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THE PERFORMANCE CONCEPT: A STUDY OF ITS APPLICATION TO HOUSING - VOLUME II

John P. Eberhard

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THE PERFORMANCE CONCEPT:

A STUDY OF ITS APPLICATION TO HOUSING

JOHN P. EBERHARD, PROJECT DIRECTOR

VOLUME TWO

INSTITUTE FOR APPLIED TECHNOLOGY
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234

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VOLUME II

PREFACE

This report, in three volumes, is the result of a study conducted by the Institute for Applied Technology of the National Bureau of Standards for the Department of Housing and Urban Development, ~~under Agreement~~ IAA-H-14-68. This study investigated the following hypothesis, ~~contained in the Agreement:~~ "It is hypothesized that, if adequate performance standards for low-cost housing could be developed, and if they were broadly used, an important and fundamental way would have been opened to accommodate the introduction of cost-reducing innovations into the design of low-cost housing."

The report finds this hypothesis to be generally correct, but emphasizes the need for the development of the necessary knowledge to implement the Performance Concept.

Volume I contains the main body of discussion and recommendations (originally issued as NBS Report No. 9849, June 3, 1968).

Volume ~~II~~ contains appendices (originally issued as NBS Report No. 9850, June 3, 1968).

Volume III contains the supplementary documents, prepared by individuals and organizations under contract to the National Bureau of Standards (originally issued as NBS Report No. 9851, June 3, 1968).

This edition of the report contains minor revisions in Volumes I and II. These involve deletions of material of interest only to NBS and to HUD, which sponsored the work. Although this report has not received the polishing and formal editorial review usually given NBS technical publications it is considered to be technically correct. It is now being issued for informational purposes pending formal release in an abridged form. No revisions have been made in Volume III.

A STUDY OF PERFORMANCE STANDARDS FOR HOUSING

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NEEDS OF THE RURAL POOR IN LOW COST HOUSING

by

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NEEDS OF THE RURAL POOR IN LOW COST HOUSING

by James Kanegis

Summary. We have formulated a brief analysis of the urgent needs of the rural poor for adequate housing and the need for research in the areas of performance standards for housing in rural and rural-farm areas. We have emphasized that the housing problem in rural America is more acute than in urban America, more diverse, more complex, and less understood. We have highlighted some of the more important variables which need study and emphasized the importance of critically examining their interrelationship.

1. Introduction

The case for needed R&D on performance standards for low cost housing and the conceptualization of criteria for such standards has been amply developed in the main body of the NBS report. (Part I) The main thrust, however, has been on urban rather than rural centers.

That such R&D is needed is not questioned, especially since there is a considerable common denominator in urban and rural housing. However, if the findings for urban housing are extrapolated to rural housing the conclusions will be unsatisfactory.

The error in such extrapolation is in failing to realize that there are significant differences in needs, desires and attitudes of the people in rural/urban America; different financial and economic problems; and certainly different geographic and environmental factors.

To some extent we may want to look at the needs of rural folk as a partial function of the term "rural" itself. Most experts attempt to define rural vs. urban largely by population, with certain area controls. The Farmers Home Administration considers all areas rural which have a population under 5500; however, the U. S. Bureau of the Census uses the 2500 figure instead. This gives a slightly different impact or significance to certain borderline statistics and variables which are covered later in this report. Community interrelationship is one good example.

Whatever figure is used as part of the definition the estimate on population density ratio, urban to rural, is still approximately two hundred to one. Therefore it surprises no one that the community interrelationships are far different, and so also are the services which can be rendered by the communities themselves to their people.

In dealing with the rural poor and housing for them, in particular, it is imperative to have an appreciation of what constitutes the major differences and problems. This report makes no attempt to show exactly what they are nor to quantify them. As a matter of fact this is exactly what cannot be done because insufficient studies have been made in this area. This presentation is primarily devoted towards noting some of the variables needing a closer scrutiny, both qualitatively and quantitatively, before an attempt can be made at even developing tentative solutions. We will concentrate on rural housing only insofar as its parameters are significantly different than those of their urban counterpart, and we will confine ourselves only to indicating those factors which appear to have some reasonable significant differences.

2. Background

In September 1967 the President's National Advisory Commission on Rural Poverty issued its long awaited report on rural poverty, along with recommendations for alleviating it. The Committee was headed by Governor Edward T. Breathitt, of Kentucky, a state which has seen much poverty and which is presently experiencing much of the kind of heartache and despair typical of the rest of the Appalachia area to which it belongs. The report notes that the Economic Opportunity Act of 1964 declared it to be the policy of this country to take firm action against poverty. Subsequently, appropriate measures were recommended or instituted at Federal, State, and local government levels, by numerous private organizations and by interested social, educational, religious, labor and business groups designed to alleviate the many rural problems which were brought to the fore--housing being one of them.

Unfortunately, most of these antipoverty programs were directed at alleviating the plight of the urban poor, with far too little emphasis on the rural poor. Even the geographical or regional approaches which were proposed were directed primarily to the needs of urban centers--where programs could be more easily instituted, monitored, and observed.

We feel there has been a gross oversimplification of the problems of the rural poor and that measures to alleviate their plight are badly needed. Since there are proportionately more rural than urban poor, since their homes are in worse shape, are more substandard, and need more rehabilitation, more attention must be directed to this part of America if we are to approach national poverty realistically. And it is housing which is one of the most critical needs of the rural poor.

When Federal and other agencies cooperate in building or improving existing homes in rural areas they should avoid conflicts and mixed responsibility in developing new codes, ordinances and criteria which are frequently needed. They may have overlapping jurisdictions and often delays; and the maze of red tape is frequently difficult for the ordinary person to untangle. Further, such overlapping of authority often leads to inadequate funding in some areas where it is sorely needed. We clearly see the nece ssity for consulting all regulatory agencies before, during, and after any attempt is made to develop new performance criteria or standards for rural homes.

Our rural poor actually total some fourteen million. Rural America has one-third the total U. S. population and one-half its poverty. And it would be larger if so many people had not moved to urban areas in the hope of escaping poverty. Ironically they generally did not succeed in escaping, for they were ill adapted to the jobs and kind of living found in larger urban areas.

Rural poverty is indeed so acute that it constitutes a national disgrace, and its consequences have spilled over into our cities--quite violently! Rural poverty has no geographical boundaries. Unemployment and underemployment are rural America's major problem. Thus while national unemployment is 4% in rural America it is 8%. Worse, we find that in rural farm America it has been estimated as being as high as 37%, this from a population which in 1960 was 7.4% of the population of the United States. Many poor live in chronically depressed poverty-stricken rural communities.

This report is not devoted to the needs of the rural poor per se but to housing specifically and the need to develop performance standards which will expedite home building, home renovating, and restoration; which will promote cheaper homes for the poor, and other approaches thereto.

3. Rural Housing Problems

Rural codes in particular should be oriented to the rural peculiarities and not to urban criteria. Unfortunately, it is not often this simple. The general level of income in rural areas is less than in urban areas, and many rural folk who feel they are not poor comparatively speaking, are often classified as "poor" anyhow--by statistics. This they resent. So if homes are built for them with the connotation of "poor" attached to them they will tend to reject them.

Homes must be built, remodeled, or modernized in the rural areas not only with the poor in mind but for those who refuse to accept that appelation. This figure could be quite high. Their need would be for homes of somewhat higher value or higher standards.

Health and sanitation problems are more acute. Rural communities are generally in far worse shape than urban communities--administratively, functionally, and financially, and therefore, cannot be depended upon to fulfill many of the needed functions connected with promoting low cost homes. Many rural areas are chronically depressed and have almost reached the point of no return.

The rural housing problem is not limited to any one area. It is acute in the South but it is also serious in other areas--East, West, and North. It exists for all racial and ethnic groups and certainly is not limited to the farms.

Most of the rural poor are living in atrocious houses and, in fact, one of every 13 of their houses has been officially classified as unfit to live in. Most are drafty and dilapidated. They are cold and wet in the winter, leaky and hot in the summer. More often than not they lack running water and inside toilets. Screening is very far from adequate. The Presidents Advisory Commission on Rural Poverty has noted the following:

In 1960, 27% of occupied rural housing was classified as substandard--deteriorated or dilapidated--compared with 14% for urban areas. More than a million rural homes are dilapidated and structurally unsafe for human occupancy. Many are beyond repair. Of the 9.2 million substandard occupied housing units in the nation, 3.9 were in rural areas.

