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Operation Breakthrough was initiated by the Department of Housing and Urban Development (HUD) to improve the process of providing housing for lower income families by demonstrating the value of industrialized (factory built) housing construction methods and by eliminating or reducing barriers to industrialized housing construction. Operation Breakthrough did not prove the marketability of most of its sponsored housing construction methods, but the program has supported some useful changes in the housing industry by exposing builders to new construction methods and materials, exploring new methods of evaluating housing construction, encouraging changes in building code requirements, and supporting statewide building codes. The program did not accomplish its objectives because unexpected decreases occurred in the housing market; HUD subsidized mortgage housing programs were suspended; and some housing systems lacked cost savings potential. Experience gained through Operation Breakthrough indicates that demonstration programs should involve: thorough preliminary work to develop criteria, evaluate proposed approaches, and analyze market uncertainties; feasible strategies to overcome marketing problems; research to resolve technical questions; and planning for program evaluation. (Author/SC)

00544

REPORT TO THE CONGRESS



*BY THE COMPTROLLER GENERAL
OF THE UNITED STATES*

Operation Breakthrough-- Lessons Learned About Demonstrating New Technology

Department of Housing and Urban Development
Department of Commerce

Operation Breakthrough was initiated by the Department of Housing and Urban Development to develop and demonstrate industrialized housing construction methods.

Operation Breakthrough did not prove the marketability of most of its sponsored housing construction methods, but it did support some useful changes in the housing industry. Experience gained through Operation Breakthrough indicates that demonstration programs should involve

- thorough preliminary work to develop criteria, evaluate proposed approaches, and analyze market uncertainties;
- feasible strategies to overcome marketing problems;
- research to resolve technical questions; and
- planning for program evaluation.



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-114860

To the President of the Senate and the
Speaker of the House of Representatives

This report describes our review of the Department of Housing and Urban Development's Operation Breakthrough program initiated to develop and demonstrate industrialized housing construction methods. Because of the Federal Government's continuing role in demonstrating new technologies, we sought to know its accomplishments and the lessons to be learned about planning and managing technology demonstration programs.

This review was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53) and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of Housing and Urban Development; and the Secretary of Commerce.

F. B. Miles

Comptroller General
of the United States

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ABBREVIATIONS

GAO	General Accounting Office
HUD	Department of Housing and Urban Development
NBS	National Bureau of Standards
RERC	Real Estate Research Corporation

D I G E S T

The Congress recognized the need for greater use of technology to help solve the Nation's domestic problems, such as the shortage of adequate housing for lower income families. Operation Breakthrough was initiated by the Department of Housing and Urban Development to improve the process of providing housing by

- demonstrating the value of industrialized (factory built) housing construction methods and
- eliminating or reducing barriers to industrialized housing construction.

Begun in 1969, Operation Breakthrough is largely complete, at a Federal cost of about \$72 million. (See p. 1.)

In 1974 the Congress authorized other demonstration programs in solar and geothermal energy and it is now considering more programs. These areas, like housing, involve complex interrelationships among Federal agencies, State and local governments, and the private sector.

In keeping with the Federal Government's continuing role in demonstrating new technologies, GAO reviewed Operation Breakthrough to find out what it has accomplished and the lessons to be learned about planning and managing technology demonstration programs. Experience gained from Operation Breakthrough should be useful to the Congress in authorizing, funding, and monitoring technology demonstration programs in the future. (See pp. 1 and 2.)

GAO sent questionnaires to industrialized housing manufacturers and conventional

homebuilders to obtain their opinions about Operation Breakthrough's contributions. GAO learned that the program has not led to major changes in the housing industry, but has supported some useful changes in the industry by

- exposing builders to new construction methods and materials (see p. 23),
- exploring new methods of evaluating housing construction (see p. 20),
- encouraging changes in building code requirements (see p. 21),
- supporting statewide building codes (see p. 21), and
- testing new labor agreements for industrialized housing construction (see p. 24).

Operation Breakthrough's objective was to create sufficient housing markets to support the high production level required for efficient industrialized housing construction. Most of the 22 industrialized housing systems sponsored in Operation Breakthrough are, however, no longer produced. (See p. 17.) The program did not accomplish its objectives because

- unexpected decreases occurred in the housing market (see p. 18);
- the Department of Housing and Urban Development's subsidized mortgage housing programs, which were intended as a housing market by planners and program participants of Operation Breakthrough, were suspended (see p. 18); and
- some housing systems lacked cost savings potential (see p. 19).

In addition, the program did not document and obtain answers to questions from the Congress concerning the cost savings to be gained by using industrialized housing

construction methods. Studies of Operation Breakthrough by the National Academy of Sciences and the Real Estate Research Corporation concluded that the established time frame for reaching the program's objectives was too short and that other management considerations needed more attention. (See p. 34.)

The Departments of Housing and Urban Development and Commerce reviewed this report and regard it as a fair assessment of their roles in Operation Breakthrough.

GAO believes Operation Breakthrough provides lessons about planning and managing technology demonstrations that Federal agencies should consider in their present and future programs. It has shown the need for

- thorough preliminary work to develop design criteria, evaluate proposed approaches, and analyze market uncertainties (see p. 31);
- feasible strategies to overcome marketing problems (see p. 32);
- research to resolve technical questions (see p. 32); and
- planning for program evaluation (see p. 33).

CHAPTER 1

INTRODUCTION

The Federal Government attempts through research and development to find better ways to meet pressing domestic problems in such areas as housing, public safety, transportation, energy, and environmental protection. Federal civilian research and development expenditures, other than for space exploration, are estimated to be \$9.6 billion for fiscal year 1977.

Many complex factors interact to delay or prevent use of new technology including

- fragmented governmental jurisdictions that prevent formation of the large markets often necessary to take advantage of modern technology,
- the inability of State and local governments to support or undertake experimentation needed to develop new or improved technology,
- resistance to change by parties with vested interests,
- private industry's reluctance to invest in technology not yet proven to be feasible and practical, and
- Government policies that inhibit technology use.

DEMONSTRATION PROGRAMS

Demonstration programs help in developing new technology by moving it out of the research laboratory to convince industry, State and local governments, or other consumers of its value. The Department of Housing and Urban Development (HUD) initiated Operation Breakthrough in 1969 to support the development and demonstration of new housing construction methods. Largely completed in 1974, Operation Breakthrough cost the Federal Government about \$72 million, which is about 25 percent of the HUD research and development budget for fiscal years 1970-74.

There is continuing interest in technology demonstration programs. In 1974, the Congress authorized Federal demonstration programs in solar and geothermal energy use and it is now considering demonstration programs to support the development and more widespread use of other energy technologies. We reviewed Operation Breakthrough to find out what it has

accomplished and the lessons to be learned. Experience gained from this program should be useful to Federal agencies in planning and managing technology demonstration programs and to the Congress in monitoring them.

HOUSING--A NATIONAL PROBLEM

Studies of the Nation's housing situation in the 1960s showed that production needed to be greatly increased because of population growth and spreading urban slums. At the same time, rising construction costs led to concern that many Americans would not be able to afford new housing if it were built. According to congressional studies, half of all American families could not afford to buy a house of average cost in 1968, the year before Operation Breakthrough began.

The Housing and Urban Development Act of 1968 (42 U.S.C. 1441a) established the goal of building or rehabilitating 26 million housing units in 10 years--a rate much higher than any previous production level. To achieve this goal, HUD anticipated in 1969 a progressive increase in required construction of housing units over the 10-year period, reaching 2.6 million units in 1973. (See chart on following page.)

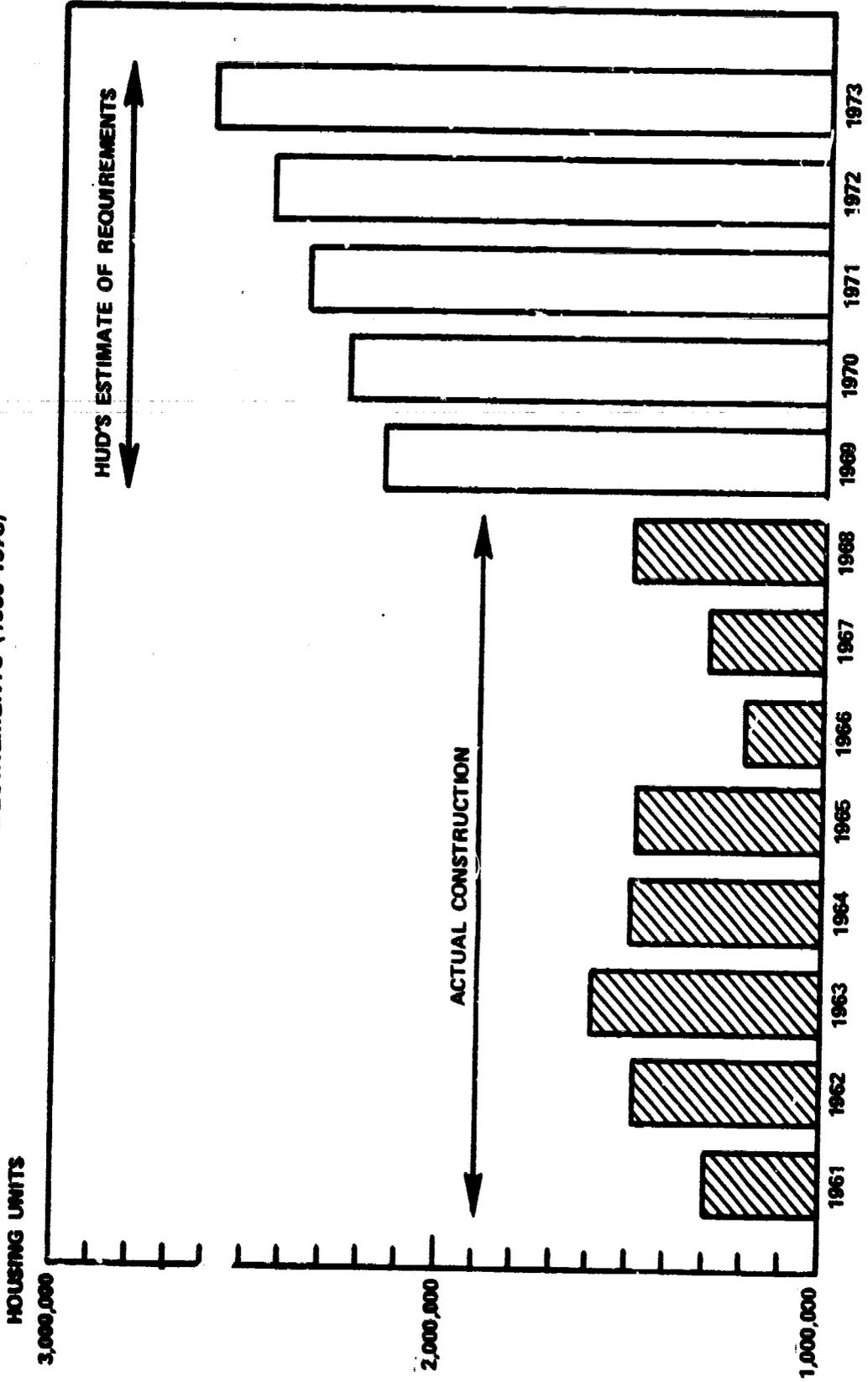
INTEREST IN INDUSTRIALIZED HOUSING

After World War II, several European countries developed industrialized housing construction methods to meet severe housing needs. These methods were based on producing building components at a factory to reduce the work required at the construction site. To increase efficiency, European systems used standardized designs, and the most advanced systems used detailed planning to speed construction and lower costs.

In 1969 most housing in the United States was constructed by conventional methods, calling for it to be built on its foundation. Some preassembled parts, such as roof trusses and prehung doors, were widely used in this construction. Some U.S. firms successfully marketed houses produced in factories and many Americans lived in mobile homes, which is another form of factory-produced housing. There were many failures, however, usually because firms could not market enough houses to reach the reduced cost of mass production.

Several studies in the 1960s investigated industrialized housing construction methods (i.e., mass production techniques), but there was no agreement on whether their use would lead to lower housing costs. The studies found industrialized methods to be technically feasible, but concluded that social,

**COMPARISON OF HOUSING CONSTRUCTION (1961-1968)
WITH HUD'S ESTIMATE OF HOUSING CONSTRUCTION
REQUIREMENTS (1969-1973)**



economic, and political factors prevented their widespread use in the United States. With their need for mass markets, industrialized housing construction methods were particularly susceptible to some problems that led to the fragmented housing markets.

Land assembly problems made orderly large-scale housing construction difficult to achieve. Assembling the land necessary for a large development could require dealing with hundreds of people and a single holdout could impair an entire development effort. In addition, many local governments did not have the authority or expertise necessary to support orderly large-scale housing construction.

Local building codes frequently limited the choice of technology and the use of industrialized housing construction methods. Delays resulted from the need to obtain building code approvals in each jurisdiction. Design changes required to meet different codes increased production costs and code inspections at the construction site limited work that could be completed at the factory.

In addition to market and code problems, industrialized housing manufacturers encountered homebuyers prejudiced against prebuilt housing and found financial institutions reluctant to support experimentation with innovative construction methods.

The Demonstration Cities and Metropolitan Development Act of 1966 (42 U.S.C. 3372) gave HUD authority to encourage adopting new and improved methods in the construction industry. The Housing and Urban Development Act of 1968 (12 U.S.C. 1701z) authorized an experimental program to test if cost savings could be achieved by using mass production methods for housing construction. The 1968 act authorized selection of up to 5 new housing systems and the construction of 5,000 units of each system. This step was intended to provide a test of whether large-scale economies or mass use of prebuilt components could reduce housing construction costs, provide production cost data on the selected systems, and determine the effect of local building codes on costs.

SCOPE OF REVIEW

We interviewed HUD and National Bureau of Standards (NBS) officials and Operation Breakthrough housing unit manufacturers; examined HUD records; reviewed studies of Operation Breakthrough and industrialized housing construction; and sent

questionnaires to Operation Breakthrough housing unit manufacturers, other industrialized housing manufacturers, and conventional homebuilders. Questionnaire data was obtained between April and December 1975.

Questionnaires were sent to 17 of the 22 Operation Breakthrough manufacturers. We obtained information from four of the other five through interviews. The remaining manufacturer withdrew from Operation Breakthrough participation without building any prototype units and went bankrupt. Questionnaire responses were received from 15 of the 17 manufacturers we solicited.

Questionnaires were sent to the 285 firms identified from available sources as industrialized housing unit manufacturers. Of the 285 firms, 53 were no longer in the industrialized housing business or could not be located. We received questionnaire responses from 162 or about 70 percent of the remaining 232 firms.

Questionnaires were sent to 900 conventional builders selected randomly from approximately 22,200 builders. Excluding 80 builders who indicated they were no longer in business and 72 we could not locate, we received questionnaire responses from 456 builders or about 61 percent of the remaining 748.

Chapter 2

OPERATION BREAKTHROUGH - OBJECTIVES AND PLANS

According to Department of Housing and Urban Development officials, labor practices, building codes, and other problems prevented developing a modern housing industry based on large-scale housing construction methods. HUD officials believed that publicity from a large-scale demonstration of industrialized housing construction methods could be a catalyst in helping reduce or eliminate the complex housing industry problems and serve as the basis for cooperation between State and local governments, private industry, and other groups involved with housing problems.

Using broad research authority in the Demonstration Cities and Metropolitan Development Act of 1966, HUD initiated Operation Breakthrough as an action program to support the development of industrialized housing construction systems and the production of a large number of such houses within 3 years.

HUD took this step because it believed

- rapid adoption of modern, systematic construction methods was necessary to achieve the national housing goal of 26 million units in 10 years;
- an experimental program could not provide convincing information on the value of such methods because the housing industry was too complex; and
- earlier studies adequately identified problems retarding housing industry modernization.

HUD officials thought section 108 of the Housing and Urban Development Act of 1968 did not adequately address problems for new housing technology. HUD, however, hoped to meet some experimental objectives of the act by identifying and developing innovative construction methods, documenting the production costs of housing construction methods, and supporting the use of these methods at the production levels the act called for.

Because of the fragmentation of the housing industry and market, HUD encouraged State and local governments to identify and assemble suitable markets for the rapid housing production planned under Operation Breakthrough. The program was planned and implemented in the following steps.

SUBMISSION OF INDUSTRY PROPOSALS

In June 1969 HUD asked industry to submit proposals for housing systems that blended the main elements of housing production, creating a complete system for the large-scale production and sale of quality residential units.

HUD received 236 proposals and after extensive evaluation selected 22 to participate in Operation Breakthrough. These were systems HUD believed had the necessary technical quality and were backed by manufacturers with sufficient managerial strength and financial resources to produce and market a large number of houses.

PHASE I--DESIGN AND DEVELOPMENT

The purpose of this phase was to support the development and testing of the 22 selected housing systems. HUD awarded contracts to the these manufacturers to prepare designs, develop engineering data, and plan the construction of prototype units.

