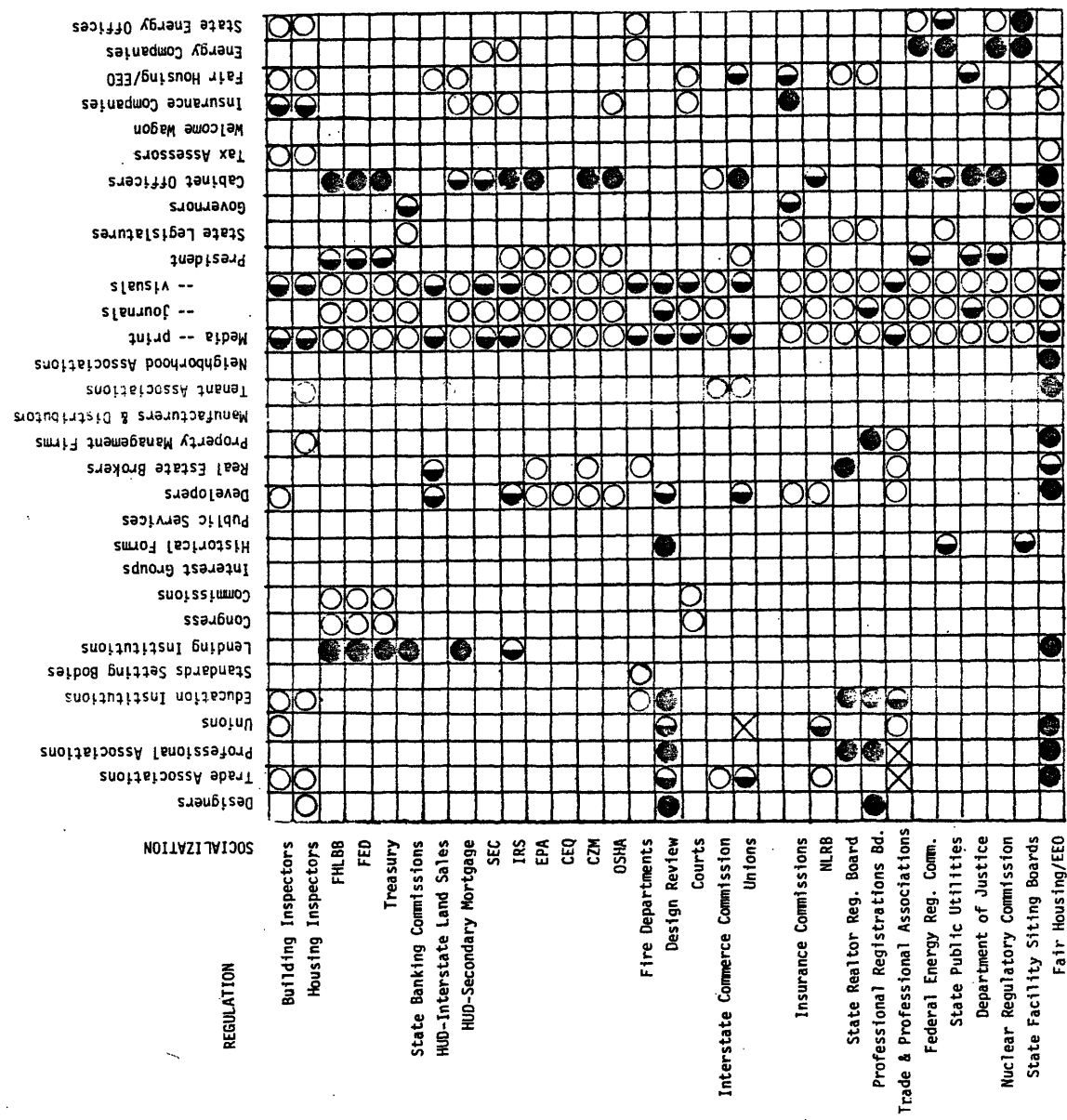


CHART 22 Institutional Entity Interaction in the Housing Arena: Regulation and Socialization Functions



INTERACTION INTENSITY KEY

●	High
◐	Medium
○	Low
X	None

CHART 23
 Institutional Entity Interaction in the Housing Arena: Production and Production Functions