At present replacement rates, it will take over a generation to replace them. This estimate ignores 2.8 million homes which are deteriorating, a large number of which may soon become too substandard to save.

Less than 25% of occupied rural farm dwellings have water piped into their homes. Of the four million housing units in the United States having no piped-in water, 90% of this total was rural, mostly in the South. About 30% of all rural families still use the traditional privy.

Fewer than half of all rural homes are centrally heated. Most of them are heated by kerosene-, gas-, or coal-burning stoves. The result is uneven heating and an ever-present danger of fire.

Nearly 60% of all rural families with incomes of less than $2,000 lived in houses that were dilapidated or lacked complete plumbing.

The Commission noted that rural families who rent are twice as likely to occupy substandard housing as families who own their homes. Some 20% of rural owner-occupied units were substandard, as compared with 42% of the renter-occupied units. Although less than 29% of rural housing was renter-occupied, families that rented housing occupied more than half of all dilapidated housing.

4. The Housing Requirements of Rural Families

In discussing the many variables involved in low cost housing for the poor as a basis for tailoring performance standards and codes to intrinsic needs, it seemed desirable to develop something of a check list for some of the more significant ones. This is what we have done. The mere fact that such a list can be drawn up is in itself a strong indication that one cannot attempt to solve constructively rural housing ills by standardizing on just a few basic designs. Far too much variation and interrelationships exist in all facets of rural needs to do this. We think these need much more study.

In order not to prolong a discussion of these variables the brief notes which follow the list are for the purpose of offering selected observations only. It is definitely not an attempt to deal comprehensively with the variables themselves.

Comments are directed towards factors which, in our estimation, will ultimately affect any recommendations for needed R&D on user needs and preferences for housing in rural America, in upgrading existing houses, and for R&D on performance standards for old and new rural houses which will incorporate adequate allowance for the specialized needs of the rural poor for new or old revitalized houses.

The categories or variables noted in the tabulation which follows are not mutually exclusive. In fact, they must overlap in part. No attempt has been made to quantify them individually or in groups. They need study in their own right and, most important, as they interrelate to each other. The list is not comprehensive since the primary purpose is to indicate important aspects only. Each group itself can be amplified at some future time if so indicated and, as a matter of fact, they should be considered illustrative rather than detailed.

Rural Variables In Low Cost Housing

HUMAN VARIABLES	Family Emphases
Family Structures	Male
	Female
Single individuals	Child
Students only	Parent
Family with students	Nonresident or experimental controls
Young childless couples	Subsidized and governmental
Young couples with children	
Middle aged couples, no children; retired	Income
Elderly living with adult children	Relief and subsidy
Elderly alone	Low, low income
Handicapped	Low income
Military personnel	Medium income
Large family	Undetermined
Small family	Rising income
Miscellaneous	Lessening income

Rural Variables In Low Cost Housing

Resident Type Preferences and Biases

Owner
Renter
Mobile home
Permanent domicile
Transient
Migrant
Ownership pride, maintenance-oriented
Disinterested and/or leisure-oriented
Personal likes, dislikes, desires, etc.
Miscellaneous

OTHER VARIABLES

Environmental, locale only

Weather, atmosphere, air pollution
Geographic, special areas (e.g., Appalachia)
Economic regions (Census list 21)
Geological (e.g., earthquake areas)
Altitude
Terrain, soil or ground structure
Temperature, humidity, dryness
Water conditions (good, poor, surface, subsurface, etc.)
Proximity to more populated areas; degree of dependence
Rural, non-farm
Rural, farm
Rural, mixed
Population density, anatomy and structure
Communal interdependence
Highly variable (one or more factors)
Fairly uniform (one or more factors)
Juxtapositional (two or more factors

Financial

General availability or lack of it
No meaningful problems
Private or institutional
Community or government--various levels
Subsidy--various levels and selectivity
Poverty or pseudopoverty orientation
Tax structure
Land, landscaping, and excavation costs
Building costs and accoutrements
Labor costs
Materials and structure costs
Miscellaneous home and contents costs

Special Problems - Non-home Oriented

Owner-transportation--good, medium, poor, public or private
Shipping and transhipping--railroads, trucks, roads
Water, health and sanitation--very diverse interrelationships
Drainage, pollution, disposal, waste and trash removal
Community services and protection--fire, police, education, etc.
Communications--phone, mail, standards, codes, ordinances, zoning, other regulations and control
Labor availability and capability
Salability and resalability
Availability of heavy equipment--very diverse needs

Indigenous Energy Sources

Electricity
Carboniferous (gas, oil, coal, wood)
Wind
Water
Solar (high sunlight)

Rural Variables In Low Cost Housing

Indigenous Raw Materials

Sand, clay, gravel
Stone
Wood

Type of Dwelling and Appurtenances

Detached or semidetached
Single family
Multiple family
Apartment
Cluster
Rambler or other conventional types
Two or more floors, basement
Low privacy
High privacy
Joint home-business types (farm homes, small business in homes)
High or low ceilings
Do-it-yourself type--in various degrees
Built from scratch--owner built--fully, partly
Semifabricated and prefabricated
Mobile or short-term life
Temporary types readily disassembled
Newer technology on complete buildings (e.g., pseudo-mobile homes)
Expandable; contractible
Preexisting and maintainable (at all levels)
Miscellaneous types
Porches, garages, farm buildings, miscellaneous appurtenances
Unfurnished, prefurnished (especially mobile homes)
"Turnkey" and related types

Special Rooms

Specialized inclinations for conventional rooms
Mud or clean-up rooms
Family rooms, guest rooms
Solar heated rooms or enclosures
Entranceways
Food and other storage rooms
Workshops; special areas for business

Special Rooms, cont.

Rooms with fireplaces or special heating requirements
Recreational areas

5. Rural Family Structure

The average rural family is larger than its urban counterpart. This should be factored into all considerations relating to the cost of rural homes. Studies have been made of the fundamental and distinctive family housing needs of various racial and ethnic groups. Unfortunately, these have been based largely upon an examination of the preferences of urban inhabitants. If such studies are to be used as a guide for low cost housing their validity will be for urban housing only--not rural, as there is no reason a priori for assuming that they would have equal validity in rural areas. In fact we can safely assume that some basic differences in orientation do exist and will show up in future studies.

We have also introduced into this check list non-resident or experimental controls, and subsidized or governmental controls. In a way it is desirable to consider these variables just as we do the individual members of the family. Obviously, if the house a family buys or rents is not primarily responsive to its needs and desires the performance concepts which relate to the house could well be different, and so would the basic design and content. The danger in subsidized low cost housing construction is that the planners and designers will give their own concepts too much dominance in deciding important matters about the houses they are building instead of considering the desires of the individual members of the family and the relative position of dominance each plays in the family life. Some of this intrafamily relationship can be understood through better knowledge of the ethnic and racial make-up of the family but there are many other statistical factors to consider as well as those which can best be understood merely on an individual basis. There is too much rule-of-thumb thinking here.

Some points worth noting are that studies have indicated that in rural areas some 96% of the people prefer to own their own house. This is definitely larger than in urban areas where so many people prefer apartment living. Paradoxically, however, rural people spend less of their income proportionately on housing than on consumer goods. So while we want to cater to the high ownership preferences in rural areas we must realize that based on their income they may be willing to settle for less on the home and more on comsumer type appliances and gadgetry--this on an already too-low income.

6. The Needs of Special Groups of Rural Poor

Migrant Farm Workers. Some 400,000 migrant farm workers need housing for short term use--quite different than one finds for temporary housing in urban areas. Obviously a special set of performance standards would have to be developed for any homes built for this special but highly neglected group. We quote from the report by the President's National Advisory Commission on Rural Poverty:

"Migratory farmworkers as a group are discriminated against. They are not welcome to take up permanent residence in the communities where they work for a brief period, or season each year. They are tolerated because

their labor is necessary to harvest crops. Established residents and service organizations have little contact with them and want less.