HUD commissioned the Department of Commerce's National Bureau of Standards to develop criteria to evaluate the housing systems and to supervise design evaluation. Evaluation was needed to insure that the system designs met standards for adequate housing. NBS was selected for this task because it had a staff knowledgeable in building technology as well as an established building research program.

Existing building codes were not flexible enough for use in evaluating new housing designs and construction methods; therefore, NBS developed special Guide Criteria for the Operation Breakthrough systems. Building codes, for example, require specific materials and/or construction methods. To provide flexibility, the Operation Breakthrough Guide Criteria followed a performance approach which stated the desired attributes of a material, component, or system to meet the needs of the potential occupant without specifying the means to achieve the results. The Operation Breakthrough housing designs were evaluated against the Guide Criteria in a testing program that included design analysis and physical testing of selected building components.

HUD records show that the Government's cost for Phase I was \$22.1 million as follows.

<u>Item</u>	<u>Amount</u> (millions)
Payments to Operation Break-through builders	\$11.1
Testing	5.5
Site design for Phase II	4.7
Other costs	_.8
Total	<u>\$22.1</u>

PHASE II--PROTOTYPE CONSTRUCTION
AND DEMONSTRATION

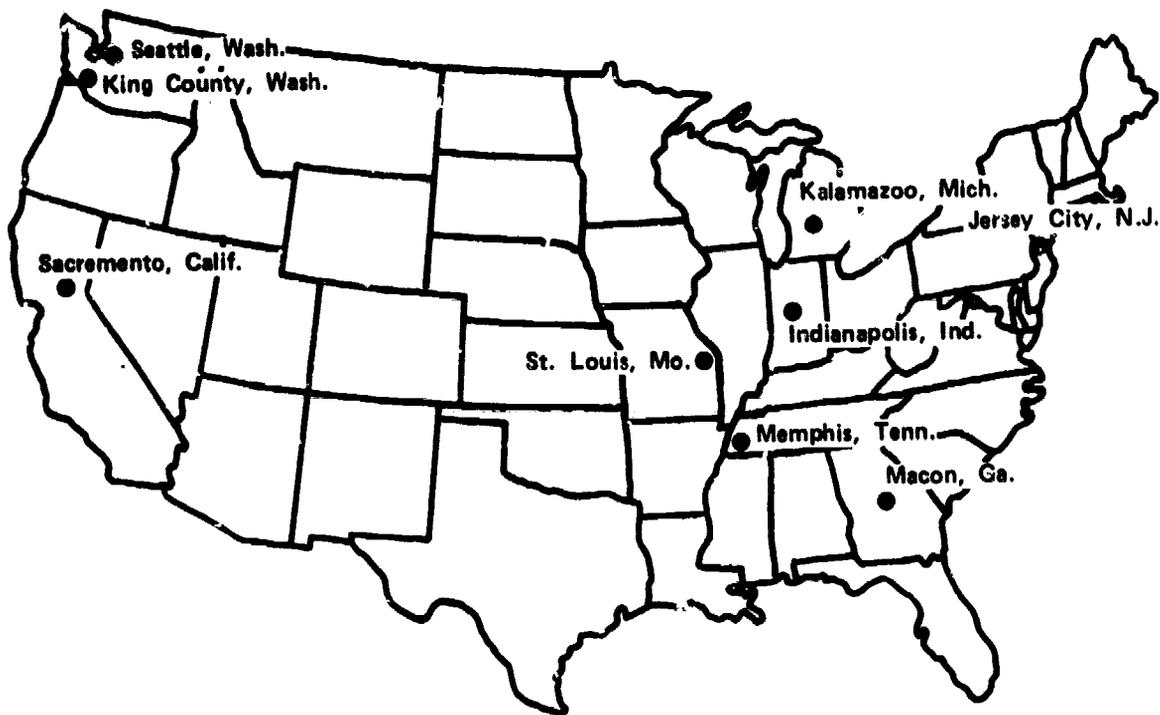
HUD wanted to provide visual demonstrations of the capability of industrialized housing construction. Consequently, it included in Operation Breakthrough the construction of prototype housing units at sites in different regions of the country. HUD wanted each site to be produced by several manufacturers, with each manufacturer represented by enough units to demonstrate land use patterns and housing system variety.

State and local governments were asked to propose locations for the sites. Among other things, HUD wanted the sites to be (1) from 5 to 30 acres in size, (2) accessible to major transportation and hotel centers, and (3) spread across the country. Together the sites would demonstrate a well-balanced combination of factors typical of the U.S. housing market and various climatic and market characteristics.

HUD received 218 proposals nominating 141 site locations in 37 States and the District of Columbia. It selected 11 locations, but two were canceled because of budget constraints. For each site, HUD contracted for the development of a prototype plan and costs were charged to Phase I. The locations are shown on page 9.

As aspects of the prototype construction were better understood, HUD recognized the need for a single point of responsibility in developing each site. Therefore, it contracted with eight corporations (site developers) to perform this function.

LOCATION OF OPERATION BREAKTHROUGH PROTOTYPE SITES



Each site developer would assume title to the land, arrange to develop the location, contract with housing systems manufacturers for construction, supervise the construction, and arrange for mortgage financing of the units. The site developer was also responsible for providing facilities for visitors and making arrangements to rent the prototype units.

Housing units constructed at the nine sites are as follows.

Operation Breakthrough Prototype Sites

<u>Location</u>	<u>Number of housing units</u>	<u>Number of manufacturers</u>	<u>Site completed and occupied</u>
Indianapolis, Ind.	295	8	Oct. 1973
Jersey City, N.J.	486	3	June 1975
Kalamazoo, Mich.	245	7	June 1973
Macon, Ga.	287	6	Jan. 1974
Memphis, Tenn.	a/374	3	Sept. 1973
St. Louis, Mo.	464	4	Feb. 1974
Sacramento, Calif.	107	7	Nov. 1973
King County, Wash.	178	4	Oct. 1974
Seattle, Wash.	<u>58</u>	1	May 1973
Total	<u>2,794</u>		

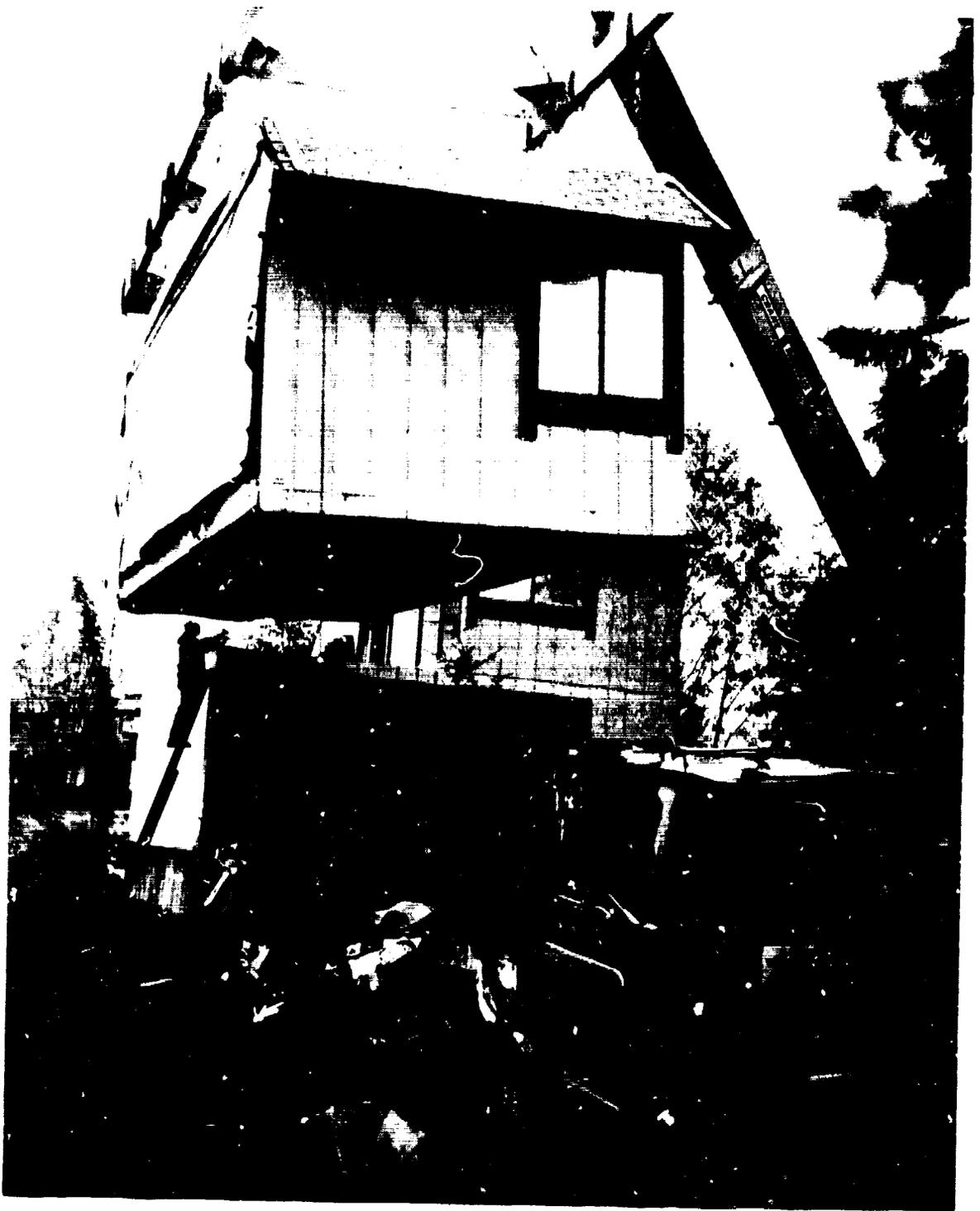
a/An additional 144 housing units constructed at this site were not Operation Breakthrough units.

Of the housing units, 46 percent were apartment houses of four or more stories, while 47 percent were townhouse and garden apartments. The remaining 7 percent were separate single-family dwellings.

HUD recognized that in demonstration phase the housing system manufacturers could not achieve lower costs through high production rates because of the small number of units constructed. Construction costs of the nine Phase II sites exceeded their market value and income and the difference of \$49.5 million was paid by the Government as shown on the following page.

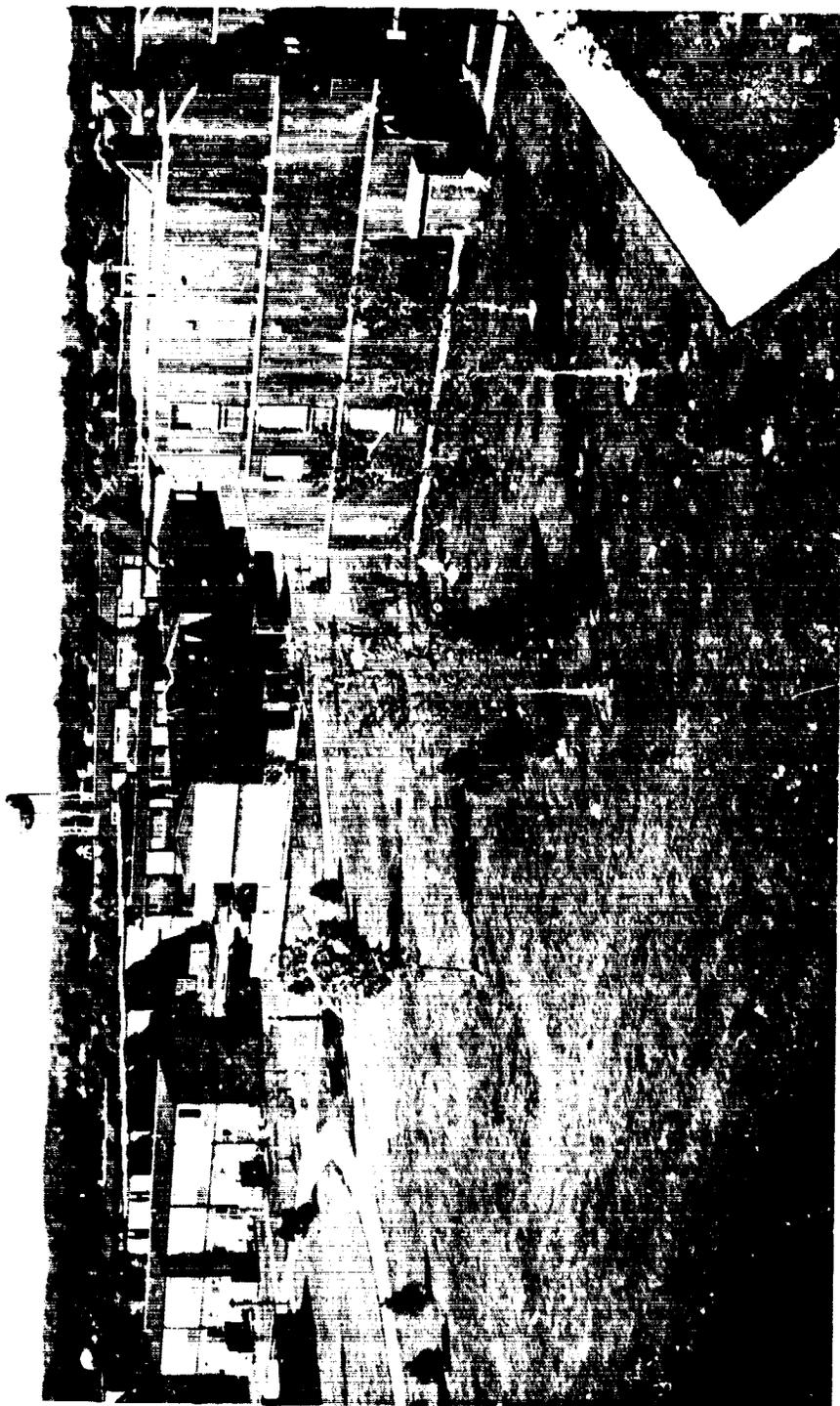
<u>Item</u>	<u>Amount</u> (millions)
Gross prototype site costs	\$126.0
Less:	
Market value of prototype sites	(65.4)
Program income (rents)	<u>(11.1)</u>
Government cost	<u>\$ 49.5</u>

Selected Operation Breakthrough housing units are shown on pages 12 through 14.



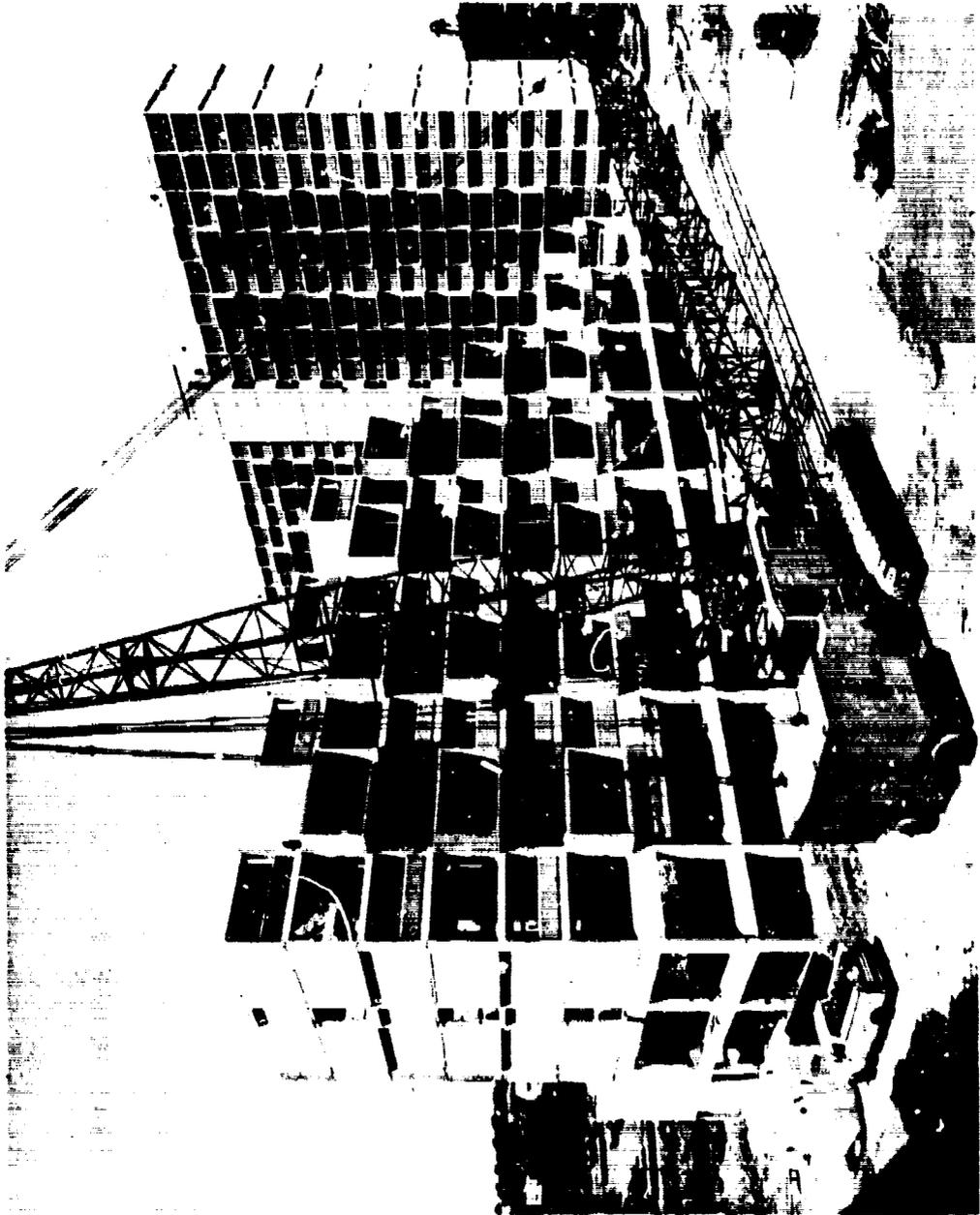
**OPERATION BREAKTHROUGH UNIT BEING
ERECTED IN KING COUNTY, WASHINGTON**

PHOTOGRAPH FURNISHED BY THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT



OPERATION BREAKTHROUGH PROTOTYPE SITE AT KALAMAZOO, MICHIGAN

PHOTOGRAPH FURNISHED BY THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT



HIGH RISE BREAKTHROUGH UNITS BEING ERECTED AT JERSEY CITY, NEW JERSEY

PHOTOGRAPH FURNISHED BY THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

PHASE III--VOLUME PRODUCTION
AND MARKETING

Phase III called for about 25,000 housing units to be constructed under HUD housing programs. In March 1976 a HUD official said about 18,000 units had been completed or were under construction, with the remaining units in the planning stage. Most units in this phase were constructed under HUD's section 236 mortgage subsidy program.