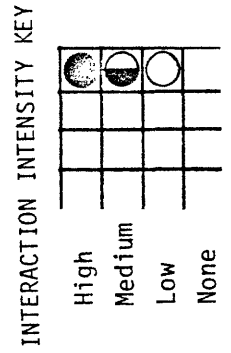
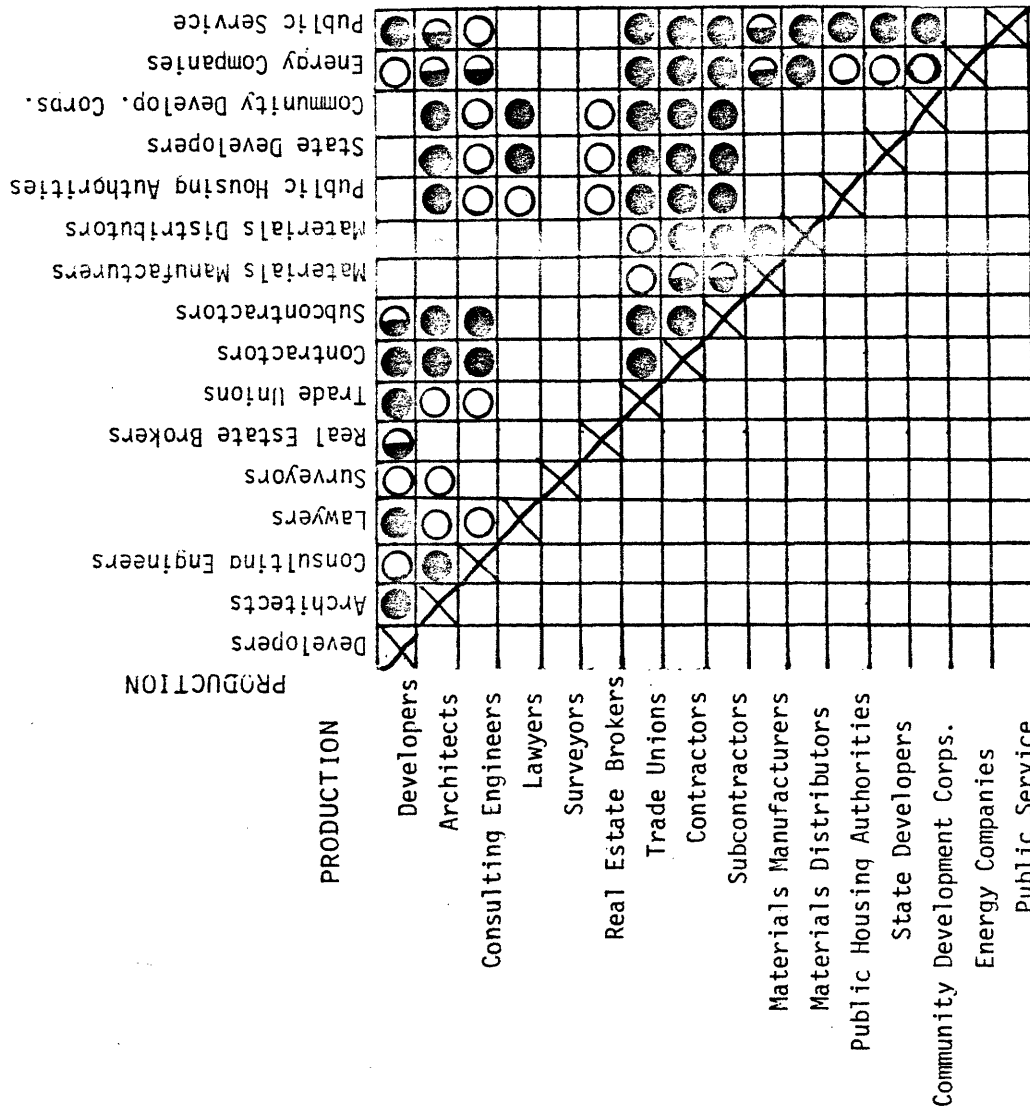


CHART 24 Institutional Entity Interaction in the Housing Arena: Production and Service Functions

SERVICE	Consulting Engineers	Planners	Lawyers	Title Companies	Real Estate Brokers	Materials Distributors	Welcome Wagon	Insurance Companies	Energy Companies - utilities	Energy Companies -- oil	Energy Companies -- solar	Municipal -- police	Municipal -- fire	Municipal -- sewer	Municipal -- water	Security Companies	Maintenance/Repair Firms	Property Management	Fair Housing/EEO -- federal	Fair Housing/EEO -- state	Fair Housing/EEO -- city	Consumer Protection Agencies	Mortgage Financiers	Tenants Organizations	Neighborhood Associations	Trade Associations	Professional Societies	Unions	Standards -- ASTM	Standards -- ANSI	Standards -- NBS	HUD Nat'l Flood Insurance Act	Materials Manufacturers				
Developers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○				
Architects	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○			
Consulting Engineers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		
Lawyers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Surveyors	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Real Estate Brokers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Trade Unions	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Contractors	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Subcontractors	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Materials Manufacturers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Materials Distributors	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Public Housing Authorities	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
State Developers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Community Development Corps.	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Energy Companies	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Public Service	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

INTERACTION INTENSITY KEY

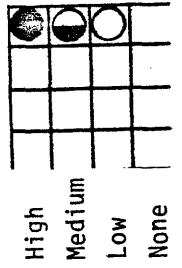


CHART 25
Institutional Entity Interaction in the Housing Arena: Production and Socialization Functions

SOCIALIZATION		PRODUCTION																																		
		Designers	Trade Associations	Professional Associations	Unions	Universities and Educa. Orgs.	Standard Setting Bodies	Lending Institutions	Congress	President	State Legislatures	Governors	Commissions	Cabinet Officers	Interest Groups	Historical Form	Public Services	Tax Assessors	Developers	Real Estate Brokers	Welcome Wagon	Prod. Managmt. Firms	Materials Distrib. & Manuf.	Insurance Companies	Fair Housing Agency/EEO	Energy Companies	Tenant Neighborhood Assoc.	Media-print (glossies, news)	-- Journals	-- Visual	State Energy Office					
Developers	High	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○				
Architects	Medium	●	●	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○				
Consulting Engineers	Low	●	●	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○			
Lawyers	None	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○			
Surveyors	None	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		
Real Estate Brokers	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		
Trade Unions	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Contractors	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Subcontractors	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Materials Manufacturers	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Materials Distributors	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Public Housing Authority	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
State Developers	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Community Development Corpora.	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Energy Companies	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Public Service	Medium	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