"Although Federal funds have been available for many years for the construction of housing for migratory workers, farmers and farm associations have been reluctant to build housing for migratory workers with the aid of these funds. Many farmers are unwilling to make the capital investment required for the construction of housing for migratory workers in spite of the liberal terms of financial assistance by the Federal Government. Moreover, they are reluctant to build housing and maintain it in good condition, since they fear it will be vacant for much of the year.

"While some improvements have been made in recent years, the general condition is still deplorable. Twenty-eight States have enacted legislation establishing minimum standards for living space, provisions for running water, bath and toilet facilities, cooking and dining space, sewage disposal, and requiring more frequent inspection of labor camps to see that standards are met. In general, however, housing for migratory labor is still intolerable. The following citation is all too typical. In one State, in 1966, of 760 migratory labor camps, occupied by 20 to 25 persons, 420 (55.26 percent) were approved. These 760 camps had a total of 717 deficiencies, including the following:

Camp site (general conditions, safety hazards)	75
Building disrepair, lack of sufficient doors or windows	56
Poor mattresses, not enough beds	28
Absence, or disrepair, of screens	102
Unsanitary privies, and in disrepair	245
Unsanitary storage and improper disposal of garbage and refuse	146
Water supply, improper well construction	14

Spanish Americans. The President's National Advisory Commission on Rural Poverty said:

"The living conditions of Spanish Americans stand out because of their concentration regionally, and because they are a distinct cultural group. Traditionally they have been the objects of discrimination and exploitation. Although for decades they were primarily rural, presently almost 80 percent of their population is urban.

"According to the 1960 Census there were approximately 3.5 million people with Spanish surnames in the United States. Although they constituted a relatively small proportion of the total population, they made up 12 percent of the population of the five Southwestern and Western States of Arizona, California, Colorado, New Mexico, and Texas. Approximately 1.4 million in Texas."

Forty-six percent of the rural Spanish Americans are employed as farm laborers, a large proportion of whom are migratory farmworkers. In 1960, 103,000 of the 261,000 Spanish-American farmworkers (39 percent) did some

migrant farm wagework. Twenty-five percent of the 409,000 migrant farmworkers in 1960 were Spanish Americans; however, they were only 5 percent of the 3.3 million nonmigratory farmworkers.

The average income level of Spanish Americans was much below the income level of the southwestern area as a whole. Fifty-two percent of the rural Spanish-American families had incomes of less than $3,000.

The housing of Spanish Americans in the southwestern region is far below the level of most of the area. A study of housing conditions in central New Mexico revealed that while 89 percent of the homes had electricity:

only 33 percent had water piped into the home;
only 26 percent had flush toilets;
only 13 percent had telephones.

Another study showed that only a third of the rural Spanish-American families in Atascosa County, Texas, had indoor plumbing, and only a fourth had hot running water.

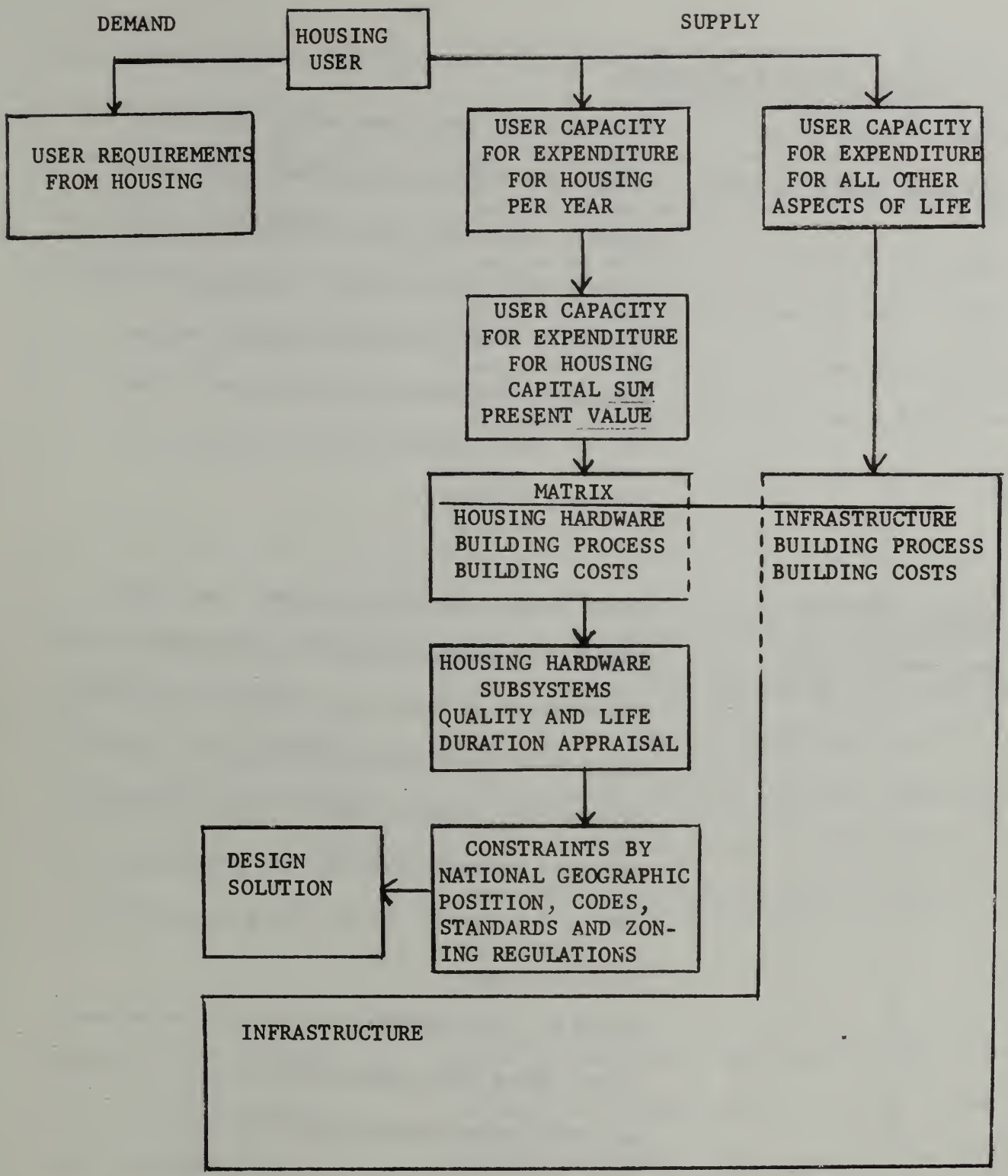
7. Financial Problems

A major problem in rural areas is the lack of capital and mortgage money. While this is a matter outside our present consideration we can note briefly that this shortage of money is far more severe in rural than urban areas. This being so, unless the government is in a position to strongly encourage more loans for home improvement and new construction we must assume that inadequate financing will continue to be more of a rural than an urban problem.

This would seem to indicate that there is a greated need for "lower" low cost housing in rural areas and therefore the performance codes which will cover such homes will have to factor in this lower cost as an essential ingredient. More poverty exists proportionately in rural than urban areas and therefore a realistic approach calls for rural homes being lower in price than urban homes and, very likely, more highly subsidized. Cheaper land does help but it is not enough.

We might reexamine conventional attitudes about how much money can be used to buy a house for any given level of income. This ratio was probably drawn up on urban considerations only. Should it have equal applicability in the purchase of low cost homes for rural buyers?

Homes in rural areas must conform to the lender's specifications or loans will not be forthcoming. And since money is scarcer it is doubly imperative to secure their acceptance before becoming committed to building. For this reason there is even a greater need to secure this cooperation of all rural lenders in the development of rural performance standards. Both FHA & VA as government agencies should be consulted at all levels. One favorable factor is the finding that apparently rural folk take their obligations once committed, more seriously. Rural foreclosure rates are lower than urban rates.