Section 236 was added to the National Housing Act by the Housing and Urban Development Act of 1968 (12 U.S.C. 1707-1715y). Its purpose was to provide rental housing for persons who could not afford housing on the private market, but who were above income levels qualifying for public housing. Mortgages were insured by HUD, but held by non-Federal institutions. Phase III did not involve Government research funds, except for minor administrative costs and two small research projects early in Operation Breakthrough.

Of the 22 Operation Breakthrough manufacturers, 14 built Phase III projects. The remainder did not participate for various reasons, such as cost and other production problems, corporate marketing policies, and bankruptcy. In addition to the 25,000 units discussed above, HUD estimates that about 7,000 other housing units have been built or are being built to Operation Breakthrough designs. Two manufacturers account for about 4,000 units, with the remaining 3,000 units shared among 5 manufacturers.

CHAPTER 3

OPERATION BREAKTHROUGH RESULTS

Operation Breakthrough contributed to some useful changes in the housing industry. It did not create the large, continuous markets necessary for efficient industrialized housing construction or document and obtain answers to questions on cost savings to be gained by using such construction methods.

Many factors make a definitive assessment of Operation Breakthrough results difficult. Evaluation problems are a result of Operation Breakthrough's broad objectives, the complexity of the housing industry, the way the program was managed, changes in the housing market, and the suspension of major Government-subsidized housing programs.

Operation Breakthrough's objectives were not stated in easily measurable terms; they addressed a wide range of housing industry problems, and the industry involves thousands of homebuilders, as well as materials suppliers and financial institutions. Construction is governed by numerous building codes and other regulations administered by different levels of government. As many forces work to promote or prevent change within the housing industry, it becomes difficult to isolate the effect of Operation Breakthrough on segments or on the whole industry. Efforts, for example, had already begun by various groups and organizations to solve some problems addressed by Operation Breakthrough.

We surveyed industrialized housing manufacturers and conventional builders for their assessment of changes in problem areas and their opinions on Operation Breakthrough contributions. The Department of Housing and Urban Development did not collect suitable data on industry attitudes and practices at the beginning of Operation Breakthrough; consequently, our questionnaires were designed to collect information on the beginning as well as present program conditions. (See apps. III through VIII for the questionnaires and responses to selected questions.)

HOUSING INDUSTRY'S REACTION

Operation Breakthrough attracted much attention in the housing industry. About 40 percent of the industrialized housing manufacturers responding to our questionnaires visited a prototype demonstration site or the production facilities of an Operation Breakthrough manufacturer. Most industrialized housing manufacturers and conventional builders were

familiar with the program, and about one conventional home-builder in three considered using housing produced by Operation Breakthrough participants. Twenty-nine, or 6 percent, of conventional builders bought industrialized housing units from Operation Breakthrough participants. HUD estimates that about 7,000 Operation Breakthrough units have been built or are under construction independently of those marketed under Government programs.

Conventional builders and industrialized housing manufacturers had widely varying opinions of Operation Breakthrough. In both groups a sizeable minority (18 percent of conventional builders and 28 percent of industrialized manufacturers) felt that Operation Breakthrough hurt their industry. Responses on the questionnaires indicate that this was because most systems were unsuccessfully marketed.

Favorable comments indicate the program increased awareness of industrialized construction methods, drew attention to problems facing the industry, and contributed to helpful changes in building codes. Only a small proportion of the respondents believed, however, the program greatly helped the housing industry.

MARKETING PROBLEMS

Of the 22 Operation Breakthrough housing systems, 5 are still being marketed by their manufacturers, 14 are not produced at all, 2 are produced under license in foreign countries but not in the United States, and 1 is produced in the United States but not by the company that participated in Operation Breakthrough.

Major problems were encountered in marketing industrialized housing. Adverse changes in the housing market and suspension of major Government-subsidized housing programs were prime contributors to the lack of market success for the Operation Breakthrough housing systems. Operation Breakthrough does indicate, however, that technology demonstration programs should be based on thorough analyses of the risks and uncertainties of socioeconomic factors affecting the widespread use of new technology. HUD's plans underestimated the difficulty of overcoming barriers to rapid marketing of industrially constructed housing.

Although studies identified the nature and extent of barriers preventing wider use of industrialized housing construction methods, preliminary work was insufficient to test the feasibility of rapidly removing these barriers.

Change in Government housing policies and the housing market

Operation Breakthrough plans assumed 26 million housing units would be built or rehabilitated in 10 years, of which 6 million would be under Government housing programs. Most Operation Breakthrough manufacturers anticipated Government housing programs would be a large market for their housing systems. At least nine depended on Government housing programs to provide over half their market. In 1969, HUD estimated that 4 million new housing units would be constructed under Government housing programs during the next decade, an average of 400,000 a year.

In the beginning of 1973, the Federal Government suspended its major subsidized housing programs pending a complete reevaluation of the Federal role in housing. The President said the programs were plagued with problems and their intended beneficiaries shortchanged. This suspension had a major effect on several Operation Breakthrough manufacturers.

In 1974, the national housing construction rate dropped below 1.4 million units a year, about half of the construction rate assumed by Operation Breakthrough plans. Consequently, market conditions faced by Operation Breakthrough manufacturers were far worse than expected.

MARKET AGGREGATION

The housing market is troubled by local governments differing in the type of housing required and the regulations under which it is produced. To provide a large market for the Operation Breakthrough housing, HUD planned to assist State and local governments in a market aggregation effort. HUD conceived market aggregation as having many elements including

- developing an inventory of housing needs,
- identifying specific sites,
- developing requirements for the sites,
- preparing the environmental systems and community services for housing construction, and
- initiating and expediting regulatory approval for housing construction.

HUD's success in its market aggregation objectives depended upon overcoming many distinct and complex barriers that previously slowed building construction. Essentially, HUD was advocating major reform of land development procedures with State and local governments bearing the major responsibility for achieving them. Federally subsidized housing programs were intended to be a large market in this effort. HUD also believed that the thorough testing of the Operation Breakthrough housing systems would permit faster and better coordinated approval of federally supported construction by local jurisdictions.

When Operation Breakthrough began, few States had programs that would enable them to pursue housing market aggregation. During the late 1960s and early 1970s, several States passed laws authorizing housing agencies to perform activities envisioned by HUD's market aggregation plans. Some States encountered legal and other problems which hindered their efforts to create such housing agencies.

A 1973 HUD study noted that 30 States had housing finance or development agencies, but only 15 had actually participated in the construction of housing projects. HUD also found that State agencies relied heavily on the Federal housing subsidy programs suspended in early 1973. As a result, market aggregation activities were not performed as anticipated in Operation Breakthrough plans and the program did not achieve the continuous housing demand necessary for efficient industrialized housing construction.

DEVELOPMENT PROBLEMS

Despite extensive proposal evaluation, at least 5 of the 22 Operation Breakthrough housing systems encountered cost and other production difficulties. One firm could not find a supplier for a major subsystem. In the other four cases, the firms were not able to develop systems that could compete economically with conventional construction. Operation Breakthrough's experience indicates that proposal evaluation alone may be insufficient to judge technical aspects of new approaches and that preliminary development work may be necessary to thoroughly assess the technical feasibility of new systems and approaches.

BUILDING CODES

Industrialized housing manufacturers disagree on whether building codes are now less of a problem for industrialized housing than before Operation Breakthrough. Over 40 percent

think building codes are now less of a problem, but about one-fourth find them to be more of a problem. One manufacturer in four believes Operation Breakthrough helped reduce building code problems.

Before Operation Breakthrough began, studies identified two important ways building codes prevent or hinder efficient industrialized housing construction.

--Rigid code requirements prevent use of new construction methods and materials.

--Differing building codes in a market area create confusion, delay, and excessive building costs.

Operation Breakthrough tried to remove these problems by having the National Bureau of Standards develop Guide Criteria to permit program builders wide latitude in design, materials, and construction methods and by supporting statewide codes for industrialized housing.

Guide Criteria

The Guide Criteria developed by NBS for evaluating Operation Breakthrough housing established comprehensive building design requirements based on performance standards rather than by specifying the types of materials and construction methods to be used. Housing experts advocated this approach to permit flexibility and innovation in building design and materials.

HUD believed that Operation Breakthrough builders would find local building code approval easier to obtain because their housing designs would have been thoroughly evaluated during the program. This evaluation, which included physical testing, was of some help to builders in obtaining code approvals, but local requirements still caused delays, increased production costs, and prevented marketing in some areas.

Although the Guide Criteria were intended to promote innovative construction methods, their use created some difficulties for Operation Breakthrough builders. The Guide Criteria were not developed until after industry had submitted proposals for Operation Breakthrough. As a result, housing manufacturers were faced with new and unfamiliar requirements during the design development process, which created confusion and delay. Also, some Guide Criteria requirements exceeded prevailing building codes. These higher requirements created difficulties in designing most Operation Breakthrough systems.

Many different groups are involved in setting building code requirements, and difficult technical questions must be resolved before new code requirements are accepted. Thus, it is only possible to measure Operation Breakthrough's general effect on building code requirements.

Model code groups are an important factor in changing building code requirements. Several such groups publish model codes that State and local governments can use in establishing their code requirements. A 1975 study for HUD by the Real Estate Research Corporation (RERC) concluded that Operation Breakthrough Guide Criteria requirements had some effect on specific code provisions, led to code requirements suited to industrialized housing construction, and changed the practices and procedures of some code organizations. The study noted, however, that it will be many years before the full impact of Guide Criteria concepts on codes is known and that many of the concepts may be modified beyond recognition of having Operation Breakthrough as their origin. A 1973 National Academy of Sciences study regarded the Operation Breakthrough Guide Criteria as an important experiment in the use of performance standards for building design, but concluded that additional research and careful consideration were necessary before using Guide Criteria requirements in building codes.

Statewide industrialized housing codes

When Operation Breakthrough began, some States were considering legislation to make industrialized housing subject to the same code requirements throughout each respective State. In May 1976, an NBS official told us that, since Operation Breakthrough began, 31 States have enacted legislation permitting statewide industrialized housing codes. Thirty of these States established statewide code approval programs. Most industrialized housing manufacturers believe that statewide codes help industrialized housing.

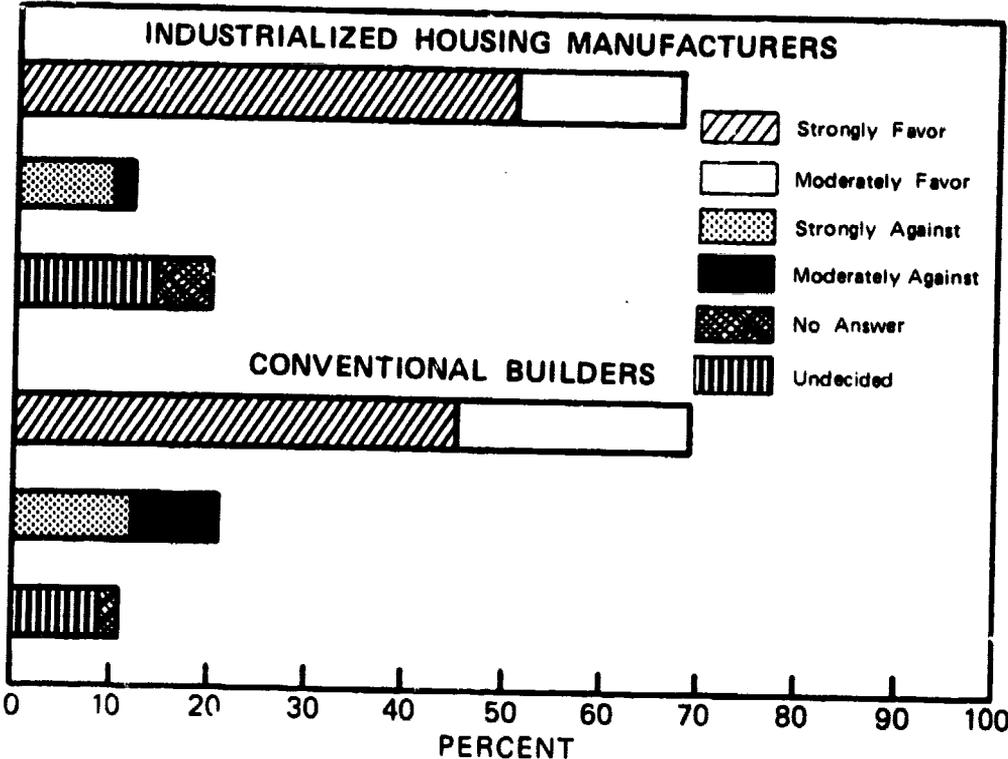
Since 1969, the National Conference on State Building Codes and Standards has provided technical and other assistance to State code administrators. This organization and others were working for statewide codes when Operation Breakthrough began and continued to do so during the program. It is difficult, therefore, to judge Operation Breakthrough's effect on statewide legislation. Housing experts believe, however, the program helped passage of some laws.

Building codes--a continuing housing industry concern

Industrialized housing manufacturers and conventional builders believe building codes restrict increased use of industrialized housing construction methods. Of the industrialized manufacturers, 43 percent still avoid certain market areas because of code approval problems.

Many in each group favor replacement of local building codes with mandatory statewide building codes.

ATTITUDES ON MANDATORY STATE-WIDE CODES



While industrialized housing manufacturers favor state-wide codes, 41 percent also want a national building code to establish uniform standards throughout the United States. A smaller proportion (21 percent) of conventional builders also favor a national building code.

Most industrialized manufacturers and conventional builders support some Federal Government role in building codes through assistance to State and local governments, development of better code requirements, and training programs for local code officials.

HOUSING INDUSTRY INNOVATIONS

Operation Breakthrough was intended to encourage using innovative construction methods and materials throughout the housing industry.

Some industrialized housing manufacturers and conventional builders believe that Operation Breakthrough helped advance building technology. Of the industrialized housing manufacturers, 29 percent thought Operation Breakthrough made at least a minor contribution. Of the conventional builders, about 19 percent believed Operation Breakthrough helped introduce new housing construction materials and 24 percent thought that the program helped introduce new housing construction methods.

HUD officials said opinions of the industrialized and conventional builders may not give an accurate picture of the technology innovations promoted by Operation Breakthrough. They pointed out that many builders obtained their knowledge about Operation Breakthrough from newspaper articles and trade journals which were negative about Operation Breakthrough's benefits. In addition, they said that HUD did not mount an effort to counteract that adverse publicity.

HUD officials said that the housing industry may not be aware of indirect effects of Operation Breakthrough on technological developments. Many building codes, for example, now require smoke detectors in residential construction, which was largely influenced by the Operation Breakthrough Guide Criteria.

The RERC study noted that building codes now permit greater use of plastic pipe than before Operation Breakthrough. HUD officials believe their program promoted greater use of plastic pipe, but the RERC found disagreement in the housing industry. In light of previous HUD efforts to gain code

approval for plastic pipe, it is not clear that Operation Breakthrough contributed to their acceptance.

LABOR PROBLEMS

Favorable labor attitudes were recognized as important to the success of industrialized housing construction when Operation Breakthrough began. Industrialized housing construction methods require different labor practices from conventional methods.