INTERACTION INTENSITY KEY

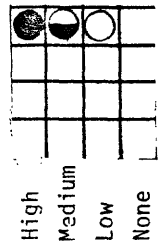
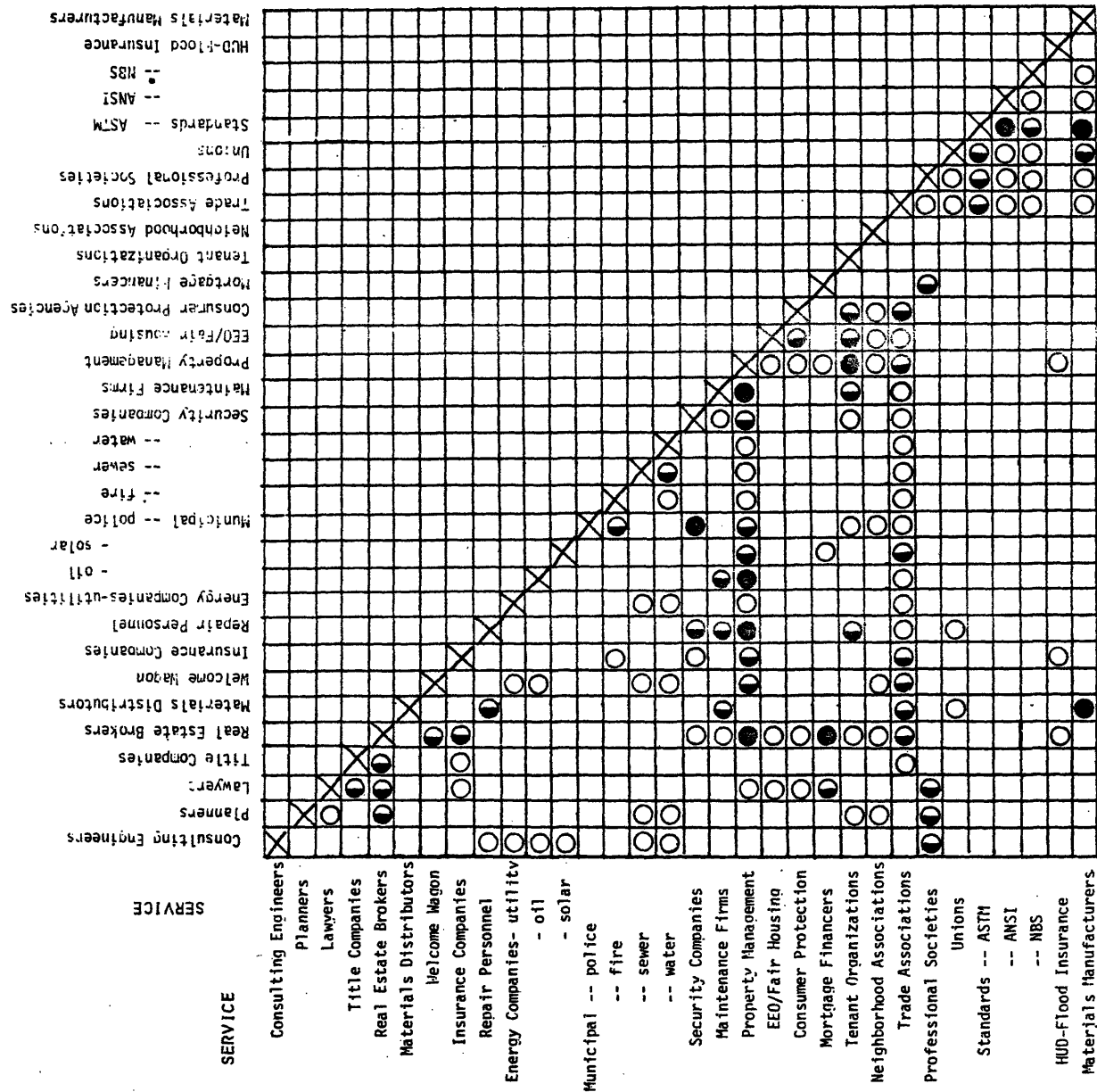
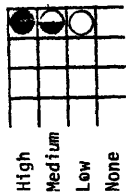


CHART 26
Institutional Entity Interaction in the Housing Area: Service and Service Functions



INTERACTION INTENSITY KEY



CHW 27 Institutional Entity Interaction in the Housing Market: Service and Socialization Functions