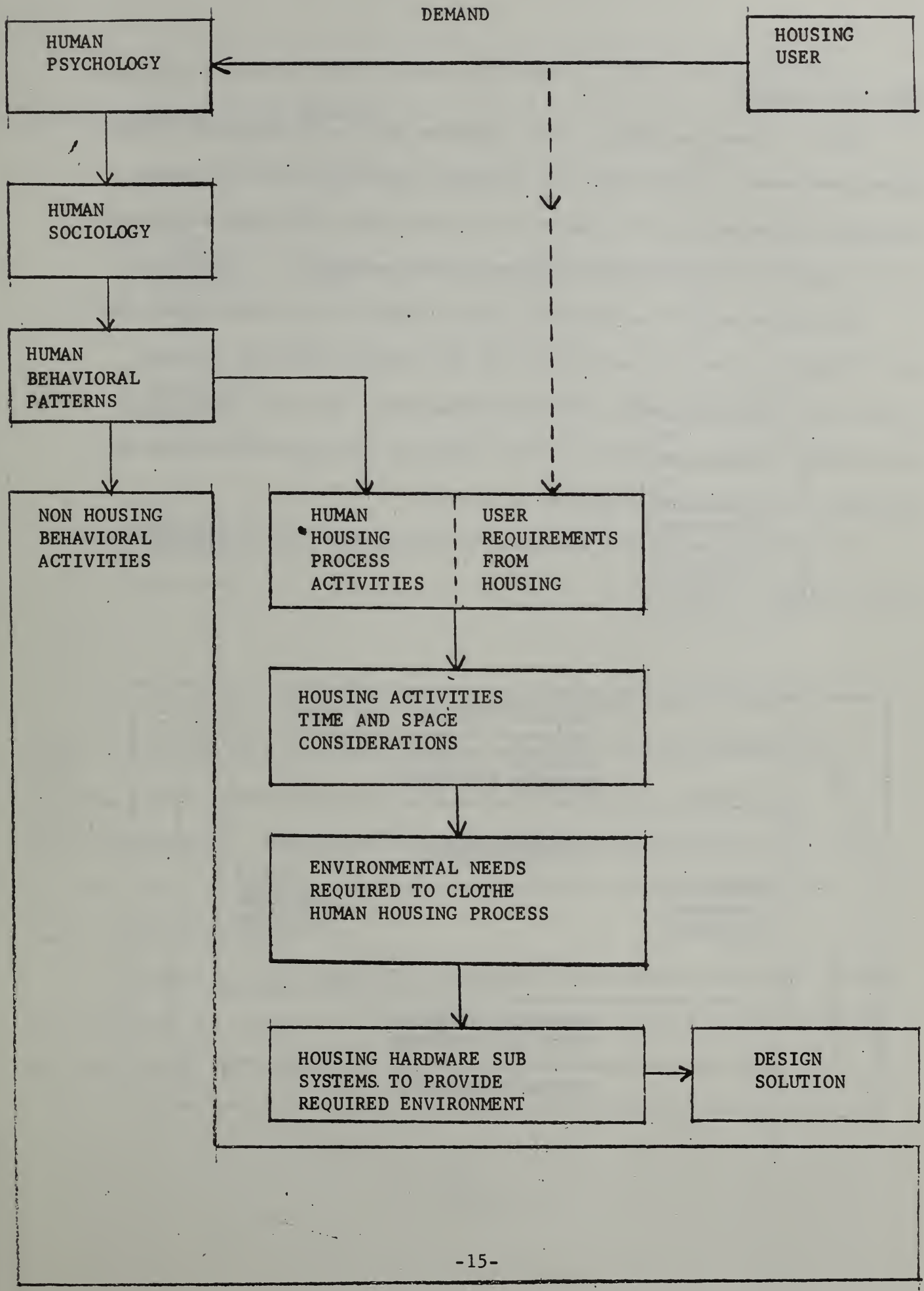

DEMAND
HOUSING USER
SUPPLY
USER REQUIREMENTS FROM HOUSING
USER CAPACITY FOR EXPENDITURE FOR HOUSING PER YEAR
USER CAPACITY FOR EXPENDITURE FOR ALL OTHER ASPECTS OF LIFE
USER CAPACITY FOR EXPENDITURE FOR HOUSING CAPITAL SUM PRESENT VALUE
MATRIX
HOUSING HARDWARE
BUILDING PROCESS
BUILDING COSTS
INFRASTRUCTURE
BUILDING PROCESS
BUILDING COSTS
HOUSING HARDWARE SUBSYSTEMS QUALITY AND LIFE DURATION APPRAISAL
DESIGN SOLUTION
CONSTRAINTS BY NATIONAL GEOGRAPHIC POSITION, CODES, STANDARDS AND ZONING REGULATIONS
INFRASTRUCTURE

Part 2 - Housing Demand Requirements

Psychological Behavior of the Individual Human Housing User	Housing users are human beings and human beings are influenced by their past and present state and have varying degrees of motivation to reach their future goals. It is partly from this psychological source that their behavioral patterns are formed for the full range of their living (i.e., not only housing).
Sociological Behavior of the Human Housing User	Human beings are social animals and their behavioral patterns must be considered in the context of their sociological relationships with their source factors etc., to produce the various human housing user behavioral pattern profiles and groupings for the full range of their living (i.e., not only housing). There will be feedback and iteration between these above two component processes to arrive at such overall Behavioral Patterns.

Identification of Activities in Human Housing Users Behavioral Patterns and Recognition of Housing Activities	The preceding various Behavioral Patterns have to be analyzed and recognizable Activities identified and evaluated as to their importance and whether they would be best considered within the context of housing. Those that are within housing have to be evaluated as to their relative Desirability and Necessity/Luxury Rating as a basis for trade off between them in subsequent component processes.
Time and Space Considerations of Housing Behavior Activities and Generation of Supporting Activities	Each of the Housing Behavioral Activities has to be analyzed regarding its requirements for Time and Space. Such Housing Activities will generate certain necessary supporting activities which should be identified and which will also require Time and Space Analysis.
Translation of Housing Behavioral Activities into Environmental Needs	Each Housing and Supporting Activity requires certain Environmental Needs for it to be carried out in the best manner. For each Activity these environmental needs have to be evaluated and listed.

Evaluation of Scope of Each Environmental Need	The same Environmental Needs from all Behavioral Activities should be gathered together and their requirements should be collated from and correlated with the Time and Space requirements etc., derived previously. Evaluation of the size and scope of each Environmental Need should then be carried out.
Translation of Environmental Needs into Housing Hardware	The Environmental Needs which have been evaluated as above to type, size and scope should then be related to types of Housing Hardware sub systems which can provide such environmental needs and the optimization of such sub systems to provide the best overall housing hardware solution.

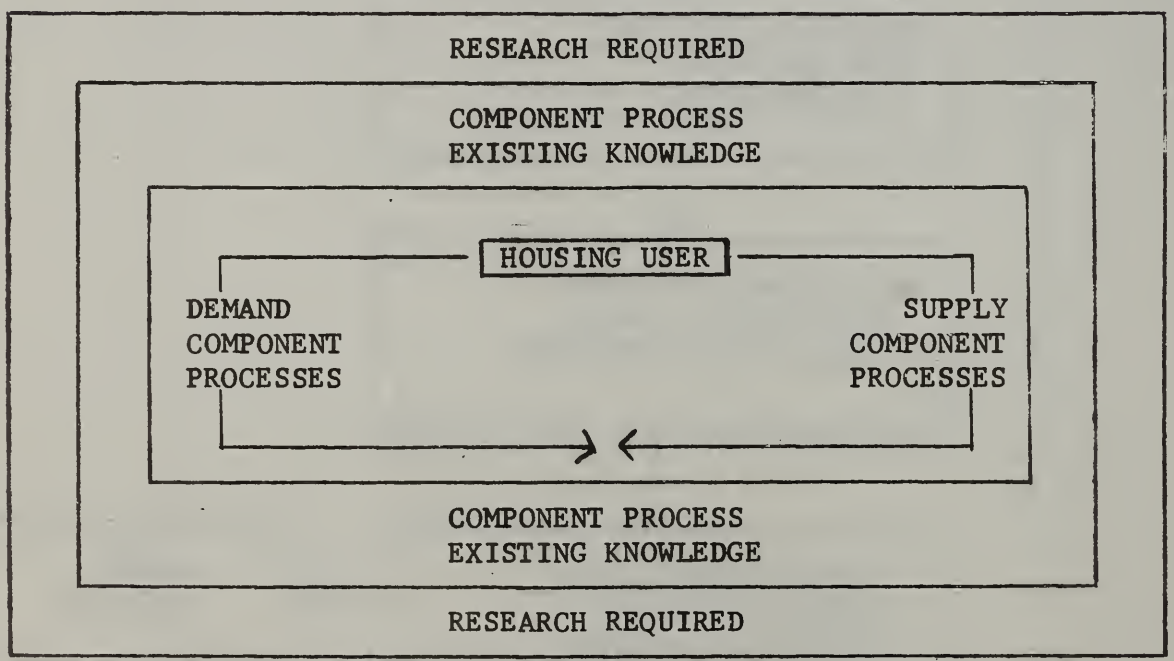

DEMAND
HUMAN PSYCHOLOGY
HOUSING USER
HUMAN SOCIOLOGY
HUMAN BEHAVIORAL PATTERNS
NON HOUSING BEHAVIORAL ACTIVITIES
HUMAN HOUSING PROCESS ACTIVITIES
USER REQUIREMENTS FROM HOUSING
HOUSING ACTIVITIES TIME AND SPACE CONSIDERATIONS
ENVIRONMENTAL NEEDS REQUIRED TO CLOTHE HUMAN HOUSING PROCESS
HOUSING HARDWARE SUB SYSTEMS TO PROVIDE REQUIRED ENVIRONMENT
DESIGN SOLUTION