Construction unions are organized by craft. Electricians, carpenters, and plumbers belong to separate unions. At the conventional construction site, work procedures are influenced by labor organization by craft. Agreements, for instance, may require that only members of the electricians' union perform certain tasks.

The assembly line process of industrialized construction may not be suited to the craft division of labor. Other potential difficulties arise because the industrialized method of labor in a factory replaces labor at the erection site. A National Commission on Urban Problems reported in 1968 that some labor practices retarded adopting new materials and improving systems of handling old materials, thereby adding to housing costs.

Early in Operation Breakthrough, HUD succeeded in getting national carpenters', plumbers', and electricians' unions to agree to support labor practices necessary for efficient industrialized housing construction methods. Under these national agreements, labor contracts were negotiated at the plants of Operation Breakthrough manufacturers. Most builders in the program did not encounter serious labor problems using industrialized housing. Several reported that Operation Breakthrough helped to resolve jurisdictional problems and other matters.

Labor unions and industry attempted to resolve difficulties in the use of industrialized housing before Operation Breakthrough began. Agreements were reached covering factory production of several labor unions in the same plant. These earlier efforts make it difficult to measure the effect of Operation Breakthrough on changes in labor attitudes and practices.

Of the industrialized housing manufacturers responding to our questionnaire, 35 percent reported their factory workers belonged to unions. Of the respondents with workers at

construction sites, 24 percent reported those workers were union members.

Opinions vary on whether labor attitudes and practices are a problem for industrialized housing. While few industrialized manufacturers found labor opposition to be a major barrier to the industry's growth, 33 percent report that they avoided marketing their units in specific areas because of possible labor opposition. Among conventional builders, 38 percent regard labor opposition at the erection site as little or no problem, but 35 percent regard labor opposition as a moderate to major problem.

Of the industrialized manufacturers who thought labor opposition was less today than it was 5 years ago, 18 percent believe that Operation Breakthrough contributed to reducing such opposition.

OTHER INDUSTRIALIZED HOUSING CONSTRUCTION BARRIERS

By demonstrating the value of industrialized housing construction methods, and by familiarizing different housing industry elements with suitable procedures, HUD believed that Operation Breakthrough could also help overcome financing and transportation obstacles to greater use of industrialized construction.

Financing

Most manufacturers believe lending institutions are now more willing to provide mortgages to industrialized housing buyers than before Operation Breakthrough began. About half of the manufacturers indicate, however, that to obtain working capital to finance production and inventory is now more of a problem. The RERC, in its study for HUD, reached similar conclusions about financial institutions' attitudes toward industrialized housing.

Housing construction loans usually provide payments to the builder as work is completed at the site. Under industrialized housing construction methods, most work is completed in a factory and little additional work is required after components are shipped to the erection site. To help industrialized housing manufacturers, HUD requested legislation to permit, for Federal housing programs, payments before delivery of components to the site. The Housing and Community Development Act of 1974 (12 U.S.C. 1735f-3) authorized the insurance of such payments by the Federal Government, but the provision had not been implemented by fall 1975. The RERC

study found that some private financial institutions do make progress payments for work completed offsite, but that the practice was not widespread and could not be directly attributed to Operation Breakthrough. The RERC also noted that HUD was successful in having private and public financial agencies provide \$67 million for construction at the nine prototype sites.

Transportation

The transportation of prebuilt components and modules from the factory to the erection site can create serious economic and technical problems for industrialized housing manufacturers. When Operation Breakthrough began, experts believed that industrialized housing could compete economically only within about 300 miles of the factory. As part of Operation Breakthrough, HUD investigated methods of highway and rail shipment to permit economical shipment over longer distances. HUD also worked with State highway officials to achieve more uniform highway load requirements in the States.

The RERC study concluded that experience gained through Operation Breakthrough shed new light on some original assumptions about the transportation of industrialized housing units. The study noted, for example, that most evidence suggests that when the industrialized housing factory is farther than 1 day's shipping time from the erection site, the transportation cost's may exceed the cost savings achieved by using industrialized rather than conventional building methods. The study reported that large shipments to an erection site are almost essential to hold down transportation costs, especially when railroads are used. The study also concluded that Operation Breakthrough

- highlighted the importance of volume in obtaining attractive shipping rates and the transportation industry's cooperation,
- made a major contribution to improving methods and equipment for transporting modules, and
- had a large effect on changes in regulatory institutions and regulations on oversized modules.

The study concluded that Operation Breakthrough did not have a major role in changing operations in the transportation industry.

Despite Operation Breakthrough's efforts, conventional builders and industrialized housing manufacturers responding to our questionnaires regard transportation costs as a continuing barrier to industrialized housing. The RERC study noted that rising energy and transportation prices could make future transportation costs much higher than those experienced with Operation Breakthrough. For most manufacturers, transportation costs have continued to be a problem.

MANAGEMENT FOR PROGRAM EVALUATION

Operation Breakthrough plans called for program evaluation, but did not provide for the timely collection and analysis of the necessary data. HUD planners believed that evaluation could be deferred until late in the program. As a result, groundwork for evaluation was not performed when it was needed. A major Operation Breakthrough objective was, for example, to change attitudes toward industrialized housing construction methods, but HUD did not collect information on attitudes at the beginning of the program. Consequently, there is no data for comparison with present industry attitudes.

During the program, more important program objectives did not allow HUD to give adequate attention to evaluation needs. HUD originally planned, for instance, to evaluate the prototype units after completion of the sites, but construction delays caused HUD to permit unit occupancy as soon as possible. Once occupancy occurred, it prevented exhaustive field testing.

Operation Breakthrough indicates that effective evaluation of large-scale demonstration programs requires thorough evaluation planning and continuing management attention to evaluation objectives. National Academy of Sciences housing experts believe that demonstration programs with complex and multifaceted objectives, such as Operation Breakthrough, may provide only limited answers in housing technology research areas. Partly because of evaluation difficulties, they believe smaller, more controlled research programs may be more useful than large-scale demonstration programs in resolving technical questions. Some technical questions they believe should be investigated through carefully correlated research include (1) reduction in the life cycle cost of housing, (2) improvement of housing design and materials selection, (3) identification of gaps and deficiencies in performance technology, and (4) standardization of building definitions.

Costs of industrialized housing

Two important housing questions of congressional interest when Operation Breakthrough began were

- the potential cost savings of new construction methods at high levels of production and
- the costs of meeting local building codes.

HUD required builders to submit information on production costs and design changes required to meet local building code requirements. HUD did not, however, receive useful information because

- there were problems in separating the costs of prototype construction from normal production costs and
- the information received on changes required by local building codes was inadequate for meaningful analysis of building code problems.

Consequently, cost and production data that would be useful to potential industrialized housing manufacturers is not available. It could provide manufacturers data for estimating the number of units necessary to reach a break-even point, thereby helping them to determine the minimum market size warranting investment in plant and facilities.

HUD recently attempted to analyze the construction costs of some Operation Breakthrough projects. Under a HUD contract in 1976, the RERC studied the relationship between the cost of selected Phase III Operation Breakthrough projects and comparable conventionally constructed section 236 projects. The study concluded that the cost of Operation Breakthrough projects exceeded the cost of conventional projects. The best available data for the cost comparisons contained differences, however, resulting from variations in accounting procedures among builders. The importance of these differences was not analyzed by the RERC.

HUD evaluations and other followup activities

HUD received studies of Operation Breakthrough from the Urban Institute, the National Academy of Sciences, and the RERC. These three studies stress that evaluation difficulties were created by the way Operation Breakthrough was planned and implemented. (See ch. 4 for conclusions of the latter two studies which contained lessons for future demonstration programs.)

HUD is also publishing descriptions of various aspects of Operation Breakthrough. Volumes already published are

- Housing Systems Proposals for Operation Breakthrough,
- Phase I Design and Development of Housing Systems,
- A Compendium of Building Concepts,
- A Documentary of Transportation and Handling Systems,
- Phase II Prototype Construction and Demonstration, and
- A Compendium of Fire Testing.

Documents are being prepared on structural testing, results of occupancy acceptance of Operation Breakthrough prototype units and sites, methods of monitoring occupancy, and site planning for Operation Breakthrough.

CHAPTER 4

LESSONS TO BE LEARNED FROM

OPERATION BREAKTHROUGH

ABOUT PLANNING AND MANAGING

TECHNOLOGY DEMONSTRATION PROGRAMS

The Department of Housing and Urban Development anticipated that after Operation Breakthrough's Phase I (development) and Phase II (demonstration) were completed, participating builders would continue production as the result of normal market demand for their housing. Most market aggregation activities and building code reforms were to be left to State and local governments. The long-range success of their strategy depended on many factors outside the control of the program. The downturn of the Nation's economy and the suspension of federally subsidized housing programs, for example, created major marketing difficulties for Operation Breakthrough builders. Furthermore, State and local governments did not develop market aggregation activities or change building code procedures as quickly as HUD expected.

Technology demonstration programs are now underway or being considered in other domestic problem areas which, like housing, are characterized by complex, institutional inter-relationships among Federal agencies, State and local governments, and the private sector. When such programs have begun, many planning and management factors influence their success. We found that Operation Breakthrough provides lessons about technology demonstrations that Federal agencies should consider in their present and future programs. Operation Breakthrough indicates that demonstration programs should involve

- thorough preliminary work to develop design criteria, evaluate proposed approaches, and analyze market uncertainties;
- feasible strategies to overcome marketing problems;
- research to resolve technical questions; and
- planning for program evaluation.

NEED FOR PRELIMINARY WORK

Design criteria should be firmly established before demonstration proposals are requested from industry. HUD recognized the importance of proposal preparation in the technology development process, but detailed design criteria were not established before HUD requested proposals from industry. Confusion and delay occurred because of untimely testing of housing designs.

Despite HUD's extensive efforts in evaluating Operation Breakthrough housing system proposals (22 proposals selected from a total of 236 submitted), at least 5 systems encountered cost and other production problems. While important to the technology development process, proposal evaluation alone may be insufficient to judge the technical aspects of new approaches. Preliminary development work may be the added factor needed to thoroughly assess technical and economic feasibility of proposed approaches. Even with timely introduction of design criteria and indepth evaluation of proposed approaches (including preliminary development work and testing), there will always be risks of failure. The goal of eliminating systems with little or no chance of market success allows the Government to concentrate its resources on systems with highest market success potential.

Experience gained through Operation Breakthrough also shows that preliminary analysis is needed to assess market uncertainties. Operation Breakthrough plans, for example, were based on assumptions that there would be high housing construction rates for 10 years and that Government-subsidized housing programs would continue. Government housing programs were suspended, the housing market declined, and Operation Breakthrough housing producers faced severe, unanticipated marketing difficulties.

Market analysis should be designed to help answer the following questions.

- Under what conditions will the new approaches have a good chance of market success?
- Are the demonstration program objectives and goals reasonably attainable in view of market uncertainties?
- Should plans be developed to cope with arising marketing problems?

NEED FOR FEASIBLE STRATEGIES

Demonstration program plans should include strategies sufficient in scope and duration to overcome marketing problems retarding using new technology. Although problems which prevented widespread use of industrialized housing construction methods were identified, HUD began marketing efforts without assessing the feasibility of its plans to remove or bypass marketing barriers.

HUD was able to help bring about change through cooperation with other Government agencies and non-Government organizations. These changes included (1) exploring new housing construction methods, (2) examining building design requirements, (3) passing statewide building codes, (4) developing and testing new labor agreements for industrialized housing construction, and (5) strengthening the National Bureau of Standards' building research program.

Operation Breakthrough, however, did not bring about the major market aggregation changes it planned. State and local governments had planning and regulatory responsibilities which were critical to greater housing market aggregation. As a result, nationwide changes occur only through the independent and deliberative actions of many State and local governments.

In domestic problem areas, responsibilities are often shared among different levels of government. It is important, therefore, to consider problems of intergovernmental relations, the time required to bring about changes, and the incentives which will work best to achieve the desired changes.

NEED FOR RESEARCH OF TECHNICAL QUESTIONS

Demonstration programs should be supported by systematic research designed to resolve major technical questions relating to the demonstration effort. Because demonstration programs with many different objectives may provide only limited answers to individual technical questions, National Academy of Sciences experts who monitored Operation Breakthrough believe that carefully controlled research is necessary to resolve technical questions. Operation Breakthrough plans and Federal legislation, for example, recognized the usefulness of obtaining detailed cost data on industrialized housing systems, but useful data was not obtained.

NEED TO PLAN FOR PROGRAM EVALUATION

Demonstration program plans should include adequate evaluation plans, provide for collection of basic data necessary to measure change, and assure the systematic and timely collection and analysis of evaluation data during the program. Because complex factors are likely to make demonstration program evaluation difficult in national problem areas, effective planning and management are necessary to produce useful evaluations.

Effective planning for demonstration program evaluation is also necessary to lay a sound foundation for future research work. If better data had been collected on building code problems encountered by Operation Breakthrough participants, more valuable contributions could have been made to present research on building requirements.

OTHER STUDIES OF OPERATION BREAKTHROUGH

Two other recent studies reported that there are lessons from Operation Breakthrough which can help improve future technology demonstration efforts. Both studies concluded that the established time frame for reaching Operation Breakthrough's objectives was too short and other management considerations needed more attention.

Under a HUD contract, the National Academy of Sciences formed an advisory committee on Operation Breakthrough. The committee's report in 1974 pointed out the following factors relevant to future technology demonstration efforts.

- Government housing programs must be planned on the basis of a long view. The time frame allotted for reaching Operation Breakthrough objectives proved unrealistic.
- Elements of housing technology may be examined better in individual research projects, rather than through complex demonstration programs with multifaceted objectives.
- If the new technology is to survive in the marketplace, demonstration programs should be based on sound cost/benefit information.

The Real Estate Research Corporation's 1975 study of Operation Breakthrough showed the following implications for technology demonstration programs.

- Operation Breakthrough, a complex program, was begun with an extremely short program-design period. One principal lesson of Operation Breakthrough is not to attempt too much too quickly because the adoption and diffusion of an innovation is not an instantaneous process. It is difficult to convince individuals and organizations to expose themselves to significant long term risks of product failure without a long term Federal commitment.
- Without sufficient staff and funding to coordinate interconnected elements, the management of balanced progress becomes impossible. Much continuing program evaluation is necessary to keep the program on target.
- Demonstration sites should be located as close to as many potential adopters as possible because communications decrease as distance increases. The demonstration should occur as much as possible in the normal marketplace. The more special waivers and exemptions allowed to complete the prototypes, the less convincing the demonstration and the later the start of the institutional learning process.

AGENCY COMMENTS

The Department of Housing and Urban Development officials found our report to be a thorough evaluation of Operation Breakthrough and cited no major problems with the contents. The Department of Commerce officials said the report presented a fair assessment of the National Bureau of Standards' activities in Operation Breakthrough.

MATTERS FOR CONSIDERATION BY THE CONGRESS

Experience gained through Operation Breakthrough should be useful to the Congress in authorizing, funding, and monitoring technology demonstration programs.



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410

AUG 18 1976

ASSISTANT SECRETARY FOR
POLICY DEVELOPMENT AND RESEARCH

Mr. Henry Eschwege
Director
Community and Economics
Development Division
United States General Accounting
Office
Washington, D. C. 20548

Dear Mr. *Henry* Eschwege:

Secretary Mills has asked me to respond to your letter of July 28 in which you enclosed a review copy of a draft report titled "Operation Breakthrough --- Lessons Learned About Demonstrating New Technology."

My staff has reviewed this report and does not find any significant problems with its contents.

I would like to congratulate your staff on a very thorough job in evaluating the program.

Sincerely,

Charles J. Orlebeke



UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

AUG 30 1976

Mr. Henry Eschwege
Director
Community and Economic Development Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

This letter is in response to your July 28, 1976, request to the Secretary of Commerce for comments on the General Accounting Office's proposed report to Congress, "Operation Breakthrough--Lessons Learned About Demonstrating New Technology." Pages 9, 24, 25, 26 and 41 present a fair assessment of the activities of the National Bureau of Standards in Operation Breakthrough. A few minor changes are suggested and are listed on the enclosed "proposed changes" sheet.

If we can be of additional assistance in making input to this report, please feel free to contact us. If you wish to contact the National Bureau of Standards directly, please feel free to call Dr. Richard N. Wright, Director, Center for Building Technology, Institute for Applied Technology, telephone number 921-3377.

Sincerely,

A handwritten signature in cursive script, appearing to read "Betsy Ancker-Johnson".

Betsy Ancker-Johnson, Ph.D.

Enclosure

GAO note: Page references are to portions of the report draft where the National Bureau of Standards' role was discussed. The minor changes proposed by the Department of Commerce were considered and made when appropriate in the final report.

U.S. GENERAL ACCOUNTING OFFICE
SURVEY OF BUILDERS AND DEVELOPERS

INSTRUCTIONS

Please read these questions carefully and answer each one as frankly and completely as possible. If a question does not apply to you, cross it out and go on to the next question. Please feel free to add any additional comments you may have at the end of the questionnaire.