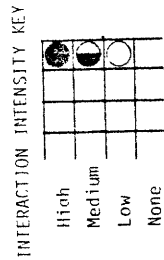
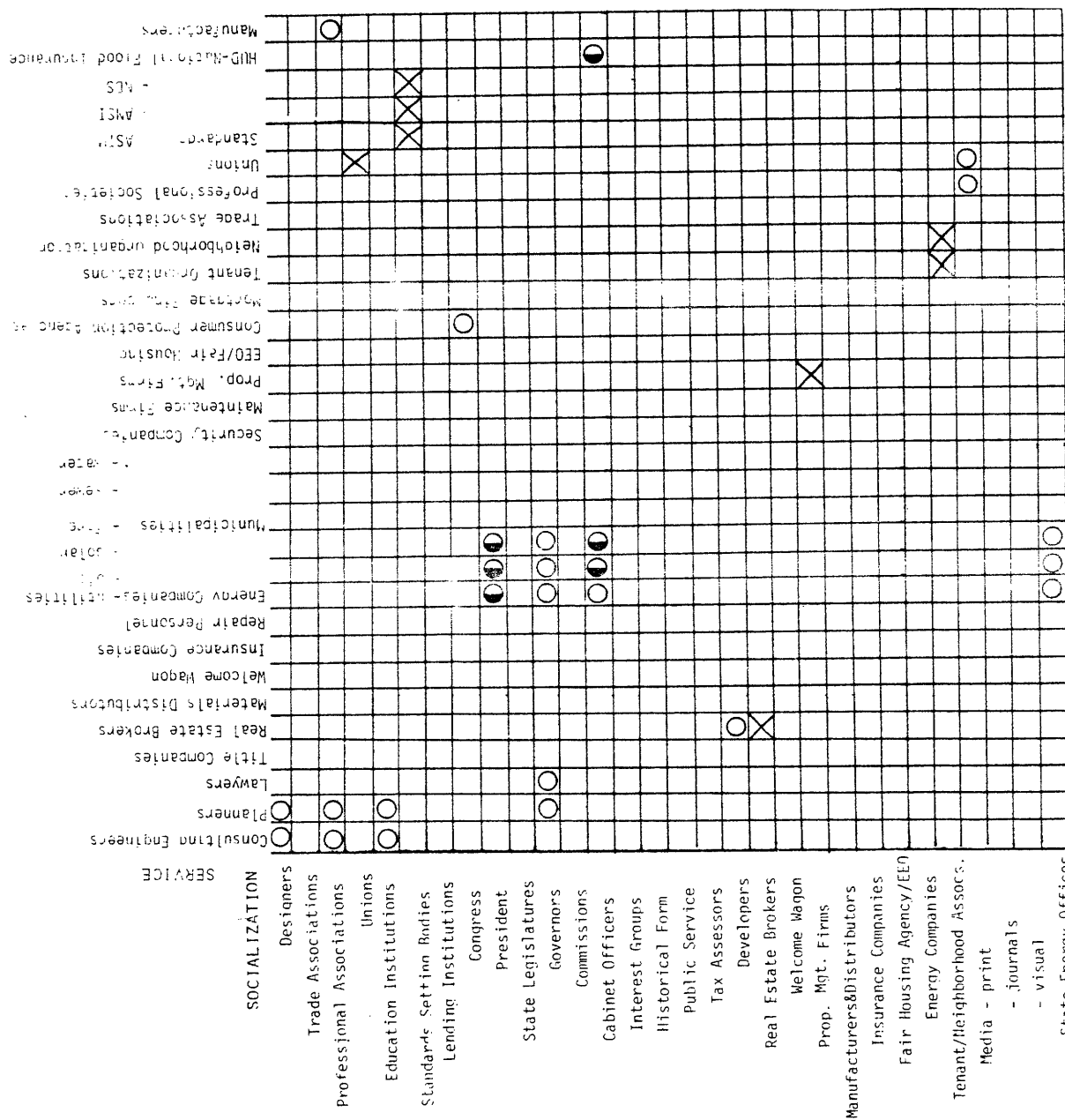
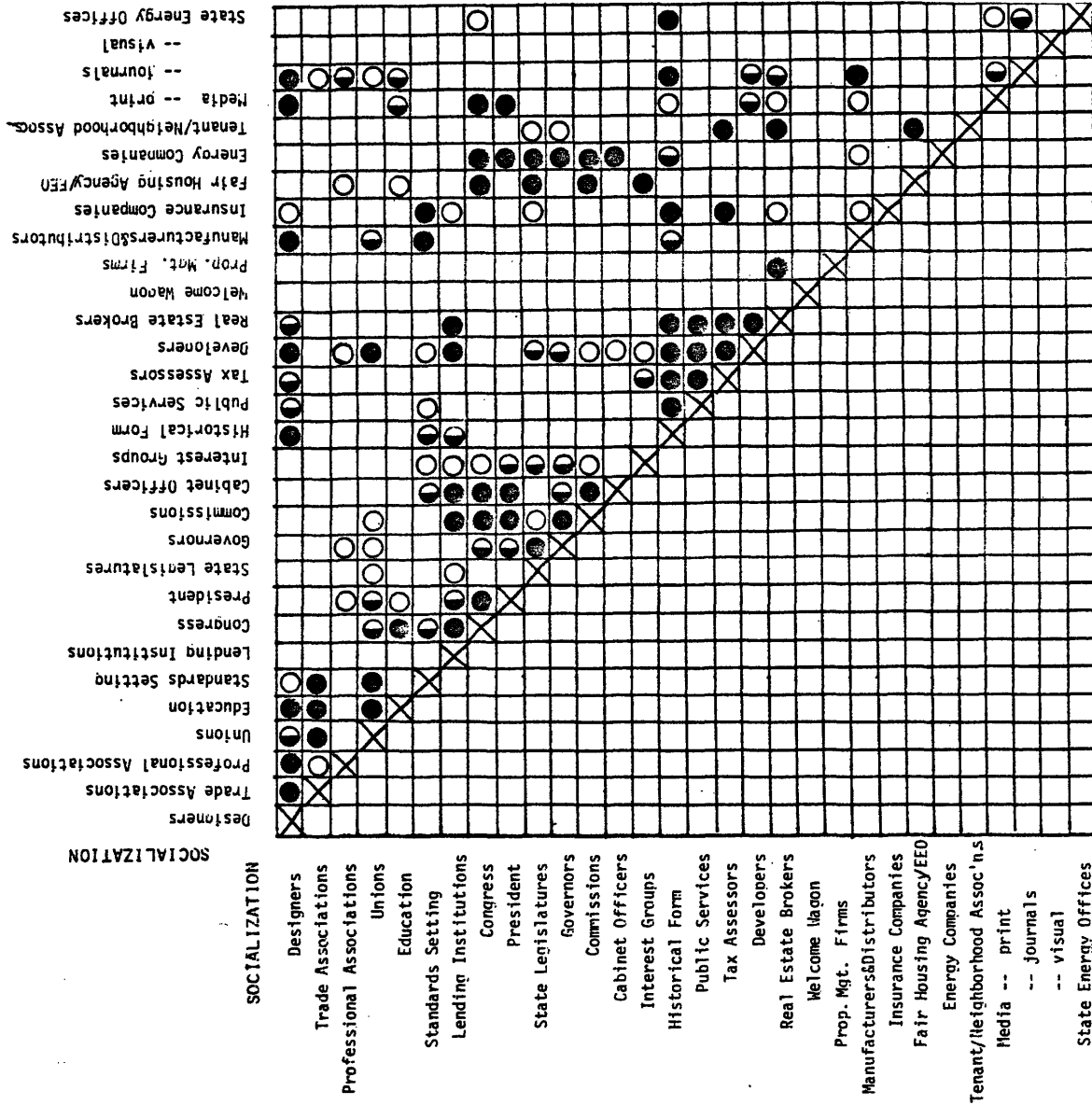