Model Development

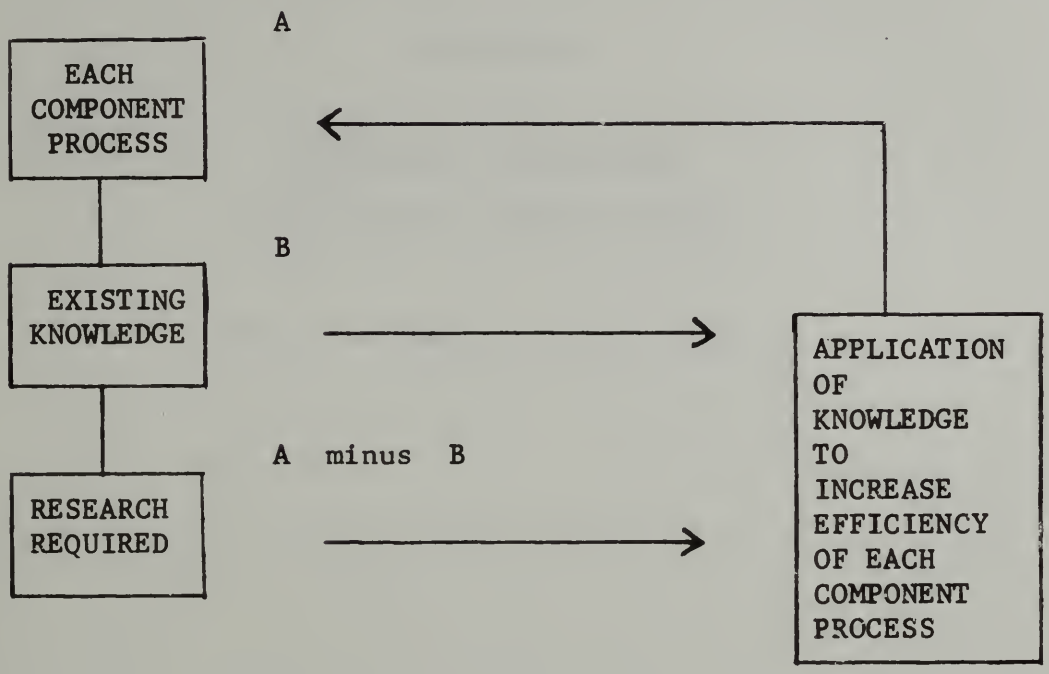
Each of these two sides of the equation must be broken into its component processes. A great deal of research into each of the following component processes will be required to produce such increased efficiency in the result of the trade-off between the two extremes.

The criterion for research will be its ability to reduce costs and/or its ability to raise the performance of the housing by making it more closely fit the requirements of the housing user. How this could be facilitated will be gone into in more detail by consideration of the constituents of the various component processes.

In outline the overall structure of the problem and required research is as follows:



By making a "radial cut" at each component process of the problem, a linear expression is as follows:



It is important to consider the passage of time when evaluating the target for the placing of effort both for attacking the problem and for research. Such efforts and resources should be directed initially at the component processes closer to the Housing Solution and gradually over time the main thrust of effort should change towards the component processes nearer the Housing User.

The length of lead time for development work on each component process will vary and the attempt to identify such different lead times will facilitate the coming "on stream" of such knowledge as and when required.

To find solutions to problems, one must first clearly understand the problem. This is what the following two-part description sets out to expose.

DOCUMENT A

CONCEPTUAL STRUCTURE OF

LOW COST/LOW INCOME HOUSING

(Part 1 -- Housing Supply Process)

Assessment of Annual Amount Affordable for Housing

The first constituent to be considered is the housing user's total annual earning capacity. There are two main factors to be considered here; (a) outside the sphere of the housing user, and (b) within the sphere of the housing user.

Outside factors are those such as geographical location with regard to employment prospects, present and future and the cost of living in that area in comparison with the national average--both taken over the long term.

Inside factors will require derivation from the appraisal of sociological behavioral patterns of the low-income persons (see Part 2). This would provide the number of persons in the one housing group, their age profile and mix of such groups over large housing developments. From this information can be derived the total income capacity of the housing group and its tax bill and therefore its total net income.

Subsequent to the sociological appraisal and derivation of the total behavioral patterns of the housing user groups, it will be possible to evaluate such behavioral patterns in terms of cost spread. By analysis of this cost spread it will be possible to assess how much the low income housing user can afford for housing per year.

In considering a definition of a low income person or housing process group (perhaps a family), there might be practical grounds for considering that such a definition may be correlated to whether or not (or on what level of income) one pays federal income tax. If incomes below this level

were exempted from federal tax or taxed only at a nominal level, a subsidy for housing and improved standard of living could be provided, and a considerable saving effected in tax collection and accounting costs. The category of low income could then be more clearly defined than at present by asking whether or not income tax is paid (thus eliminating costly screening procedures).

In summary, this component process is the assessment and splitting of Housing User into his Capacity for Expenditure for Housing, i.e., SUPPLY, and his Capacity for Expenditure for all other aspects of his life.

This component process is already carried out to a certain extent by FHA and other lending bodies before committing money for mortgages, but such evaluation is integrated into the next component process and is executed for the benefit of the lender rather than the housing user.

Transfer of Annual Amount Affordable to Present Value

The next component phase to be considered comprises the translation of the Housing User's "Annual Amount Affordable for Housing" to a Present Value, to facilitate subsequent trade-off processes (Present Value being the capitalization of the above annual amount by the Discounted Cash Flow technique).

The major constituents which have to be considered here are (1) the interest rate used, and (2) the duration of the payment period.

In considering (1), the interest rates, the main issues involved are--What is the present market interest rate for this type of proposition? Should one consider only the cost of money or should one consider the opportunity/earnings forgone interest rate? What is the duration of the loan? What are the effects of mortgage interest rebates from income tax (fed back to preceding component process)? What will be the direction of interest rates in the immediate future?

Consideration could be given that the interest rates in the calculations be based on the concept of a "floating" rate as used between international currencies. This floating rate concept would not fix the interest rates at a prespecified level but would keep within a specified limit the variances in the interest level for house purchases.

Also consideration could be given to a variation clause in mortgage contracts stating that the interest rate varied with but kept a fixed relationship to the central government money discount rate and that such variations in individual mortgages were absorbed by changes in the duration of the mortgage.

Because the variances in the interest level have a multiplying effect on change in overall housing costs, and thus on overall production level of housing, these innovations would tend to stabilize the fluctuations in the size of the housing market and thus the production rate of housing, which would be beneficial to all concerned, especially the construction industry part of the building process.

Because most people who buy houses do not have the initial capital, or if they have it they do not wish to tie it up in the purchase process of a house, then mortgages are the most common medium for purchases of houses. If a house is purchased with a mortgage, then the largest cost constituent of the whole housing deal is the cost of financing.

It is in recognition of the major effect of this constituent on total cost of house purchase that the Federal Government recently proposed that it will absorb, i.e., subsidize, all of the interest payments except the first 1% on loans for low-cost housing for low-income people. While not eliminating such payment (i.e., the government is paying it), this has been chosen as a point where the subsidizing capacity of the remainder of society can have the greatest effect on the cost of housing to the particular user.