While most of the terms will be clearly understood the term industrialized housing may be ambiguous and should be defined. For the purpose of this questionnaire, **INDUSTRIALIZED HOUSING** includes the three following types of housing:

- A. **Modular house** - a house built, assembled and finished in a factory and then shipped to the site as a three-dimensional module or section which meets typical local building codes. More than one module or section may be used to make a complete living unit.
- B. **Prefabricated house** - a house in which major parts (pre-hung doors, cabinets, trusses, wall panels, mechanical, electrical or plumbing cores, etc.) are fabricated to some degree in the factory, but not necessarily as three dimensional units, and then shipped to the site to be assembled.
- C. **Pre-cut house** - a house which requires some degree of on-site fabrication (trusses and wall panels may be included, however). On-site labor is used to a greater extent than in prefabricated houses, but to a lesser degree than that used in conventional construction.

Industrialized housing, as we have defined it, does not include mobile homes, double-wide mobile homes or components (pre-hung doors, ready-made windows, assembled roof trusses, wall and floor panels, electrical or plumbing cores) which are not sold in a complete housing package.

SECTION I - GENERAL INFORMATION

1. Please identify your firm.

Name _____
 Address _____
 _____ Zip Code _____

2. Please identify company official completing this questionnaire.

Name _____
 Title _____
 Telephone _____ Area Code _____

3. How is your firm organized?

- Sole proprietorship
- Partnership
- Public corporation
- Private corporation
- Other (please specify) _____

4. Are you a subsidiary of another corporation?

Yes No
 If yes, please list the name of parent corporation.

5. What is the approximate sales value of your 1973 and 1974 housing construction? (Also include market value of units built for your own account).

1973 _____ 1974 _____

6. Please indicate the number of housing units constructed by your firm in 1973 and 1974, and planned for 1975 construction.

	1973	1974	Planned 1975
Single-family			
Multifamily			

7. What percentage of your housing units are erected in the following areas?

Scattered lots in metropolitan areas	
Scattered lots in small towns	
Scattered lots in rural areas	
Planned developments in metropolitan areas	
Planned developments in small towns	
Recreational developments	
Other (please specify)	
	100%

8. During the last five years, did your firm discuss with the following firms the possibility of using their industrialized housing units? Please (✓) any such firms.

If you bought units from any of the firms please place a "B" in the appropriate box(es).

- | | |
|---|---|
| <input type="checkbox"/> ALCOA | <input type="checkbox"/> Material Systems Corp. |
| <input type="checkbox"/> Boise-Cascade | <input type="checkbox"/> National Homes |
| <input type="checkbox"/> Building Systems Intern'l | <input type="checkbox"/> PANTEK (Ball Brothers) |
| <input type="checkbox"/> CAMCI (Module Communities, Inc.) | <input type="checkbox"/> Pempton |
| <input type="checkbox"/> Christiana Western | <input type="checkbox"/> Republic Steel |
| <input type="checkbox"/> Descon/Concordia | <input type="checkbox"/> Rouse-Wales |
| <input type="checkbox"/> Forest City Enterprises/Dillon | <input type="checkbox"/> Sch. 's |
| <input type="checkbox"/> General Electric | <input type="checkbox"/> Shelley |
| <input type="checkbox"/> Hercules | <input type="checkbox"/> Stirling Homes |
| <input type="checkbox"/> Home Building Corp. | <input type="checkbox"/> TRW |
| <input type="checkbox"/> Levitt | <input type="checkbox"/> Townland (Keene Corp.) |

9. What year did your firm enter the residential housing business?
Year _____

10. Excluding your customer's concern over high interest rates and the unavailability of money which are problems common to the entire housing industry, to what degree do you believe that the following factors are a barrier or problem for the growth of the industrialized housing industry -- that is, what factors are keeping the industrialized housing industry from increasing its share of the total housing units built each year? (Check one box for each factor.)

	Little or no problem	Somewhat of a problem	Moderate problem	Somewhat of a major problem	Major problem
a. Building code requirements					
b. Labor cost					
c. Material cost					
d. Consumer acceptance					
e. Builder/developer's acceptance					
f. Difficulty in getting permanent financing for industrialized housing					
g. Labor opposition at the plants					
h. Labor opposition at erection sites					
i. Working capital for financing inventories and production					
j. Scattered markets					
k. Transportation costs					
l. Highway load width restrictions					
m. Other (please specify)					

11. In your opinion, which of the factors listed in the above question (question 10) are the three most significant barriers or problems for the growth of the industrialized housing industry today? Please respond to this question by placing the letter to the left of the selected factor in the appropriate spaces below.

Most significant factor is letter _____

2nd most significant factor is letter _____

3rd most significant factor is letter _____

SECTION II - QUESTIONS FOR BUILDERS WHO HAVE USED INDUSTRIALIZED HOUSING

Please complete questions 12 through 20 if your firm has used industrialized housing units in 1973, 1974 or 1975. If your firm has not used industrialized units during this period, please skip to Section III (Question 21).

12. What year did your firm start using industrialized housing units?
Year _____

13. What is the approximate sales value of the industrialized housing units erected by your firm in 1973 and 1974? (Also include market value of units built for your account).
1973 _____ 1974 _____

14. Please indicate, the number of single-family and multifamily industrialized housing units used by your firm in 1973 and 1974 and the planned use of the same type of units in 1975.

	Module	Prefabricated	Pre-Cut
1973			
Single-family			
Multifamily			
1974			
Single-family			
Multifamily			
PLANNED 1975			
Single-family			
Multifamily			

15. What percentage of your industrialized housing units are erected in the following areas?

	Percentage
Scattered lots in metropolitan areas	
Scattered lots in small towns	
Scattered lots in rural areas	
Planned developments in metropolitan areas	
Planned developments in small towns	
Recreational developments	
Other (please specify)	

16. In 1969, approximately what percent of the total housing built by your firm were industrialized units?
_____ %

17. What effect did Operation Breakthrough have on your firm's decision to use industrialized housing? (Check one box only).

- None - already using industrialized housing prior to Operation Breakthrough
- None - other factors influenced decision more than Operation Breakthrough
- Some influence but not major factor
- Moderate influence or factor
- Major influence or factor

18. Which statement best describes how your industrialized units are sold? (Check one box only).

- Most industrialized units are built on a pre-sold basis to the order of specific buyers.
- About half of the industrialized units are built on a pre-sold basis to the order of specific buyers. The rest are built on a speculative basis for sale.
- Most industrialized units are built on a speculative basis for sale.
- Other

19. What is the usual shipping distance from the plant where industrialized housing units are built to the place where they are erected?

_____miles.

20. Which of the following factors best describe what your firm believes to be the major advantages of using industrialized housing. Indicate the most important advantage with 1; the second most important, with 2; and the third, with 3. (Check three boxes only).

- Cost of industrialized housing units is less than cost of conventional units of comparable quality.
- Shorter construction time.
- Prefer buying complete industrialized unit from one manufacturer to purchasing materials from many different sources.
- Better control of construction costs.
- More design flexibility.
- Better quality control
- Manufacturer's help in marketing
- Other (please explain) _____

PLEASE SKIP TO SECTION IV (QUESTION 25) AFTER COMPLETING THIS SECTION.

SECTION III - QUESTIONS FOR BUILDERS WHO HAVE NOT USED INDUSTRIALIZED HOUSING

Please complete questions 21 through 24 if your firm has not used industrialized housing units in 1973, 1974 or 1975. If your firm has used industrialized units during this period, please skip to Section IV (Question 25).

21. Which of the following statements best describes your firm's use of industrialized housing units? (Check one box only).

- Explored the possibility of using industrialized housing units, but never seriously negotiated with an industrialized housing manufacturer.
- Negotiated with specific industrialized housing manufacturers, but never used industrialized housing units.
- Used industrialized housing in the past, but do not use them now.
- Never considered using industrialized housing.

22. Which of the following statements best describes your firm's future use of industrialized housing units? (Check one box only).

- Firm plans to use industrialized units in next two years.
- Firm has no specific plans to use industrialized units, but is likely to use them in the next five years.
- Firm is unlikely to use industrialized units during the next five years.

23. Would your firm consider using industrialized housing if adequate information or studies were available showing that industrialized housing cost less than conventional housing of comparable quality?

- Yes No

If you checked "No", please explain:

24. Which of the following factors best describe what your firm believes to be the major disadvantages of using industrialized housing? Indicate the most important with 1; the second most important with 2; and the third with 3. (Check three boxes only).

- The cost of transportation from the factory to the site makes the use of industrialized housing more costly than conventional built housing units of the same quality.
- Even ignoring transportation costs, the use of industrialized housing is more costly than conventional built housing units of the same quality.
- More building code problems with industrialized housing than conventional built housing
- Homebuyers prefer conventional built housing to industrialized housing
- More labor problems with industrialized housing than conventional built housing
- Other (please specify) _____

27. Please describe any major changes in the building materials used by your firm during the last five years.

28. Please describe any major changes in housing construction methods used by your firm during the last five years.

29. Check the statement that best describes your opinion of future housing construction. (Check only one box.)

- Neither construction method nor the materials used will change much in the next five years
- While construction methods won't change much, new materials will be widely used in the next five years
- In the next five years, there will be great changes in housing construction methods, but the materials used will be the same
- Both materials and construction methods will change greatly in the next five years

30. Do you believe that the technical knowledge and materials needed to effectively produce industrialized housing existed in 1969 and 1974? (Check one box for each year.)

	Yes	No	Don't Know
1969			
1974			

SECTION IV - QUESTIONS TO BE COMPLETED BY ALL BUILDERS

CONSTRUCTION METHODS AND MATERIALS

25. Has your firm used major components (such as kitchen and bathroom modules, and wall and floor panels) in its housing construction during the last two years? (Please do not include major components included as part of complete industrialized housing units.)

- Purchase of major components
- Off-site fabrication of major components by your own firm
- On-site fabrication of major components by your own firm
- Have not used major components
- Other (please describe) _____

31. What do you think the Federal Government should do to support technological innovation in the housing industry? Check ALL the functions you believe the Federal Government should perform.

- No role for Federal Government
- Develop better code requirements
- Develop better test procedures
- Test new materials and techniques
- Perform research to develop new materials
- Develop new approaches to housing construction
- Support training programs for building code inspectors
- Other (please specify) _____

26. Does your firm now use materials and construction methods that it did not use in 1969? Check one box under materials and one box under construction methods. (If your firm did not construct housing in 1969, skip to question 29.)

	Materials	Construction Methods
Almost no change		
Some change, but mostly same		
Major changes		

BUILDING CODES

32. Some states have enacted mandatory state-wide building codes. In those states, all housing is inspected according to a single code that has been adopted by the state government. How do you feel about such state codes?

- Strongly against
- Moderately against
- Undecided
- Moderately for
- Strongly for

33. What should the Federal Government do to help improve building codes and building code administration? (Check one box only.)

- Should not be involved
- Should assist state and local governments and model code groups but not set requirements
- Should establish and administer a national building code
- Other (please specify) _____

34. OPERATION BREAKTHROUGH

As part of Operation Breakthrough, HUD constructed nine prototype sites at locations listed below. Please indicate how many of these Operation Breakthrough sites you had heard of and how many of them you or another member of your firm have visited. Please check the appropriate box(es).

	Visited	Not Visited But Heard Of
Indianapolis, Indiana		
Jersey City, New Jersey		
Kalamazoo, Michigan		
Macon, Georgia		
Memphis, Tennessee		
St. Louis, Missouri		
Sacramento, California		
King County, Washington		
Seattle, Washington		

35. Have you visited any of the production facilities of the 22 Operation Breakthrough producers listed in Question 8?

- Yes No

36. Check ALL of the sources listed that provided your firm with information on Operation Breakthrough.

- Newspaper articles
- Trade journals
- Reports from 22 builders that produced units under Operation Breakthrough
- HUD Housing System Proposals for Operation Breakthrough
- HUD Feedback reports on Operation Breakthrough
- HUD newsletters
- Conventions
- Other sources (please specify) _____

37. What is your general feeling of the information received on the results of Operation Breakthrough?

- More than adequate
- Adequate
- Inadequate
- No opinion

38. What is your opinion on the following statements about Operation Breakthrough?

	Agree	Disagree	Don't Know/ No Opinion
Operation Breakthrough helped introduce new housing construction materials			
Operation Breakthrough helped introduce new housing construction methods			
Operation Breakthrough helped support new building code legislation			
Operation Breakthrough helped draw attention to problems facing the housing industry			

39. Which of the following statements best describe the general effect you feel Operation Breakthrough had on the housing industry?

- Greatly hurt the housing industry
- Slightly hurt the housing industry
- No effect on the housing industry
- Slightly helped the housing industry
- Greatly helped the housing industry

IMPACT OF OPERATION BREAKTHROUGH ON THE HOUSING INDUSTRY:

Please use this space to describe how you believe Operation Breakthrough helped or hurt the housing industry.

GENERAL COMMENTS:

Please use this space for any general comments on the questionnaire or Operation Breakthrough you may wish to make. Thank you for completing the questionnaire.

**RESPONSES BY CONVENTIONAL BUILDERS AND DEVELOPERS
TO SELECTED QUESTIONS ON THE GAO QUESTIONNAIRE**

10. Excluding your customer's concern over high interest rates and the unavailability of money which are problems common to the entire housing industry to what degree do you believe that the following factors are a barrier or problem for the growth of the industrialized housing industry -- that is, what factors are keeping the industrialized housing industry from increasing its share of the total housing units built each year? (Check one box for each factor.)

-----Percent-----

	Little or no problem	Somewhat of a problem	Moderate problem	Somewhat of a major problem	Major prob	No answer
a. Building code requirements	21	20	16	15	18	11
b. Labor cost	26	13	18	13	17	12
c. Material cost	22	9	18	16	23	13
d. Consumer acceptance	24	12	16	16	22	11
e. Builder/developer's acceptance	24	15	16	17	16	12
f. Difficulty in getting permanent financing for industrialized housing	33	15	17	8	11	15
g. Labor opposition at the plants	49	9	11	6	4	21
h. Labor opposition at erection sites	38	11	13	14	8	17
i. Working capital for financing inventories and production	19	11	18	15	19	18
j. Scattered markets	23	8	20	10	17	22
k. Transportation costs	16	8	16	18	25	17
l. Highway load width restrictions	25	12	17	11	15	21
m. Other (please specify)				1	16	83

Note: Percentages may not total 100 because of rounding.

11. In your opinion, which of the factors listed in the above question (question 10) are the three most significant barriers or problems for the growth of the industrialized housing industry today? Please respond to this question by placing the letter to the left of the selected factor in the appropriate spaces below.

---Percent---

	Most Significant	2nd Most	3rd Most
a. Building code requirements	12	8	10
b. Labor cost	10	12	7
c. Material cost	12	12	11
d. Consumer acceptance	21	8	7
e. Builder/developer's acceptance	4	13	8
f. Difficulty in getting permanent financing for industrialized housing	5	4	6
g. Labor opposition at the plants	-	1	2
h. Labor opposition at erection sites	2	3	5
i. Working capital for financing inventories and production	5	6	11
j. Scattered markets	2	6	7
k. Transportation costs	5	7	12
l. Highway load width restrictions	1	2	2
m. Other (please specify)	1	4	2
No answer		11	12

Note: Percentages may not total 100 because of rounding.

26. Does your firm now use materials and construction methods that it did not use in 1969? Check one box under materials and one box under construction methods. (If your firm did not construct housing in 1969, skip to question 29.)

-----Percent-----

	Materials	Construction Methods
Almost no change	25	28
Some change, but mostly same	49	43
Major changes	9	12
No answer	16	17

29. Check the statement that best describes your opinion of future housing construction. (Check only one box.)

	<u>Percent</u>
Neither construction method nor the materials used will change much in the next five years . . . . .	.42
While construction methods won't change much, new materials will be widely used in the next five years. . . . .	.30
In the next five years, there will be great changes in housing construction methods, but the materials used will be the same . . . . .	.6
Both materials and construction methods will change greatly in the next five years . . . . .	.19
No answer. . . . .	.3

Note: Percentages may not total 100 because of rounding.

30. Do you believe that the technical knowledge and materials needed to effectively produce industrialized housing existed in 1969 and 1974? (Check one box for each year.)

-----Percent-----

	Yes	No	Don't Know	No answer
1969	40	28	29	4
1974	58	13	25	4

31. What do you think the Federal Government should do to support technological innovation in the housing industry? Check ALL the functions you believe the Federal Government should perform.

	<u>Percent</u>
No role for Federal Government	31
Develop better code requirements	39
Develop better test procedures	14
Test new materials and techniques	28
Perform research to develop new materials	26
Develop new approaches to housing construction	29
Support training programs for building code inspectors	25
Other (please specify) _____	18

Note: Percentages may not total 100 because of rounding.