CHART 28 Institutional Entity Interaction in the Housing Arena: Socialization and Socialization Functions



INTERACTION INTENSITY KEY

High	●
Medium	◐
Low	◑
None	○

THE PERTURBATION PROMPTER

The 1973 oil embargo provided dramatic evidence of the nation's reliance on imported non-renewable energy resources. It prompted the passage in 1974 of the Solar Heating and Cooling Demonstration Act (P.L. 93-409), which authorized a wide range of federal activities intended to help establish solar energy as a viable energy resource for the US. A comprehensive program is being conducted by the Department of Energy (DOE) under the authorization of this and related legislation. As part of this effort, DOE is conducting the National Program for Solar Heating and Cooling of Buildings. According to DOE's 1978 annual report on the program, its thrust is to promote and demonstrate the economic viability of solar energy for the heating and cooling of buildings. There are four basic elements:

Research and technology development of new and advanced system approaches and subsystems or components to reduce costs, improve reliability, and provide solutions to problems.

Engineering development aimed at bringing systems, subsystems, and components to a marketable stage for utilization.

Demonstration of solar heating and cooling in commercial and residential buildings, using available systems installed both in new and existing buildings, and the associated collection, evaluation and dissemination of data and development of standards and performance criteria.

Market development to assure that an institutional framework exists for widespread use of solar energy including technology transfer, environmental and resource assessment, and studies on barriers and incentives.

(DOE, 1978c.)

The activities other than residential demonstration that have been completed are summarized in two DOE documents. (DOE, 1978a; DOE, 1978b.)

The Department of Housing and Development (HUD) has responsibility for residential applications. HUD has developed a demonstration program

which provides grants to builders and developers who equip new residential construction or existing housing with solar systems. HUD's residential demonstration program is designed to:

- finance solar systems in both new and existing dwellings;
- develop performance criteria and test procedures for solar dwellings;
- disseminate solar heating and cooling information;
- undertake market development efforts to encourage the rapid and widespread acceptance of solar heating and cooling technologies by the housing industry throughout the US. (HUD, 1976, p. vii.)

The solar systems may be used for water heating and home heating and/or cooling. The program has proceeded in a series of award cycles, each initiated by Requests for Grant Applications (RFGA) announced through the solar and construction press and through HUD's own solar mailing list (HUD, 1978). Five cycles of awards have been made in the HUD residential demonstration, with awards announced on January 19, 1976 (Cycle 1), October 15, 1976 (Cycle 2), May 30, 1977 (Cycle 3), March 29, 1978 (Cycle 4), and September 28, 1978 (Cycle 4a). In addition, HUD (with DOE and the Solar Energy Research Institute) has sponsored a Passive Residential Design Competition and Demonstration, with design prizes and construction grants. Awards were announced December 20, 1978.