In considering (2) the duration of the payment period, the main consideration will be (a) prudence regarding the life of the building, and (b) the financial capacity of the receiver of the loan to meet his obligations (this was dealt with in the previous component process on Housing User Income). The former can be broken into physical life of the building and the environmental obsolescence of the building, meaning that the building in its later life may be perfectly sound physically but due to the

environmental erosion or change it may not constitute desirable housing. Subsequent to these assessments, a life-duration for the housing can be reached which would be no longer than the shortest of these life spans.

Having arrived at a suitable interest rate and a duration of payment period, the discounted cash flow calculations can be carried out by reference to the appropriate tables and arithmetic to produce the Present Value of the Annual Amount Affordable for Housing.

At the end of this component process, there will be a Capital Sum for Housing Hardware which can be reasonably prudently afforded and secured for Housing Hardware, both as regards the human housing user and the environment of the housing project.

Allocation of Capital Sum for Housing Hardware to Major Sub-Systems of Housing Hardware

The basic subject deals with housing, which comprises houses surrounded by their immediate environment (including other houses) and the project site and community of which the above form part. These major components are "Housing Hardware," the "Building Process," and "Building Costs;" each is at least comparable in stature to each component process being described, although encompassed in this description under one component process.

A considerably fuller documentation of these major components and their relationship with each other and other component processes is given in Document B and Document C.

Housing is the thing which is consumed by the housing user and also, therefore, it must be produced either directly or via some satisfying agent--in either case hardware must be produced. Thus there is "housing hardware" (usually considered as buildings) and the means to produce housing hardware can be considered as the "building process" or the housing procurement process (the means to produce and sustain the buildings through their life).

When a specific building, i.e., "housing hardware," is required to be produced, this work places demands on the resources of the building process. The result of the interplay between housing hardware and the building process produces building costs to the client for the housing. This is the price he has to pay for the satisfying of his chosen requirements. It is desirable to be able to allocate such costs to the appropriate constituents of both housing hardware and the building process.

The relationship between housing hardware, the building process, and building costs can be considered as a matrix comprising one axis as housing

and the other axis as the building process. Each axis is broken into its main constituents such that the core elements of the matrix are of meaningful content for information analysis and cost analysis for use on each project or types of projects for comparison with others. These axes contain the reality of the building process and the housing hardware required to "clothe" the human housing process. It should be borne in mind that there are other constituents of each of the above major components which are detailed in Documents B and C by "exploding" the description of each axis into its major components and each major component into its subcomponents. The allocation matrix is as on the next page.

ALLOCATION MATRIX

BUILDING PROCESS FACTORS ←

HOUSING HARDWARE ↓

HOUSING HARDWARE SUB SYSTEMS TOTAL LIFE CYCLE COSTS	FUNCTIONING: OPERATING	FUNCTIONING: MAINTENANCE	PRESENT VALUE OF FUNCTIONING	CONSTRUCTION PROCESS: CONSTRUCTION RESOURCES	CONSTRUCTION PROCESS: MATERIALS	PRE-REQUISITES: PLANNING	PRE-REQUISITES: LAND	PRE-REQUISITES: FINANCE	PRE-REQUISITES: ENTREPRENEURSHIP			
$	I	H	G	F	E	D	C	B	A			
										1	SUPPLY	INFRA-STRUCTURE
										2	REMOVAL	
										3	SOCIAL SERVICES	
										4	COMMUNICATIONS	
										5	CENTRAL SERVICES	
										6	SERVICES	SITE
										7	ROADS	
										8	LANDSCAPE	
										9	EXCAVATIONS / FOUNDS	LINK
										10	FABRIC	
										11	SERVICES	
										12	STRUCTURAL	FABRIC
										13	WALLS EXTERNAL	
										14	WALLS INTERNAL	
										15	OPENINGS (VISUAL & ACCESS)	
										16	SHAFTS	
										17	FLOORS	
										18	CEILINGS	
										19	ROOFS	
										20	FINISHES / DECORATIONS	
										21	ACCESS SYSTEMS	SERVICES
										22	AIR CONDITIONING	
										23	POWER & LIGHT	
										24	HEAT	
										25	COMMUNICATIONS	
										26	WATER	
										27	SANITARY FIXTURES	
										28	WASTE REMOVAL	
										29	INSTALLED EQUIPMENT	
										30	FURNITURE & FURNISHINGS	
										$	PROJECT BUILDING PROCESS TOTAL COSTS	

It is important to realize that the area of the matrix core, Prerequisites by Link, Fabric, Services, etc., is redundant and thus void, and that all considerations of Prerequisites for each whole housing project are satisfied within the area Prerequisites by Site.

One of the main uses of this matrix is that one can take the output of the preceding component process, Present Value Capital Sum, and allocate it across the viable Prerequisites and the life cycle total costs of each subsystem of housing hardware in proportion either to the cost records of previous projects, or any other method or permutation of methods of allocation and trade-off process among these subsystems. It should be borne in mind at this stage that it is the total life-cycle cost of each subsystem which is being considered, and traded off one against the other under the heading Housing Hardware Subsystems Total Life Cycle Costs on the diagram.

After making the above life-cycle "cost spread" along the totals of each of these subsystems, one can then consider each subsystem individually as to the allocation of its life-cycle cost between construction costs and functioning costs.

The next sub-process is the allocation of the construction costs and functioning costs to their respective constituents of Materials and Construction Resources for the former and Maintenance and Operating for the latter.

On the matrix in the area of Site there are two constituents which should be considered separately; (1) Site by Prerequisites, and (2) Site

by Construction and Functioning. The latter can be treated for evaluation and trade-off process, etc., just as described above for the other parts of the project.

Site by Prerequisites can be treated for evaluation and tradeoff by considering separately Site by each of the constituents of Prerequisites. It will be prudent to consider these components prior to the above processes when carrying out this work, due to (1) the relative marketplace volatility of Finance and Land, and the importance of the former and its interrelationship with other component processes and (2) that the controlling factors of the volatility of these two constituents are motivated by elements considerably removed from the field of housing and the entrepreneurs in that field.

The next constituent in the cost allocation process is that the Maintenance and Operating Costs of the Functioning of the Housing would be translated back into annual costs by DCF process.

During all of these constituent subprocesses, there would have to be tradeoffs, feedback cycles to previous more general tradeoff areas, and also to previous and subsequent component processes.

At the end of these component processes, a life-cycle cost picture of the housing both as regards construction and functioning, has been built up and within which has been structured the major sub-components of housing hardware required to "clothe" the human housing process. This in turn can enable a picture to be built up of the housing hardware which is available to and affordable by the human housing user. In other words, for each major subsystem--if it has to be constructed for $X and maintained for $Y and operated for $Z, what kind of subsystem can be provided?

Appraisal of Life Duration and Quality of Housing Affordable

Firstly, an appraisal has to be made as to what physical type and capacity of subsystem can be provided for these construction and functioning costs.

Given the above, two major characteristics should be looked for: (1) the subsystem's life as regards both its physical construction and its social/environmental characteristics, and (2) its performance measured against user requirements for that type of services provided by that subsystem. This latter characteristic is fed forward to subsequent trade-off component processes derived from the Human Housing User Requirements end of the Overall Structure.

It will be realized that there will be great advantages of close links between this component process and those in the latter stages of Part 2.

The former charcteristic, i.e., subsystem life duration, is considered in the two mentioned constituents--physical and social/environment. The concern regarding the physical life of each subsystem is to ensure an approximately similar longevity for all subsystems in the one housing system (i.e., project), given the above constraints regarding construction and functioning.

The concern regarding the social/environmental life of the housing system made up of subsystems is that while the housing may still have a considerable part of its physical life to run, it may be so unsatisfactory in comparison with its surrounding environment (either housing or other components of the infrastructure) that its overall performance is not up to standard in comparison with future performance requirements which may be incorporated in the later component processes on performance requirements (always presuming that the average standard of living is rising).

As a result of this Life appraisal, the least duration is fed back to correlate with housing life duration calculations in the component process, titled Transfer of Annual Amount Affordable to Present Value, and in the tradeoffs of costs for each subsystem between Construction and Functioning in the Housing Cost Appraisal Matrix, each enabling subsequent adjustment reverberations to take place.