32. Some states have enacted mandatory state-wide building codes. In those states, all housing is inspected according to a single code that has been adopted by the state government. How do you feel about such state codes?

	<u>Percent</u>
Strongly against	12
Moderately against	9
Undecided	9
Moderately for	24
Strongly for	45
No answer	2

33. What should the Federal Government do to help improve building codes and building code administration? (Check one box only.)

	<u>Percent</u>
Should not be involved	36
Should assist state and local governments and model code groups but not set requirements	36
Should establish and administer a national building code	21
Other (please specify) _____	4
No answer	3

Note: Percentages may not total 100 because of rounding.

38. What is your opinion on the following statements about Operation Breakthrough?

-----Percent-----

	Agree	Disagree	Don't Know/ No Opinion	No Answer
Operation Breakthrough helped introduce new housing construction materials	19	26	40	16
Operation Breakthrough helped introduce new housing construction methods	24	24	36	17
Operation Breakthrough helped support new building code legislation	17	17	50	17
Operation Breakthrough helped draw attention to problems facing the housing industry	39	13	33	15

39. Which of the following statements best describe the general effect you feel Operation Breakthrough had on the housing industry?

Percent

Greatly hurt the housing industry	6
Slightly hurt the housing industry	12
No effect on the housing industry	34
Slightly helped the housing industry	22
Greatly helped the housing industry	2
No answer	24

Note: Percentages may not total 100 because of rounding.

**QUESTIONS FOR BUILDERS WHO
HAVE USED INDUSTRIALIZED
HOUSING IN 1973, 1974, or 1975**

17. What effect did Operation Breakthrough have on your firm's decision to use industrialized housing? (Check one box only).

	<u>Percent</u>
None - already using industrialized housing prior to Operation Breakthrough	55
None - other factors influenced decision more than Operation Breakthrough	31
Some influence but not major factor	5
Moderate influence or factor	3
Major influence or factor	6

20. Which of the following factors best describe what your firm believes to be the major advantages of using industrialized housing. Indicate the most important advantage with 1; the second most important, with 2; and the third, with 3. (Check three boxes only).

-----Percent-----

- Cost of industrialized housing units is less than cost of conventional units of comparable quality.
- Shorter construction time.
- Prefer buying complete industrialized unit from one manufacturer to purchasing materials from many different sources.
- Better control of construction costs.
- More design flexibility.
- Better quality control
- Manufacturer's help in marketing
- Other (please explain) _____

Most Significant	2nd Most	3rd Most
8	5	5
45	20	16
8	15	15
21	34	23
1	1	3
2	11	21
2	1	5
14	14	13

Note: Percentages may not total 100 because of rounding.

**QUESTIONS FOR BUILDERS WHO
HAVE NOT USED INDUSTRIALIZED
HOUSING IN 1973, 1974, or 1975**

23. Would your firm consider using industrialized housing if adequate information or studies were available showing that industrialized housing cost less than conventional housing of comparable quality?

	<u>Percent</u>
Yes	74
No	26

24. Which of the following factors best describe what your firm believes to be the major disadvantages of using industrialized housing? Indicate the most important with 1; the second most important with 2; and the third with 3. (Check three boxes only).

-----Percent-----

The cost of transportation from the factory to the site makes the use of industrialized housing more costly than conventional built housing units of the same quality.

Even ignoring transportation costs, the use of industrialized housing is more costly than conventional built housing units of the same quality.

More building code problems with industrialized housing than conventional built housing

Homebuyers prefer conventional built housing to industrialized housing

More labor problems with industrialized housing than conventional built housing

Other (please specify) _____

No answer

	Most Significant	2nd Most	3rd Most
The cost of transportation from the factory to the site makes the use of industrialized housing more costly than conventional built housing units of the same quality.	10	20	17
Even ignoring transportation costs, the use of industrialized housing is more costly than conventional built housing units of the same quality.	26	14	15
More building code problems with industrialized housing than conventional built housing	6	15	20
Homebuyers prefer conventional built housing to industrialized housing	39	17	16
More labor problems with industrialized housing than conventional built housing	4	15	18
Other (please specify) _____	4	3	5
No answer	12	15	10

Note: Percentages may not total 100 because of rounding.

U.S. GENERAL ACCOUNTING OFFICE
SURVEY OF INDUSTRIALIZED HOUSING MANUFACTURERS

INSTRUCTIONS

Please read these questions carefully and answer each one as frankly and completely as possible. If a question does not apply to you, cross it out and go on to the next question. Please feel free to add any additional comments you may have at the end of the questionnaire.

While most of the terms will be clearly understood the term industrialized housing may be ambiguous and should be defined. For the purpose of this questionnaire, INDUSTRIALIZED HOUSING includes the three following types of housing:

- A. Modular house - a house built, assembled and finished in a factory and then shipped to the site as a three-dimensional module or section which meets typical local building codes. More than one module or section may be used to make a complete living unit.
- B. Prefabricated house - a house in which major parts (pre-hung doors, cabinets, trusses, wall panels, mechanical, electrical or plumbing cores, etc.) are fabricated to some degree in the factory, but not necessarily as three dimensional units, and then shipped to the site to be assembled.
- C. Pre-cut house - a house which requires some degree of on-site fabrication (trusses and wall panels may be included, however). On-site labor is used to a greater extent than in prefabricated houses, but to a lesser degree than that used in conventional construction.

Industrialized housing, as we have defined it, does not include mobile homes, double-wide mobile homes or components (pre-hung doors, ready-made windows, assembled roof trusses, wall and floor panels, electrical or plumbing cores) which are not sold in a complete housing package.

GENERAL INFORMATION ON FIRM

1. Please identify your firm.

Name _____
 Address _____
 _____ Zip Code _____

2. Please identify company official completing this questionnaire.

Name _____
 Title _____
 Telephone _____ Area Code _____

3. How is your firm organized?

Sole proprietorship
 Partnership
 Public corporation
 Private corporation
 Other (please specify) _____

4. Are you a subsidiary of another corporation?

Yes No
 If yes, please list name of parent corporation.

5. What year did your firm start producing industrialized housing?

Year _____

6. What is the approximate value of your 1973 and 1974 sales of industrialized housing units?

1973 sales _____ 1974 sales _____

7. Check all the types of industrialized housing your company produces.

Modular houses
 Prefabricated houses
 Pre-cut houses
 Other (please specify) _____

8. Check all the other housing manufacturing areas below that your firm was engaged in in 1974.

Mobile homes
 Double-wide mobile homes
 Modularity for non-residential uses -- schools, commercial and industrial buildings.
 Components (such as pre-hung doors, windows, roof trusses, floor and wall panels, etc.)
 Other (please specify) _____

9. Please indicate the number of single-family and multifamily industrialized housing units produced by your firm in 1973 and 1974 and the planned production for the same type of units in 1975.

	Modular	Prefabricated	Pre-cut
1973			
Single-family			
Multifamily			
1974			
Single-family			
Multifamily			
1975 PLANNED			
Single-family			
Multifamily			

10. Excluding your customer's concern over high interest rates and the unavailability of money which are problems common to the entire housing industry, to what degree do you believe that the following factors are a barrier or problem for the growth of the industrialized housing industry -- that is, what factors are keeping the industrialized housing industry from increasing its share of the total housing units built each year? (Check one box for each factor.)

	Little or no problem	Somewhat of a problem	Moderate problem	Somewhat of a major problem	Major problem
a. Building code requirements					
b. Labor cost					
c. Material cost					
d. Consumer acceptance					
e. Builder/developer's acceptance					
f. Difficulty in getting permanent financing for industrialized housing					
g. Labor opposition at the plants					
h. Labor opposition at erection sites					
i. Working capital for financing inventories and production					
j. Scattered markets					
k. Transportation costs					
l. Highway load width restrictions					
m. Other (please specify)					

11. In your opinion, which of the factors listed in the above question (question 10) are the three most significant barriers or problems for the growth of the industrialized housing industry today? Please respond to this question by placing the letter to the left of the selected factor in the appropriate spaces below.

Most significant factor is letter _____
 2nd most significant factor is letter _____
 3rd most significant factor is letter _____

MARKETING

12. Please provide the following information on the plants your firm has for producing industrialized housing.

Number of plants _____
 Total area of all plants _____ (square footage)

number of states in which plants are located _____

13. What percentage of your industrialized housing units are marketed by the following methods:

	<u>Percentage</u>
Through builder/developers	_____
Through dealers	_____
Direct to buyers	_____
Used in own developments	_____
Other (please specify)	_____
	<u>100%</u>

14. What percentage of your industrialized housing units are erected in the following areas?

	<u>Percentage</u>
Scattered lots in metropolitan areas	_____
Scattered lots in small towns	_____
Scattered lots in rural areas	_____
Planned developments in metropolitan areas	_____
Planned developments in small towns	_____
Recreational developments	_____
Other (please specify)	_____
	<u>100%</u>

15. Which of the following sources are used by your firm in obtaining information on potential housing markets?

- Federal agencies
- State agencies
- County or local government agencies
- Dealers and builder/developers
- In-house market surveys
- Other (please specify) _____

16. What do you feel should be the Federal Government's role in identifying and developing markets for industrialized housing?
- Heavy involvement
 - Assist industrialized housing manufacturers
 - No involvement at all
 - Other (please specify) _____

23. How much of a problem are transportation costs today compared to five years ago?
- Much less of a problem
 - Somewhat less of a problem
 - Same as before
 - Somewhat more of a problem
 - Much more of a problem

TRANSPORTATION

17. How much of a factor are transportation distances and costs in determining how far from your plants your firm markets its industrialized housing units?
- Little or no factor
 - Somewhat of a factor
 - Moderate factor
 - Somewhat of a major factor
 - Major factor

18. How far from your plants does your firm market its industrialized housing units? (For example: within a 150 mile radius of plants.)
- Within a _____ mile radius of plants

19. How does your firm ship its industrialized housing units?
- Most or all units shipped by highway using firm's own trucks and equipment
 - Most or all units shipped by highway using common carrier
 - Other (please specify) _____

20. What is the average cost per mile for shipping your industrialized housing units?
- Average cost per mile _____

21. Does your firm ship any of its industrialized housing units by rail?
- Yes No
- If yes, what percentage of your units are shipped by rail?
- Percentage shipped by rail _____

22. How much of a problem were transportation costs for the industrialized housing industry in 1969 and 1974? (Check one box for each year.)

	Little or no problem	Somewhat of a problem	Moderate problem	Somewhat of a major problem	Major problem
Transportation costs in 1969					
Transportation costs in 1974					

FINANCING

24. When is the buyer usually required to pay for the industrialized housing unit?
- Payment in full when order is placed
 - Downpayment when order placed and balance prior to shipment of housing unit from plant
 - Downpayment when order placed and balance at time of delivery to the site
 - Downpayment when order placed and balance at final settlement on the house
 - Other (please specify) _____

25. How much of a problem is it to obtain working capital funds to finance your production and inventories until final payments are received for your sold industrialized housing units?
- Not a problem
 - Minor problem
 - Moderate problem
 - Major problem

26. Is obtaining working capital funds to finance your production and inventories more of a problem today compared to five years ago?
- Much more of a problem
 - Somewhat more of a problem
 - Same as before
 - Somewhat less of a problem
 - Much less of a problem

27. Under conventional building practices, the builder is allowed to draw portions of his construction loan at various stages of completion of the house. How do you feel about a similar financing mechanism for the industrialized housing industry? That is, when a unit is sold the manufacturer could obtain portions of the unit's sales price during the production and delivery period instead of waiting until delivery to the site or the homebuyer's final settlement on the house.

- Strongly against
- Moderately against
- Undecided
- Moderately for
- Strongly for

28. Do you feel that the Federal Government should take the initiative in developing an interim financing mechanism for the industrialized housing industry similar to that mentioned in the previous question?

- Yes No

29. Is it more difficult for buyers to obtain permanent (mortgage) financing for industrialized housing units than for conventional built homes?

- Much easier
- Somewhat easier
- About the same
- Somewhat more difficult
- Much more difficult

30. Do you feel that mortgage companies are more willing to grant the buyer permanent (mortgage) financing for industrialized housing today compared with five years ago?

- Much more willing
- Somewhat more willing
- Same as before
- Somewhat less willing
- Much less willing

BUILDING CODES

31. How much of a problem was it for the industrialized housing industry to deal with local building codes in 1969 and 1974? (Check one box for each year.)

	Little or no problem	Somewhat of a problem	Moderate problem	Somewhat of a major problem	Major problem
1969					
1974					

32. How much of a problem is it to deal with building codes today compared with five years ago?

- Much less of a problem
- Somewhat less of a problem
- About the same
- Somewhat more of a problem
- Much more of a problem

33. If you believe that dealing with building codes is less of a problem for the industrialized housing industry today than five years ago, what effect do you feel Operation Breakthrough had on reducing the building code problems?

- Major contribution in reducing building code problems
- Minor contribution in reducing building code problems
- No effect, one way or the other, on building code problems
- Don't know

34. Some states have statewide industrialized housing codes which permit inspections normally made at the building site (by local inspectors) to be made at the factory. In such cases, the state codes may (1) make factory inspections mandatory for all communities so that after the unit is inspected at the factory it can be erected at any site within the state without being inspected again, or (2) make it optional for local communities to accept inspections made at the factory. Indicate how you feel about such statewide industrialized housing codes.

Statewide Codes

MANDATORY
for local communities

- Strongly against
- Moderately against
- Undecided
- Moderately for
- Strongly for

Statewide Codes

OPTIONAL
for local communities

- Strongly against
- Moderately against
- Undecided
- Moderately for
- Strongly for

35. Which of the following statements best describes how many industrialized housing units receive code inspections (structural, mechanical, electrical and plumbing) at your factories where they are built?

- Most or all inspected in factory
- About half of the units inspected in factory
- A few units inspected in factory
- No units inspected in factory

APPENDIX V

36. Please provide information on the states where your units are sold and statewide industrialized housing codes.

Number of state where your housing units are sold. _____

Number of states where you sell your units that have statewide industrialized housing codes _____

Number of states with statewide industrialized housing codes that have approved your housing units _____

37. Describe how statewide certification or code approval from one state helps your firm get local code approval or statewide code approval for your units in other states. (Skip to next question if your units do not receive state certification or code approval.)

<u>Local Code Approval</u>	<u>Statewide Code Approval</u>
<input type="checkbox"/> Significantly helps	<input type="checkbox"/> Significantly helps
<input type="checkbox"/> Moderately helps	<input type="checkbox"/> Moderately helps
<input type="checkbox"/> No help	<input type="checkbox"/> No help

38. Do you avoid trying to market in certain areas because of code problems?

Yes No

39. What should the Federal Government do to help improve building codes and building code administration?

Should not be involved

Should assist State and local governments and model code groups but not set requirements

Should establish and administer a national building code

Other (please specify) _____

LABOR

40. (a) Which of the following statements best describes your factory workers membership in labor unions.

Factory workers do not belong to any union

Factory workers belong to only one union

Factory workers belong to two or more unions

Other (please specify) _____

(b) Do you have employees that work at the construction sites?

Yes No

If yes, do they belong to a union?

Yes No

41. How much of a problem were labor union rules and work restrictions in the plant and at construction sites for your firm in 1969 and 1974? (Check one box for factory category and construction sites category, if applicable, for each year.)

		Little or no problem	Somewhat of a problem	Moderate problem	Somewhat of a major problem	Major problem
1969	Factory					
	Construction sites					
1974	Factory					
	Construction sites					

42. How much of a problem are labor union rules and work restrictions in the plant and at construction sites today compared to five years ago?

- Much more of a problem
- Somewhat more of a problem
- Same as before
- Somewhat less of a problem
- Much less of a problem

43. If you feel that labor opposition to industrialized housing is less today than five years ago, what effect, if any, did Operation Breakthrough have in reducing labor's opposition?

- Major contribution in reducing labor's opposition
- Minor contribution in reducing labor's opposition
- No effect
- Don't know

44. Does your firm avoid marketing its units in any specific areas because of possible labor opposition?

- Yes No

PRODUCTION METHODS AND MATERIALS

45. Does your firm now use materials and production methods in the manufacture of its industrialized housing units that it did not use five years ago? Check one box under materials and one box under production methods. (If your firm did not produce industrialized housing in 1969, skip to question 49.)

	Materials	Production Methods
Almost no change		
Some change, but mostly same		
Major changes		

46. Please describe the materials you are now using which were not used in your industrialized housing units five years ago?

47. Please describe the changes made in your production methods during the past five years.

48. What statement do you feel best describes the contributions made by Operation Breakthrough to the development of technological innovations in the industrialized housing industry?

- Major contribution to the development of technological innovations
- Minor contributions to the development of technological innovations
- No effect
- Don't know

49. Please describe any changes in your method of producing or marketing industrialized housing systems that were made as a result of Operation Breakthrough.

50. Do you believe that the technical knowledge and materials needed to effectively produce industrialized housing existed in 1969 and 1974?