While the oil embargo/energy crisis serves as the general perturbation prompter, the specific perturbation prompter is the HUD residential demonstration program, and in particular the RFGA defining the nature of activity required to receive a grant. HUD asked that applicants provide information in two areas: (1) technical aspects of the solar energy system to be used; and (2) reasons why the particular project should be funded as part of a demonstration program. (HUD, 1978). HUD assumed the marketability of the

applicant's projects, as the awards were to cover only the incremental costs of using a solar system. (In all cases backup systems were provided for.)

SPECIFIC RESEARCH DESIGN

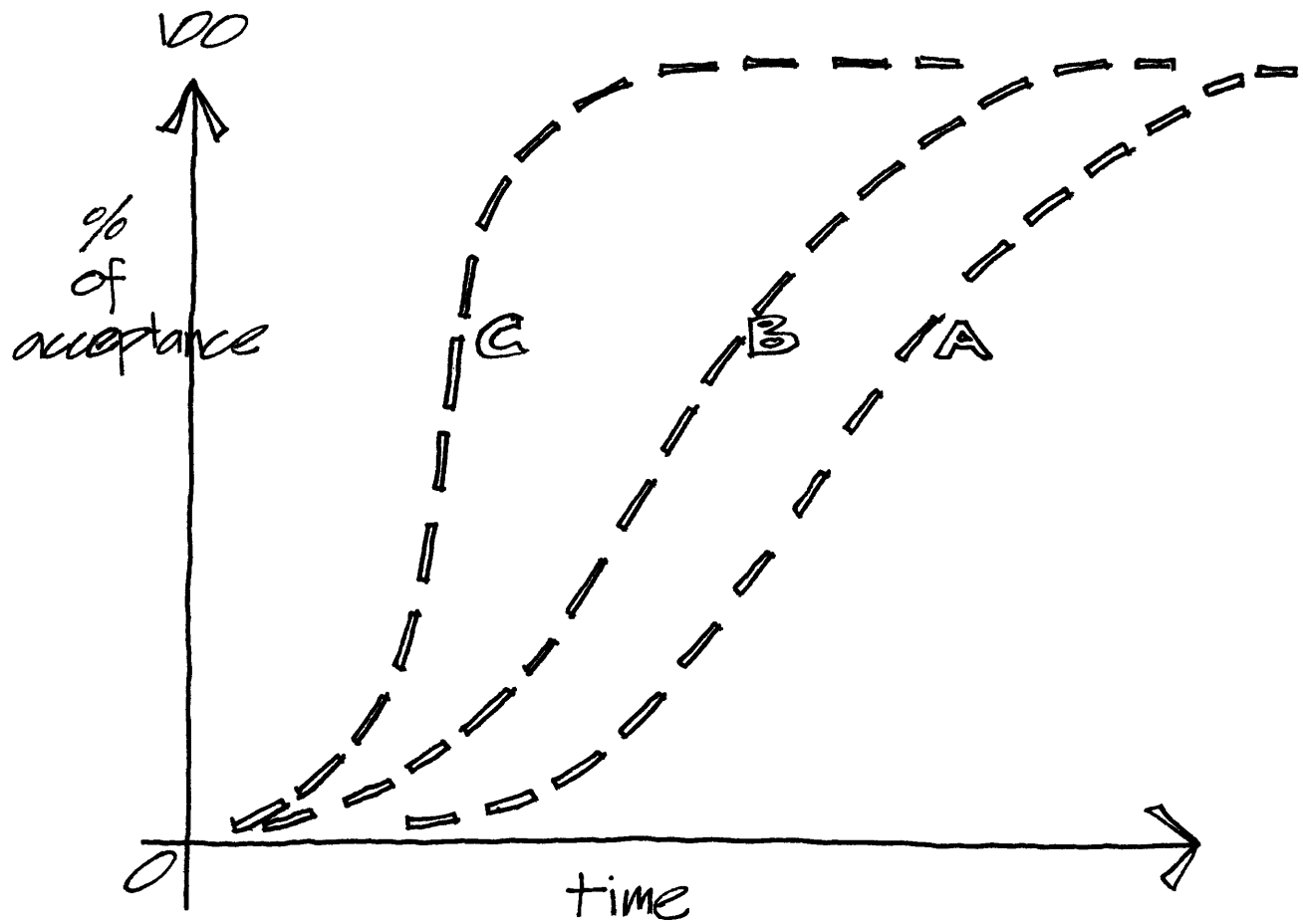
The HUD Heating and Cooling Demonstration Program represents a deliberate public intervention into the housing market to accelerate the acceptance of an innovation, solar energy. The HUD program uses solar thermal technologies. Because solar energy is an innovation in housing, the introduction of both solar thermal and photovoltaic (PV) will have comparable impact in the housing institutional arena. It is for that reason that the study of HUD's program provides useful guidance to framers of programs to accelerate the acceptance of PV in residential applications.