By the end of this component process, the housing which began as the annual amount available to the housing user to provide himself with housing has been gradually translated into meaningful housing hardware sub-components which can be afforded and performance evaluated, life duration measured and costed, etc.

Constraint on Optimal Solution by National Geographical Position and Codes, Standards and Zoning Regulations

In this overall Structure of the tradeoff process prior to this component process, there has been an evolutionary process to a satisfying solution to housing originating from the housing user's capacity to satisfy his housing requirements and constrained by that capacity, the market place, the building process, and housing hardware constituent subsystems. Now consideration must be given to important non-housing-user constraints.

National geographical position will require different "housing hardware profiles", i.e., individual solutions, across their major subsystems due to the variances from area to area for reasons of climatic, socio-environmental, ethnic roots, economic capacities, building process differences, building material differences, etc.

The results of the previous component processes should be subjected to appraisal by these constraints stated above, and changes and variations evaluated and reverberated through the previous component phases and back to the present position on the tradeoff cycle.

The second category of constraints in this component process is that of building codes, standards, and zoning regulations which will also reflect some of the above geographical constraints.

These will further affect the results of previous tradeoff component processes to ensure safety, health and welfare, etc. considerations, as well as local ethnic considerations where these are not obsolete or redundant (this could be expressed that the codes should meaningfully reflect a feasible and desirable profile for the performance of human living process in the field of housing).

Should these codes, standards, and zoning regulations not provide such a feasible and meaningful fit, then consideration should be given to changing them.

These constraints do exist (whether or not they are as they should be), and thus must be considered in the tradeoff process. Also, due to their present structure, there is a feedback loop from them to the housing hardware, building process and building cost constituents of that component process of the tradeoff system. Another feed-forward loop should exist from these geographical and code constraints to the component process originating from the Housing Users' Requirement end of the tradeoff axis.

The output from this tradeoff area is the facility to view the boundaries within which individuals or groups of individuals, or their professional designers of the housing can design specific solutions to their housing problems, and which have been processed through the preceding component processes.

Design Solution

Between the starting point of the Human User of Housing and the previous component process of tradeoff, all consideration has been to what might be termed the "constraints of the real world market place on housing."

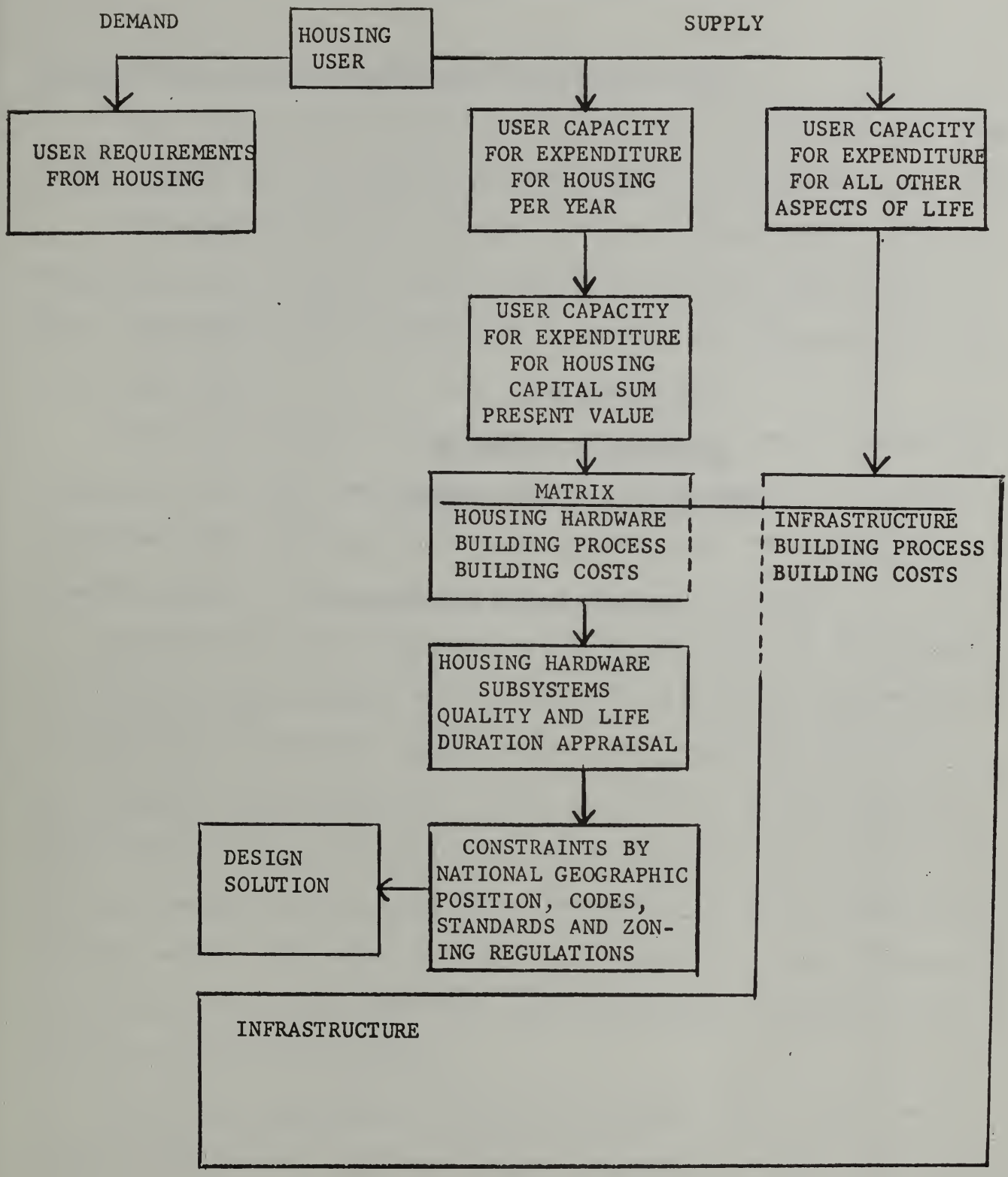
The output of such a process is a definition of the feasible boundaries within which individuals or groups of individuals may design housing to satisfy their needs.

These outputs can be in the form of drawings or design specifications which clearly define the solution of the specific housing problem being tackled. Provided that such solutions fall within the above-mentioned boundaries and it should be possible to create many satisfying permutations (i.e., wide variety) of components of solutions, then a requisite breadth of design field is in existence for the exercise of design skills. Should this not be so, then the constraints of the real world market place on housing is too constricting for the happiness of the human user of housing.

Dependent upon the position of reality between the positive and negative extremes of the previous paragraph, it will cause feedback and feed forward loops to emanate from this component process to all others, to bring an adequate and satisfying fit between the housing users' requirements from housing and his capacity to satisfy such requirements.

The remainder of this explanation of the tradeoff area between the housing user requirements for housing and his capacity to satisfy that requirement will be by starting at the Human User Requirement end of the system and evolving to this component process, i.e., Design Solution.

Meanwhile, the diagram developed to the present point in the explanation, is now shaped as follows:


DEMAND
HOUSING USER
SUPPLY
USER REQUIREMENTS FROM HOUSING
USER CAPACITY FOR EXPENDITURE FOR HOUSING PER YEAR
USER CAPACITY FOR EXPENDITURE FOR ALL OTHER ASPECTS OF LIFE
USER CAPACITY FOR EXPENDITURE FOR HOUSING CAPITAL SUM PRESENT VALUE
MATRIX
HOUSING HARDWARE
BUILDING PROCESS
BUILDING COSTS
INFRASTRUCTURE
BUILDING PROCESS
BUILDING COSTS
HOUSING HARDWARE SUBSYSTEMS QUALITY AND LIFE DURATION APPRAISAL
DESIGN SOLUTION
CONSTRAINTS BY NATIONAL GEOGRAPHIC POSITION, CODES, STANDARDS AND ZONING REGULATIONS
INFRASTRUCTURE

D O C U M E N T A

CONCEPTUAL STRUCTURE OF

LOW COST/LOW INCOME HOUSING

(Part 2 -- Housing Demand Requirements)

Psychological Behavior of the Individual Housing User

Very briefly and in a considerably summarized manner human psychology may be considered to be involved in human behavior in the following manner.