	Yes	No	Don't know
1969			
1974			

51. What do you think the Federal Government should do to support technological innovation in the housing industry? Check ALL the functions you believe the Federal Government should perform.

- No role for Federal Government
- Develop better code requirements
- Develop better test procedures
- Test new materials and techniques
- Perform research to develop new materials
- Develop new approaches to housing construction
- Support training programs for building code inspectors
- Other (please specify) _____

OPERATION BREAKTHROUGH

52. Did your firm submit a proposal to HUD for Operation Breakthrough?

- Yes
- No If no, please explain why you chose not to participate in this program.

53. Which of the following statements best describes what influence Operation Breakthrough had on your firm's decision to enter the industrialized housing industry?

- None - already manufacturing industrialized housing prior to Operation Breakthrough
- None - other factors influenced decision more than Operation Breakthrough
- Some influence but not major factor
- Moderate influence or factor
- Major influence or factor

54. Have you or a member of your firm visited any of the original nine Operation Breakthrough prototype sites at the following locations?

- Indianapolis, Indiana Yes No
- Jersey City, New Jersey Yes No
- Kalamazoo, Michigan Yes No
- Macon, Georgia Yes No
- Memphis, Tennessee Yes No
- St. Louis, Missouri Yes No
- Sacramento, California Yes No
- King County, Washington Yes No
- Seattle, Washington Yes No

55. Have you visited any of the production facilities of the 22 Operation Breakthrough producers?

- Yes No

56. Which of the sources below provided your firm with information on Operation Breakthrough?

- Newspaper articles
- Trade journals
- Reports from 22 builders that produced units under Operation Breakthrough
- HUD Housing System Proposals for Operation Breakthrough
- HUD Feedback reports on Operation Breakthrough
- HUD newsletters
- Conventions
- Other sources (please specify)

57. What is your general feeling of the information received on the results of Operation Breakthrough?

- More than adequate
- Adequate
- Inadequate
- No opinion

58. Which of the following statements best describe the general effect you feel Operation Breakthrough had on the industrialized housing industry?

- Greatly hurt the industrialized housing industry
- Slightly hurt the industrialized housing industry
- No effect on the industrialized housing industry
- Slightly helped the industrialized housing industry
- Greatly helped the industrialized housing industry

Please use this space to describe the significant effects, if any, you think Operation Breakthrough had on the housing industry, and add any general comments on the questionnaire or on Operation Breakthrough you may wish to make. Thank you for completing the questionnaire.

IMPACT OF OPERATION BREAKTHROUGH ON THE HOUSING INDUSTRY:

GENERAL COMMENTS:

**RESPONSES BY INDUSTRIALIZED HOUSING MANUFACTURERS
TO SELECTED QUESTIONS ON THE GAO QUESTIONNAIRE.**

10. Excluding your customer's concern over high interest rates and the unavailability of money which are problems common to the entire housing industry, to what degree do you believe that the following factors are a barrier or problem for the growth of the industrialized housing industry -- that is, what factors are keeping the industrialized housing industry from increasing its share of the total housing units built each year? (Check one box for each factor.)

-----Percent-----

	Little or no problem	Somewhat of a problem	Moderate problem	Somewhat of a major problem	Major problem	No answer
a. Building code requirements	20	19	22	17	21	1
b. Labor cost	41	20	19	11	7	2
c. Material cost	23	14	23	15	22	3
d. Consumer acceptance	51	21	16	5	5	3
e. Builder/developer's acceptance	38	20	20	16	3	4
f. Difficulty in getting permanent financing for industrialized housing	38	12	10	19	20	1
g. Labor opposition at the plants	78	6	7	5	2	3
h. Labor opposition at erection sites	49	20	16	7	6	1
i. Working capital for financing inventories and production	28	17	14	11	28	1
j. Scattered markets	32	19	26	12	7	4
k. Transportation costs	17	19	28	15	20	1
l. Highway load width restrictions	32	11	19	15	22	2
m. Other (please specify)	1	-	3	-	12	84

Note: Percentages may not total 100 because of rounding.

11. In your opinion, which of the factors listed in the above question (question 10) are the three most significant barriers or problems for the growth of the industrialized housing industry today? Please respond to this question by placing the letter to the left of the selected factor in the appropriate spaces below.

---Percent---

	No. t Significant	2nd Most	3rd Most
a. Building code requirements	23	12	12
b. Labor cost	6	7	5
c. Material cost	9	17	10
d. Consumer acceptance	1	5	1
e. Builder/developer's acceptance	4	1	8
f. Difficulty in getting permanent financing for industrialized housing	19	11	9
g. Labor opposition at the plants	1	0	2
h. Labor opposition at erection sites	2	4	6
i. Working capital for financing inventories and production	16	15	9
j. Scattered markets	1	6	11
k. Transportation costs	6	9	11
l. Highway load width restrictions	6	4	7
m. Other (please specify)	5	6	3
No Answer	3	4	6

Note: Percentages may not total 100 because of rounding.

16. What do you feel should be the Federal Government's role in identifying and developing markets for industrialized housing?

	<u>Percent</u>
Heavy involvement	9
Assist industrialized housing manufacturers	45
No involvement at all	32
Other (please specify) _____	6
No answer	8

23. How much of a problem are transportation costs today compared to five years ago?

	<u>Percent</u>
Much less of a problem	3
Somewhat less of a problem	3
Same as before	31
Somewhat more of a problem	30
Much more of a problem	27
No answer.	7

Note: Percentages may not total 100 because of rounding.

26. Is obtaining working capital funds to finance your production and inventories more of a problem today compared to five years ago?

	<u>Percent</u>
Much more of a problem	28
Somewhat more of a problem	25
Same as before	32
Somewhat less of a problem	9
Much less of a problem	3
No answer	3

30. Do you feel that mortgage companies are more willing to grant the buyer permanent (mortgage) financing for industrialized housing today compared with five years ago?

	<u>Percent</u>
Much more willing	30
Somewhat more willing	43
Same as before	17
Somewhat less willing	3
Much less willing	3
No answer	6

Note: Percentages may not total 100 because of rounding.

31. How much of a problem was it for the industrialized housing industry to deal with local building codes in 1969 and 1974? (Check one box for each year.)

-----Percent-----

	Little or no problem	Somewhat of a problem	Moderate problem	Somewhat of a major problem	Major problem	No answer
1969	20	12	16	20	22	11
1974	20	25	17	20	11	7

32. How much of a problem is it to deal with building codes today compared with five years ago?

	<u>Percent</u>
Much less of a problem . . . . .	.12
Somewhat less of a problem . . . . .	.30
About the same . . . . .	.26
Somewhat more of a problem . . . . .	.15
Much more of a problem . . . . .	.13
No answer . . . . .	.05

Note: Percentages may not total 100 because of rounding.

33. If you believe that dealing with building codes is less of a problem for the industrialized housing industry today than five years ago, what effect do you feel Operation Breakthrough had on reducing the building code problems?

	<u>Percent</u>
Major contribution in reducing building code problems	9
Minor contribution in reducing building code problems	16
No effect, one way or the other, on building code problems	37
Don't know	25
No answer	14

34. Some states have statewide industrialized housing codes which permit inspections normally made at the building site (by local inspectors) to be made at the factory. In such cases, the state codes may (1) make factory inspections mandatory for all communities so that after the unit is inspected at the factory it can be erected at any site within the state without being inspected again, or (2) make it optional for local communities to accept inspections made at the factory. Indicate how you feel about such statewide industrialized housing codes.

<u>Statewide Codes</u> <u>MANDATORY</u> <u>for local communities</u>	<u>Percent</u>
Strongly against	10
Moderately against	2
Undecided	14
Moderately for	17
Strongly for	51
No answer	6

<u>Statewide Codes</u> <u>OPTIONAL</u> <u>for local communities</u>	<u>Percent</u>
Strongly against	33
Moderately against	5
Undecided	16
Moderately for	12
Strongly for	6
No answer	28

Note: Percentages may not total 100 because of rounding.

39. What should the Federal Government do to help improve building codes and building code administration?

	<u>Percent</u>
Should not be involved	20
Should assist State and local governments and model code groups but not set requirements . . .	32
Should establish and administer a national building code	41
Other (please specify) _____ .	3
No answer	4

42. How much of a problem are labor union rules and work restrictions in the plant and at construction sites today compared to five years ago?

	<u>Percent</u>
Much more of a problem	7
Somewhat more of a problem	12
Same as before	47
Somewhat less of a problem	9
Much less of a problem	3
No answer	24

Note: Percentages may not total 100 because of rounding.

43. If you feel that labor opposition to industrialized housing is less today than five years ago, what effect, if any, did Operation Breakthrough have in reducing labor's opposition?

	<u>Percent</u>
Major contribution in reducing labor's opposition	6
Minor contribution in reducing labor's opposition	12
No effect	33
Don't know	30
No answer	19

45. Does your firm now use materials and production methods in the manufacture of its industrialized housing units that it did not use five years ago? Check one box under materials and one box under production methods. (If your firm did not produce industrialized housing in 1969, skip to question 49.)

-----Percent-----

	Materials	Production Methods
Almost no change	22	15
Some change, but mostly same	53	48
Major changes	10	23
No answer	15	15

Note: Percentages may not total 100 because of rounding.

43. What statement do you feel best describes the contributions made by Operation Breakthrough to the development of technological innovations in the industrialized housing industry?

	<u>Percent</u>
Major contribution to the development of technological innovations	4
Minor contributions to the development of technological innovations	25
No effect	30
Don't know	25
No answer	15

50. Do you believe that the technical knowledge and materials needed to effectively produce industrialized housing existed in 1969 and 1974?

-----Percent-----

	Yes	No	Don't know	No answer
1969	69	14	12	6
1974	81	6	8	6

Note: Percentages may not total 100 because of rounding.

51. What do you think the Federal Government should do to support technological innovation in the housing industry? Check ALL the functions you believe the Federal Government should perform.

	<u>Percent</u>
No role for Federal Government	26
Develop better code requirements	41
Develop better test procedures	15
Test new materials and techniques	30
Perform research to develop new materials	28
Develop new approaches to housing construction	25
Support training programs for building code inspectors	36
Other (please specify) _____	9

Note: Does not total 100 because each respondent checked more than one box.

53. Which of the following statements best describes what influence Operation Breakthrough had on your firm's decision to enter the industrialized housing industry?

	<u>Percent</u>
<u>None</u> - already manufacturing industrialized housing prior to Operation Breakthrough	72
<u>None</u> - other factors influenced decision more than Operation Breakthrough	17
Some influence but not major factor	3
Moderate influence or factor	1
Major influence or factor	3
No answer.	4

Note: Percentages may not total 100 because of rounding.

58. Which of the following statements best describes the general effect you feel Operation Breakthrough had on the industrialized housing industry?

	<u>Percent</u>
Greatly hurt the industrialized housing industry	12
Slightly hurt the industrialized housing industry	15
No effect on the industrialized housing industry	23
Slightly helped the industrialized housing industry	28
Greatly helped the industrialized housing industry	6
No answer	15

Note: Percentages may not total 100 because of rounding.

QUESTIONNAIRE TO OPERATION BREAKTHROUGH HOUSING SYSTEMS PRODUCERS

1. Name of Breakthrough System _____

2. Person Completing Questionnaire:

Name _____

Present Title _____

Firm _____

Address _____

_____ Zip Code _____

Telephone _____

3. Before participating in Operation Breakthrough, what was your firm's involvement in the housing industry?

- Conventional builder
- Produced industrialized housing
- General contractor
- Supplier
- No previous involvement in housing industry
- Other: (Please explain) _____

4. Which of the following factors led your firm to participate in Operation Breakthrough?

	Major Factor	Minor Factor	Not a Factor
Already in industrialized housing, and saw Operation Breakthrough as a way to increase market			
Regarded Operation Breakthrough as a good way to enter industrialized housing industry			
Wanted greater involvement in Government housing programs			
Thought HUD certification of system would help market system			
Wanted HUD support in developing and testing system			
Other (Please specify) _____			

5. How did Operation Breakthrough influence your firm in developing its housing system?

- Had little effect, would have introduced the same system at about the same time.
- Would have introduced the same system, but at a later time
- Would not have produced Breakthrough system, but would have produced industrialized housing using other designs
- Would not have entered industrialized housing industry without Operation Breakthrough
- Other: (Please explain) _____

6. What is the present production status of your firm's Breakthrough System?

- Still produced in United States
- Produced under license in foreign countries, but not produced in United States
- Modified version of Breakthrough system produced by your firm
- System not produced, but developments that were part of system are being marketed by your firm

Please describe these developments briefly: _____

- No present production related to participation in Operation Breakthrough
- Other: (Please explain) _____

7. If your firm is not producing Breakthrough system in the United States, when did it stop production? _____ (year)

Please describe the reasons for stopping production briefly. _____

- 8 a. In total, how many units of your Breakthrough System were produced through 1974? _____.
- b. If your system is still produced, how many units do you plan to produce for the United States market in 1975? _____ (units)

Marketing

9. Were HUD's market aggregation plans a major factor in your firm's decision to participate in Operation Breakthrough?

- The most important reason for participating
- A major reason for participating
- Had little influence on decision to participate
- Other: _____

10. Which statement best describes the role of government housing programs in your firm's plans for marketing its Breakthrough System?

- Plans relied on government housing programs for most of production
- Government housing programs were to provide a significant market, but less than half of production
- Government housing programs were not a significant part of the planned market
- Other: _____

11. Were the Breakthrough prototype sites effective in generating new orders for your units?

- A great help
- Some help
- Little or no help

12. Was the testing provided in Operation Breakthrough helpful in marketing your housing units?

- A great help
- Some help
- Little or no help

13. Please describe any other ways Operation Breakthrough was helpful in marketing your housing units.

14. Which of the following were useful to the firm in marketing its Breakthrough System?

Federal housing programs			
State Governments			
Private developers			

Very helpful
Some help
No help

15. Did the "moratorium" on HUD housing programs at the beginning of 1973 affect your marketing plans for the Breakthrough System?

- Little or no effect
- Some effect
- Major effect

16. Do you think consumer prejudice against industrialized housing was a major problem in marketing your system?

- Not a problem
- A minor problem
- A major problem

17. Did Operation Breakthrough help increase consumer acceptance of your system?

- Helped a lot
- Helped somewhat
- Had little effect

18. Please describe any major marketing problems encountered with your Operation Breakthrough system.

Cost

19. At what sustained annual production rate do you estimate your system could cost less than conventional construction?

_____ (annual production rate). Please add any qualifying remarks you feel necessary.

20. Would your Breakthrough system be cheaper than conventional construction at a production rate of 1,000 units per year for 3 years?

- Breakthrough system would be much cheaper
- Breakthrough system would be slightly cheaper
- Costs would be about the same
- Breakthrough system would be more expensive
- Don't know; no opinion
- No simple answer possible - it depends

Technological Innovation

21. Which of the following statements best describes the status of your housing system when Operation Breakthrough was announced in 1969?

- Most features of the system were already used in production in the United States
- System in use overseas, but not in United States
- System nearly ready for production, but had not been produced
- Much development work had been completed, but system not ready for production
- Little development work had been completed when Operation Breakthrough was announced
- Other: (Please explain) _____

22. Which of the following statements best describes your firm's use of new building materials in its Operation Breakthrough system?

- Almost all building materials proposed for the Breakthrough system were already widely used for housing construction
- Firm planned extensive use of new materials, but design changes eliminated new materials for prototype construction
- Extensive use of new materials was included in proposal, and actually employed in construction

If your firm proposed, or used new materials extensively, please describe them briefly

23. Which of the following statements best describes the construction techniques used in your Breakthrough system?

- Construction techniques were already used in United States
- New construction techniques were planned for system, but design was changed to use techniques already in use
- New construction techniques were proposed for, and actually used in Breakthrough system

Please describe the new construction techniques proposed for or used in the Breakthrough system.

24. Which of the following statements best describes the influence of the performance standards developed by NBS on your Breakthrough design?

- They permitted greater flexibility in design and materials usage than existing building codes
- They had little effect upon design; design met existing code requirements
- They created difficulties because standards were higher than existing codes
- Other, please describe: _____

25. Which statement best describes the time available in Operation Breakthrough for design development. (From program announcement to the end of Phase I design development)?