In an economy based on free marketing assumptions, it is necessary to justify market interventions by public bodies. In housing, for example, interventions have been justified by appeals to inequities in access (for housing subsidies), and to the societal importance of historic form (for special tax treatment of income-producing rehabilitated historic structures). Intervention to encourage use of indigenous renewable energy resources (such as solar) is justified on the grounds of political independence and the control of inflationary forces. Because the housing sector is a high consumer of energy, there are several intervention efforts. The efforts include those aimed at user practices (for example, energy conservation practices including thermostat settings and automobile usage) as well as those aimed at equipment used (for example, energy efficiency ratings on major appliances and gas mileage ratings on automobiles.) The HUD Solar Heating and Cooling Demonstration Program fits into the second category.

In general, public intervention into market practices to accelerate innovation acceptance is based on an "S-curve" model of innovation diffusion. As shown in Figure 1, private market acceptance of an innovation occurring

FIGURE 1

INNOVATION ACCEPTANCE UNDER NORMAL, MARKET-BASED PUBLIC INTERVENTION AND INSTITUTIONALLY-BASED INTERVENTION CONDITIONS



A = normal conditions

B = market-based public intervention conditions

C = institutionally-based public intervention conditions

through time is plotted by curve A. Market-based public intervention theory is plotted by curve B. Curve C plots innovation acceptance prompted by institutionally-based public intervention. In the case of curve C, the public intervention not only prompts the acceptance of the innovation earlier in time, it also encourages the acceptance to occur more rapidly once begun. Hence, where curves A and B are identical in slope and duration, with curve B merely beginning sooner, curve C has a sharper slope and begins sooner.

The difference between curves A/B and C effectively reflects a difference between market and institutional analysis. In A/B the factors influencing acceptance are reduced to cost. Government intervention strategies to accelerate innovation are premised on impacting cost, typically to minimize the initial costs of innovation development by the private sector. However, once the acceptance process begins, it follows a trajectory no different from private market acceptance. The only difference is that it has begun sooner.

By comparison, institutional analysis identifies multiple currencies influencing the innovation acceptance decision. Institutional exchanges consist of information, of which cost is only one type. Among other currencies of exchange are source (From whom do I hear the information?), form (In what form do I acquire the information?), context (In what institutional context am I acting?), and application (How easily can this be made part of my routine?). The various currencies interact to yield some measure of comprehensibility of the innovation. To the extent that the innovation is comprehensible, its acceptance will accelerate.

The HUD Solar Heating and Cooling Demonstration Program uses a market-based public intervention strategy. The program proceeds on the hypothesis that financial incentives are both necessary and sufficient to accelerate

acceptance of solar technologies in housing. It further hypothesizes that the financial incentives can be focused on a single actor, the developer/builder.

A sound research design for institutional analysis of this program includes cost as one of the currencies of institutional exchange which contribute to the comprehensibility of an innovation. But the research design must also account for the other currencies listed above: sources, form, context, and application.

Method

Acceptance of HUD's RFGA and solar increment grants to developers as the perturbation prompter, combined with research constraints of time, funds and personnel (and in light of the fragmentation, disaggregation and localization of the housing arena), led to a decision to adopt an illustrative case study method for this research. Specific projects were selected for detailed study based on their possible usefulness in representing institutional currency exchange processes relevant to solar innovation acceptance in housing. The case studies are intended to illustrate particular currency exchange dynamics in various localized housing institutional arenas.

Sample Selection

Though HUD focused on developers as the critical actors to whom to demonstrate solar technologies, it did not make grants according to the type of developer. The work completed in preparing the hypothesized institutional arena for housing revealed that factors contributing to comprehensibility would vary according to developer type. Hence, the first variable used in sample selection was developer type. A second primary variable was market location. Finally, high intensity interactions between institutional entities (as shown in the hypothesized institutional arena) were used to cull possible cases for sample selection.

The sample universe was all grant awards made in Cycles 1, 2, and 3. As shown in Table 8, this consisted of 317 recipients. The grant recipients were categorized according to ten developer types. The ten types of developer are:

- + Small builder -- primary activity is the construction of housing
- + Small developer -- primary activity is the packaging of housing developments with a volume of up to 75 units/year
- + Housing Authority -- a municipal housing authority
- + Large developer -- primary activity is the packaging of housing developments with a volume of 75 or more units/year
- + Non-profit developer -- primary activity is the packaging of housing developments, with a non-profit incorporation
- + Manufacturer -- primary activity is the manufacture of building materials, with housing development as a secondary activity
- + Designer/Engineer -- primary activity is either as a designer or engineer, with housing development as a secondary activity
- + Utility -- primary activity is as a utility company
- + City -- primary activity is as a municipality
- + Institution -- primary activity is as an institution, such as university

Designation as a type of developer was made by project staff members, based on project information contained in the three summary volumes about HUD's project. (ERDA, 1976; HUD, 1976; HUD, 1977.) The distribution of awards by developer type was shifted during the three cycles, with small builders and large developers being increased proportionally. (See Tables 9, 10, and 11.) It was decided that the sample would include at least one project for each developer type (excepting institution and city), with at least one project in each of four regions into which the continental US was divided. The four regions (and states included in them) are:

- * Mid-Atlantic and Northeast -- VT, NH, MA, CT, RI, ME, NY, NJ, PA

Table 8

HUD-DOE Solar Heating and Cooling Demonstration Program
 Residential Project Funded by type, size, and developer
 Cycles 1, 2, and 3

	NEW				RETROFIT				TOTAL
	10 or less	11-74	75+	10 or less	11-74	75+	TOTAL		
Small builder	36.3%	112	1		1	1		115	
Small developer	19.9%	59			4			63	
Housing Authority	5.4%	3	4		3	3	4	17	
Large developer	9.5%	8	5	7		3	7	30	
Non-profit developer	7.6%	9	3	1	5	5	1	24	
Manufacturer	0.3%			1				1	
Designer/Engineer	11.0%	29	4		2			35	
Utility	1.3%	3	1					4	
City	2.8%	4	1		2	2		9	
Institution	6.0%	7			6	2	4	19	
TOTAL		234	19	9	23	16	16	317	

Table 9

HUD-DOE Solar Heating and Cooling Demonstration Program
Residential Project Funded by type, size, and developer
Cycle 1

	NEW			RETROFIT			TOTAL
	10 or less	11-74	75+	10 or less	11-74	75+	
Small builder	26.1%	12					12
Small developer	17.4%	8					8
Housing Authority	4.3%	2					2
Large developer	4.3%	2					2
Non-profit developer	8.7%	3	1				4
Manufacturer	0.0%						0
Designer/Engineer	21.7%	10					10
Utility	0.0%						0
City	8.7%	1		2	1		4
Institution	8.7%	4					4
TOTAL		42	1	0	2	1	46

Table 10

HUD-DOE Solar Heating and Cooling Demonstration Program
Residential Project Funded by type, size, and developer
Cycle 2

	NEW				RETROFIT			TOTAL
	10 or less	11-74	75+	10 or less	11-74	75+		
Small builder 36.2%	36			1			37	
Small developer 18.6%	17			2			19	
Housing Authority 7.8%		3		2	2	1	8	
Large developer 6.9%	1	3	2			1	7	
Non-profit developer 5.9%	1			2	3		6	
Manufacturer 1.0%			1				1	
Designer/Engineer 11.8%	8	2		2			12	
Utility 2.0%	2						2	
City 3.9%	3	1					4	
Institution 5.9%				3	1	2	6	
TOTAL	68	9	3	12	6	4	102	

Table 11

HUD-DOE Solar Heating and Cooling Demonstration Program
Residential Project Funded by type, size, and developer
Cycle 3

	NEW				RETROFIT				TOTAL
	10 or less	11-74	75+		10 or less	11-74	75+		
Small builder	64 39.1%	1			1			66	
Small developer	34 21.3%				2	0		36	
Housing Authority	1 4.1%	1			1	1	3	7	
Large developer	5 13.0%	3	5		3	3	6	22	
Non-profit developer	5 8.3%	2	1		3	2	1	14	
Manufacturer	0 0.0%							0	
Designer/Engineer	11 7.7%	2						13	
Utility	1 1.2%	1						2	
City	0 0.6%					1		1	
Institution	3 4.7%				3	1	2	9	
TOTAL	124	10	6		9	9	12	170	

Table 12

Indicative Sample by Developer Type & Region

	Mid-Atlantic & Northeast	Southeast	Southwest & West	Midwest & Northwest
Small builder				1
Small developer		1		
Housing Authority		1		
Large developer	1			
Non-profit developer	3			
Manufacturer			1	
Designer/Engineer			1	
Utility			1	
City			1	

- * Southeast -- MD, VA, DE, WVA, KY, TN, NC, SC, GA, FL, MI, AL, LA, AR
- * Southwest and West -- TX, OK, NM, AZ, CA, NV, UT
- * Midwest and Northwest -- OH, IN, MI, WI, IL, MT, IA, MN, ND, SD, NE, KS, CO, WY, ID, WA, OR, AK, MO

The regional delineation was based primarily on climatic conditions with particular reference to insolation.

On first review, 34 projects were identified as of potential interest for case study. A detailed review of project application and subsequent development information was conducted using HUD's files. The Real Estate Research Corporation is also conducting research on factors contributing to the acceptance of solar technology on housing, under contract with HUD; where applicable, their field files on the list of potential sample projects were also reviewed. Based on this review, 11 projects were selected for direct contact and on-site case study. The number selected by developer type and region is shown in Table 12.

Data Collection Process

An initial notice of case study activity was directed to the developer of record for each project. A list of additional informants, produced on the bases of hypothesized interaction intensity as revealed in the various matrices, was developed for each project. The developer was asked to supply names and addresses of each actor, for purposes of direct contact by project staff. Insofar as was possible, informants were supplied in advance with some basic information on the purpose of the research.

Interviews were held with informants, with data collected using a specifically developed open-ended semi-structured survey research instrument. (See Appendix A.) Most field research was conducted during January, 1979, with follow-up inquiries conducted by telephone through February, March, and

April. Interviews with additional informants were often scheduled on the site, at the suggestion of one or more informants.

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