- Time for design development was adequate
- More time would have been useful, but lack of time had no serious effect
- Lack of time led to production problems
- Lack of time led to major design changes that could have been avoided if more development time was allowed
- Other remarks: _____

Building Codes

26. Has your Breakthrough system received any state-wide code approvals?

- Did not seek state-wide code approvals
- Applied for state-wide code approvals, but have not yet received any
- Have received state-wide code approvals in _____ (number) states

27. Which statement best describes your opinion on local building codes as a barrier to industrialized housing?

- Local codes were not a major barrier to industrialized housing before the program began
- Operation Breakthrough made a major contribution to resolving local building code problems for industrialized housing
- Operation Breakthrough had some effect on local building codes, but major problems remain for industrialized housing
- Operation Breakthrough had little effect upon local building codes. They are still a major problem for industrialized housing

28. Which of the following is the greatest building code problem for industrialized housing?

- Lack of training of local code officials
- On-site inspection requirements
- Differing requirements between local codes
- Delays encountered in obtaining the approval of new jurisdictions
- No serious problems with local building codes
- Other: (Please explain) _____

29. Did the need for obtaining local code approval create difficulties in marketing your system?

	<u>Agree</u>	<u>Disagree</u>
-Local code approval was no problem in marketing	<input type="checkbox"/>	<input type="checkbox"/>
-Local code approvals caused delays in marketing system	<input type="checkbox"/>	<input type="checkbox"/>
-Changes caused by local code requirements significantly increased production costs	<input type="checkbox"/>	<input type="checkbox"/>
-Local code requirements prevented marketing in some areas	<input type="checkbox"/>	<input type="checkbox"/>

30. Did the testing of your system in Operation Breakthrough help resolve local building code problems?

- Testing was a great help in obtaining local code approvals
- Testing helped some, but problems were still encountered
- Testing was little help in obtaining local code approval
- Don't know, unsure

31. Are state-wide codes for industrialized housing helpful?

- Very helpful to the industrialized housing industry
- Some help to industrialized housing
- No significant help to industrialized housing
- Other _____

Financing

32. Did participation in Operation Breakthrough help attract capital investment in your housing system?

- Participation helped greatly
- Participation helped some
- Participation had little effect
- Other (please explain) _____

33. Did participation in Operation Breakthrough help make it easier to obtain mortgages and other permanent financing for industrialized housing?

- Made it much easier
- Made it somewhat easier
- Had little or no effect
- Other (please explain) _____

Labor

34. Which statement best describes your firm's experience with labor opposition to industrialized housing methods when Operation Breakthrough began in 1969?

- Already had agreements with labor unions for industrialized housing production before Operation Breakthrough began
- Did not regard potential labor opposition as a problem for industrialized housing
- Regarded potential labor opposition as a problem, but not a major barrier to industrialized housing
- Regarded potential labor opposition as a major barrier to industrialized housing
- Other: _____

35. Did Operation Breakthrough help reduce labor opposition to industrialized housing?

- Operation Breakthrough helped bring about major changes in labor's attitude toward industrialized housing
- Operation Breakthrough did not produce major changes in labor attitudes, but helped resolve jurisdictional problems and other matters related to specific situations
- Labor opposition was never a major problem for industrialized housing
- Operation Breakthrough had little effect labor opposition is still a problem

36. Have labor union rules and work restrictions interfered with industrialized housing production in your plant or on site?

Yes _____ No _____

Please briefly describe any problems:

Transportation

37. Did Operation Breakthrough help resolve any transportation problems with your system?

- A great help
- Some help
- Little or no help
- Please explain: _____

38. How was your Breakthrough system shipped?

- Highway only
- Mostly highway, some rail
- Mostly rail
- Other _____

39. Which of the following statements best describes the effect of 12' highway load width restrictions on your Breakthrough systems?

- Highway loadwidth restrictions were not a factor in the design
- 14' load width limits would have been of some help in transporting the system
- 14' load width limits would have been of great help to the system

40. Were transportation costs a significant problem for your Breakthrough system?

- Transportation costs were a serious problem
- Transportation costs were a factor, but not a serious problem
- Transportation costs were not significant in marketing system

General

41. Excluding your customer's concern over high interest rates and the unavailability of money which are problems common to the entire housing industry, to what degree do you believe that the following factors are a barrier or problem for the growth of the industrialized housing industry—that is what factors are keeping the industrialized housing industry from increasing its share of the total housing units built each year? (Check one box for each factor.)

	Little or no problem	Factor of a problem	Major barrier	Major problem
1. Building code requirements				
2. Labor cost				
3. Material cost				
4. Consumer acceptance				
5. Builder/developer's acceptance				
6. Difficulty in getting permanent financing for industrialized housing				
7. Labor opposition at the plants				
8. Labor opposition at erection sites				
9. Working capital for financing inventories and production				
10. Scattered markets				
11. Transportation costs				
12. Highway load width restrictions				
13. Other (please specify)				

42. In your opinion, which of the factors listed in the above question (question 41) are the three most significant barriers or problem for the growth of the industrialized housing industry today? Please respond to this question by placing the number to the left of the selected factor in the appropriate spaces below.

Most significant factor is number _____
 2nd most significant factor is number _____
 3rd most significant factor is number _____

43. How did Operation Breakthrough help your firm?

	Greatly hurt	Slightly hurt	No effect	Slightly helped	Greatly helped
Improved quality control procedures					
Helped increase housing production					
Helped overcome building code problems					
Made the industry more responsive to new construction methods					
Provided support for development and testing of system					
Helped resolve labor problems					
Provided useful production and marketing experience					
Familiarized company with government housing programs					
Other: (please specify)					

44. Which of the following statements best describe the general effect you feel Operation Breakthrough had on the housing industry?

- Greatly hurt the housing industry
- Slightly hurt the housing industry
- No effect on the housing industry
- Slightly helped the housing industry
- Greatly helped the housing industry

Please explain your answer:

45. Please add any additional comments you wish to make, using additional paper if necessary. Thank you for completing the questionnaire.

RESPONSES BY OPERATION BREAKTHROUGH MANUFACTURERS
TO SELECTED QUESTIONS ON THE GAO QUESTIONNAIRE

4. Which of the following factors led your firm to participate in Operation Breakthrough?

Number of housing
manufacturers
responding

	Number of housing manufacturers responding			
	Major Factor		Minor Factor	
	1	2	3	4
Already in industrialized housing, and saw Operation Breakthrough as a way to increase market	6	1	2	6
Regarded Operation Breakthrough as a good way to enter industrialized housing industry	8	2	1	4
Wanted greater involvement in Government housing programs	3	5	2	5
Thought HUD certification of system would help market system	7	2	2	4
Wanted HUD support in developing and testing system	5	5	2	3
Other (Please specify) 2				13

5. How did Operation Breakthrough influence your firm in developing its housing system?

Had little effect, would have introduced the same system at about the same time.	1
Would have introduced the same system, but at a later time	4
Would not have produced Breakthrough system, but would have produced industrialized housing using other designs	4
Would not have entered industrialized housing industry without Operation Breakthrough	6
Other (Please explain) _____	

Number of housing
manufacturers
responding

9. Were HUD's market aggregation plans a major factor in your firm's decision to participate in Operation Breakthrough?
- The most important reason for participating 2
 - A major reason for participating 10
 - Had little influence on decision to participate 3
 - Other: _____
-
10. Which statement best describes the role of government housing programs in your firm's plans for marketing its Breakthrough System?
- Plans relied on government housing programs for most of production 9
 - Government housing programs were to provide a significant market, but less than half of production 5
 - Government housing programs were not a significant part of the planned market 0
 - Other: _____ 1
-
11. Were the Breakthrough prototype sites effective in generating new orders for your units?
- A great help 1
 - Some help 3
 - Little or no help 11
12. Was the testing provided in Operation Breakthrough helpful in marketing your housing units?
- A great help 2
 - Some help 5
 - Little or no help 8

Number of housing
manufacturers
responding

Very helpful
Some help
No help
No answer

14. Which of the following were useful to the firm in marketing its Breakthrough System?

Federal housing programs
State Governments
Private developers

6 2 6 1
1 5 7 2
4 3 6 2

15. Did the "moratorium" on HUD housing programs at the beginning of 1973 affect your marketing plans for the Breakthrough System?

Little or no effect 4
Some effect 3
Major effect 8

16. Do you think consumer prejudice against industrialized housing was a major problem in marketing your system?

Not a problem 6
A minor problem 7
A major problem 2

17. Did Operation Breakthrough help increase consumer acceptance of your system?

Helped a lot 0
Helped somewhat 3
Had little effect 12

Number of housing
manufacturers
responding

21. Which of the following statements best describes the status of your housing system when Operation Breakthrough was announced in 1969?

Most features of the system were already used in production in the United States	3
System in use overseas, but not in United States.	1
System nearly ready for production, but had not been produced	0
Much development work had been completed, but system not ready for production	2
Little development work had been completed when Operation Breakthrough was announced	7
Other: (Please explain) _____	2

22. Which of the following statements best describes your firm's use of new building materials in its Operation Breakthrough system?

Almost all building materials proposed for the Breakthrough system were already widely used for housing construction	8
Firm planned extensive use of new materials, but design changes eliminated new materials for prototype construction	2
Extensive use of new materials was included in proposal, and actually employed in construction.	5

23. Which of the following statements best describes the construction techniques used in your Breakthrough system?

Construction techniques were already used in United States	6
New construction techniques were planned for system, but design was changed to use techniques already in use	2
New construction techniques were proposed for, and actually used in Breakthrough system	7

Number of housing
manufacturers
responding

24. Which of the following statements best describes the influence of the performance standards developed by NBS on your Breakthrough design?

- They permitted greater flexibility in design and materials usage than existing building codes 0
- They had little effect upon design; design met existing code requirements 2
- They created difficulties because standards were higher than existing codes 12
- Other, please describe: _____ 1

25. Which statement best describes the time available in Operation Breakthrough for design development. (From program announcement to the end of Phase I design development)?

- Time for design development was adequate 6
- More time would have been useful, but lack of time had no serious effect 5
- Lack of time led to production problems 0
- Lack of time led to major design changes that could have been avoided if more development time was allowed 3
- Other remarks: _____ 1

APPENDIX VIII

27. Which statement best describes your opinion on local building codes as a barrier to industrialized housing?

Local codes were not a major barrier to industrialized housing before the program began	4
Operation Breakthrough made a major contribution to resolving local building code problems for industrialized housing	2
Operation Breakthrough had some effect on local building codes, but major problems remain for industrialized housing	3
Operation Breakthrough had little effect upon local building codes. They are still a major problem for industrialized housing	0

28. Which of the following is the greatest building code problem for industrialized housing?

Lack of training of local code officials	1
On-site inspection requirements	7
Differing requirements between local codes	10
Delays encountered in obtaining the approval of new jurisdictions	5
No serious problems with local building codes	2
Other: (Please explain) _____	1

29. Did the need for obtaining local code approval create difficulties in marketing your system?

	<u>Agree</u>	<u>Disagree</u>	No Answer
-Local code approval was no problem in marketing	3	7	5
-Local code approvals caused delays in marketing system	5	6	4
-Changes caused by local code requirements significantly increased production costs	4	5	6
-Local code requirements prevented marketing in some areas	5	4	6

Number of housing
manufacturers
responding

30. Did the testing of your system in Operation Breakthrough help resolve local building code problems?	
Testing was a great help in obtaining local code approvals	2
Testing helped some, but problems were still encountered	4
Testing was little help in obtaining local code approval	6
Don't know, unsure	1
No Answer	2
31. Are state-wide codes for industrialized housing helpful?	
Very helpful to the industrialized housing industry	6
Some help to industrialized housing	7
No significant help to industrialized housing	1
Other _____	1
33. Did participation in Operation Breakthrough help make it easier to obtain mortgages and other permanent financing for industrialized housing?	
Made it much easier	1
Made it somewhat easier	2
Had little or no effect	9
Other (please explain) _____	2
No answer.	1
35. Did Operation Breakthrough help reduce labor opposition to industrialized housing?	
Operation Breakthrough helped bring about major changes in labor's attitude toward industrialized housing	1
Operation Breakthrough did not produce major change in labor attitudes, but helped resolve jurisdictional problems and other matters related to specific situations	8
Labor opposition was never a major problem for industrialized housing	3
Operation Breakthrough had little effect labor opposition is still a problem	2
No Answer	1

	<u>Yes</u>	<u>No</u>	<u>No Answer</u>
36. Have labor union rules and work restrictions interfered with industrialized housing production in your plant or on site?	5	8	2
37. Did Operation Breakthrough help resolve any transportation problems with your system?			
A great help			0
Some help			4
Little or no help			10
Please explain: _____			1
40. Were transportation costs a significant problem for your Breakthrough system?			
Transportation costs were a serious problem			9
Transportation costs were a factor, but not a serious problem			5
Transportation costs were not significant in marketing system			1

Number of housing
manufacturers
responding

41. Excluding your customer's concern over high interest rates and the unavailability of funds which are problems common to the entire housing industry, to what degree do you believe that the following factors are a barrier or problem for the growth of the industrialized housing industry—that is what factors are keeping the industrialized housing industry from increasing its share of the total housing units built each year? (Check one box for each factor.)

	Little or no problem	Somewhat of a problem	Fairly serious problem	Serious problem	Major problem	No Answer
1. Building code requirements	1	2	8	3	1	0
2. Labor cost	4	3	4	3	1	0
3. Material cost	3	4	3	1	4	0
4. Consumer acceptance	5	2	1	4	1	2
5. Builder/developer's acceptance	2	3	2	6	1	1
6. Difficulty in getting permanent financing for industrialized housing	6	5	0	2	2	0
7. Labor opposition at the plants	8	4	0	2	0	1
8. Labor opposition at erection sites	4	6	4	1	0	0
9. Working capital for financing inventories and production	0	3	3	6	3	0
10. Scattered markets	0	0	4	0	10	1
11. Transportation costs	1	2	2	2	7	1
12. Highway load width restrictions	6	1	2	3	3	0
13. Other (please specify)	0	0	0	0	5	10

42. In your opinion, which of the factors listed in the above question (question 41) are the three most significant barriers or problems for the growth of the industrialized housing industry today?

Number of housing manufacturers responding

	Most Significant	2nd Most Significant	3rd Most Significant
1. Building code requirements	1	1	1
2. Labor cost	1	1	1
3. Material cost	1	3	-
4. Consumer acceptance	1	-	2
5. Builder/Developer's acceptance	-	3	1
6. Difficulty in getting permanent financing for industrialized housing	-	1	1
7. Labor opposition at the plants	-	-	-
8. Labor opposition at erection sites	-	-	-
9. Working capital for financing inventories and production	3	2	3
10. Scattered markets	4	1	3
11. Transportation costs	1	3	2
12. Highway load width restrictions	-	-	-
13. Other (please specify)	3	1	1

43. How did Operation Breakthrough help your firm?

Number of housing manufacturers responding

	Great help	Some help	No help	No Answer
Improved quality control procedures	3	5	5	1
Helped increase housing production	1	3	9	2
Helped overcome building code problems	1	5	5	2
Made the industry more responsive to new construction methods	3	4	5	3
Provided support for development and testing of system	4	5	4	1
Helped resolve labor problems	0	6	3	1
Provided useful production and marketing experience	0	7	5	2
Familiarized company with government housing programs	3	9	2	1
Other: (please specify)	1	0	1	13

44. Which of the following statements best describe the general effect you feel Operation Breakthrough had on the housing industry?

- Greatly hurt the housing industry 3
- Slightly hurt the housing industry 3
- No effect on the housing industry 3
- Slightly helped the housing industry 6
- Greatly helped the housing industry 0

**PRINCIPAL OFFICIALS RESPONSIBLE FOR ADMINISTERING
ACTIVITIES DISCUSSED IN THIS REPORT**

Tenure of office
From To

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

**SECRETARY OF HOUSING AND
URBAN DEVELOPMENT:**

George W. Romney	Jan. 1969	Jan. 1973
James T. Lynn	Feb. 1973	Feb. 1975
Carla A. Hills	Mar. 1975	Present

**ASSISTANT SECRETARY FOR
POLICY DEVELOPMENT AND
RESEARCH (Formerly Re-
search and Technology):**

Harold B. Finger	Apr. 1969	Dec. 1972
Theodore R. Britton, Jr. (Acting)	Jan. 1973	Feb. 1973
Michael H. Moskow	Mar. 1973	Sept. 1975
Charles J. Orlebeke	Sept. 1975	Present

DEPARTMENT OF COMMERCE

SECRETARY OF COMMERCE:

Maurice H. Stans	Jan. 1969	Feb. 1972
Peter G. Peterson	Feb. 1972	Feb. 1973
Frederick B. Dent	Feb. 1973	Mar. 1975
John K. Tabor (Acting)	Mar. 1975	Apr. 1975
Rogers C. B. Morton	May 1975	Feb. 1976
Elliot L. Richardson	Feb. 1976	Present

**ASSISTANT SECRETARY FOR SCIENCE
AND TECHNOLOGY:**

Myron Tribus	Mar. 1969	Nov. 1970
Allen V. Astin (Acting)	Dec. 1970	Feb. 1971
James H. Wakelin	Feb. 1971	Aug. 1972
Richard O. Simpson (Acting)	Aug. 1972	Apr. 1973
Betsy Ancker-Johnson	Apr. 1973	Present

**DIRECTOR, NATIONAL BUREAU
OF STANDARDS:**

Allen V. Astin	June 1952	Aug. 1969
Louis J. Branscomb	Sept. 1969	May 1972
Lawrence Cushner (Acting)	May 1972	Feb. 1973
Richard W. Roberts	Feb. 1973	June 1975
Ernest Ambler (Acting)	June 1975	Present