People behave in set or usually slowly evolving patterns. Why? Behavioral patterns are the manifestation of the person's motivation. What is Motivation? It is the desire to change from their past state to their goal state.

What is the source of their past state? This is mainly derived from their past and present experiences. (Due to the incrementally changing nature over time of the goal satisfying process, past and present are closely similar).

From the past the individual has (1) his physique, (2) his parents, and (3) his social and built environment. His physique is comparatively unchanging in its influence on the person. In a simplified description the influence of his parents will depend on (a) their inherent physical, mental and emotional characteristics, (b) on their behavior patterns, and (c) on the manner of upbringing which they provided - all of which are of an evolving nature. The social and built environment of the persons past comprises his relationships with others and the physical environment of the home and its surrounding areas.

It is very important to note that all aspects of the above can be looked at in two ways: (1) what they are in reality, and (2) what they are as perceived by the human being. While it is the reality which provides the source, it might well be, and usually is, the perceived upon which the human being will decide and act, i.e., behave.

What are the goals of human beings? These comprise three main streams, (a) physiological, (b) sociological, and (c) psychological, and each requires to be satisfied by the behavioral pattern of the individual. Again it must be remembered that the goal can be considered as real and perceived.

The physiological goals of people tend to be relatively finite and unchanging, and their satisfaction can be considered as the basic datum for a behavioral pattern. The sociological and psychological aspects of human goals tend to be infinite (e.g., the ever-changing process of "keeping up with the Jones'.") It is this infinite, ever-changing (albeit slowly) constituent of goals which is difficult to define, but essential if success in defining goals is to be achieved.

Conversly, the society as a whole may set up goals which are difficult to attain or are of such a nature as to preclude happiness of the individuals concerned, e.g., it could be speculated that in housing for low income people it might be that the naming of the housing as being for low income people will be construed as a stigma on those people in the light of the "material success" and "income level evaluation" of the status of these people in the society in which they live.

The humans behavior pattern (which is hoped will eventually be clothed with housing where required) is derived from the motivation to normalize the disfunction between his past and his goal.

It might be that by increasing the disfunction between their past and their goals by raising the goal expectation of such people by propaganda methods (from others in their society) could lead to increased motivation in the low income people to better their housing by their own efforts.

This would have to be carried out very carefully and slowly because a converse argument is made by some sociologists who consider that the fast rising crime rate in the U.S. is considerably due to individuals being unable to reach, through legal channels, the "All-American" goal of "success" (as portrayed on entertainment screens and advertising.) Thus they revert to criminal channels either to try to achieve that goal, or to vent their frustrations at society as a result of their own incapacity to achieve their perceived goal. Perhaps U.S. society would be happier if the society status goals were not placed as high or as demanding as they are, and as a result, almost certainly society would contain less crime and corruption which might well provide a more fulfilling and satisfactory way of living for the citizens.

Therefore, to have clear knowledge of that behavioral pattern, firstly there must be clear knowledge of the past and the goals of these people who make up the housing user.

It is certain that, even within the context of low income people, this will throw up a variety of pasts and goals, and thus, behavioral patterns.

The output of this component process would be a clarification of the housing used by his past, his goals and his resultant motivated behavior pattern. It must be remembered that these behavioral patterns are not only within the context of housing, but would be his total behavior patterns and will probably be a series of behavioral pattern profiles for different geographical areas, ethnic roots and sociological roles, etc.

The Sociological Behavior of the Human Housing User

This component process would take the outputs of the preceding component process and adjusts them as a result of their being contained by the housing process "group," be it a family or not, but that such behavioral patterns are still being considered as the full spectrum of life behavioral patterns.

First consideration perhaps should be given to whether or not the family is the best group context for such an appraisal. Considerable changes have been wrought in family structures because of the impact of sociological equality which follows from the potential for economic independence of mothers from the fathers of their children, and of young people from their parents.

Sociologists have defined the family and home as "a highly specialized agency for affection" and a mechanism for the appropriation, rearing and primary socialization of the child and sexual satisfaction and stabilization of adult members of society.

Therefore, consideration must be given to what is the best "housing process human group" from the point of view of these people.

Having considered what is the best housing user human grouping or groupings, then analysis must be made of their configuration by number, sex, age mix, etc., not only for each housing unit, but for mixes of these over large housing developments (e.g., whether old people should be mixed in with young people, etc.). Another sociological consideration should be regarding the preference for either the linear (three or more generations together) or the nuclear family structure (parents and children only).

The assessment of whether the housing process human grouping is patriarchal or matriarchal will be important in assessing sociological consequences. There is evidence in studies defined by ethnic and by low income segmentation that matriarchal families are predominant.

The configuration of such groups must be studied, not only as regards their relationships as above, but also their responsibilities, etc., to and from each other in order to assess the homogeniety of such housing process groups. This is an important characteristic which will provide continuity to the evaluated group.

The affect on such matters as a result of changes in population trends into the future -- both as numbers and constituent mix -- must also be considered.

It is highly probable and may be desirable and advantageous that there will be a number of housing process group profiles, and the output of this component process will be such profiles.

The results of these profiles should be fed back to the preceding individual human psychology component process, and the results of both normalized by reiteration before proceeding to the next component process.

Both this component process and the preceding one deal with: What are the Behavioral Pattern Profiles of the people? The answer to that question would be the output from this component process.

It must be realized that this is a very difficult question to answer at the present stage of research in these fields.

Subsequent component processes will analyze these profiles into activities, then evaluate the required environmental needs for such activities, and then how best to clothe the housing needs with housing hardware.

Identification of Housing Activities within the Behavioral Pattern and Evaluating the Desirability Rating of Each

The input to this component process would be the various Behavioral Pattern Profiles which have been normalized from appraisal of human psychology and sociology. Such Behavioral Patterns deal with their full spectrum of living.

The basic desires for space to live and proximity to others is a very important one, but the amount of space required will depend on psychological and sociological aspects of the humans in question. A range of principles has been abstracted from observations of human behavior and considered under the name of "Proxemics." This may provide a general framework for considering groups of Behavioral Activities analyzed from the Behavioral Pattern Profiles of the preceding component processes.

Initially these Behavioral Pattern Profiles are taken one by one and analyzed into their constituent activities (e.g., sleeping, shopping, vacations, eating, etc.), and a spectrum of activities drawn up from the analysis of all behavioral pattern profiles.

Then each Behavioral Pattern Profile is analyzed as to its incidence across that spectrum and when finished, a count of each activity would provide a desirability rating for each activity (i.e., the more Behavior Pattern Profiles which contain that activity, the higher the rating.) This process and its results could be appraised by sociologists as to their validity in relation to theory and also, more importantly, to look for evolving trends and thus consider what these activities will be in the future. This could be done over a period of time to produce changes in these profiles from which projections will be made.

Dependent on the results, there would be feedbacks to previous component processes e.g., the activity sortation of the profiles may show segmentation by ethnic groups which is too large to solve by similar housing environments or this aspect may be shown to a less schismatic degree.

Subsequent to the above appraisals and feedbacks, the Activity Spectrum can be analyzed as to which activities are best "clothed" in housing with reference to the various Housing Process Groupings of the preceding component process.

Once this has been carried out, then such activities are those which should be clothed in housing. The remainder would provide the guide for those activities which should be satisfied by the infra-structure component of the society, and thus facilitate total community planning which forms a major support element to housing.

The mainstream of this component process would be a list or lists of behavioral activities which are best carried out within housing with their desirability ratings from the overall living behavioral profiles. Each of these activities would have then to be rated on a scale Necessity/Luxury, and this could be in the context of human psychology, sociology and housing as laid out in the preceding component processes.

The output of this component process would be a list or lists of behavioral activities which are best carried out within housing and, each activity would have its Desirability Rating in the context of overall living and housing. Examples of such activities could be, Eat, Entertain, Recreation, Sex, Sleep, Solitude/Privacy, Store, Study, Wash, Work, Diagramatically this would be as follows:

Housing Behavioral Activity	Desirability Rating	Necessity /Luxury Rating

Time and Space Considerations of Behavioral Activities and Generation of Supporting Activities

The input to this component process would be the list or lists of behavioral activities with each activity having its Desirability Rating and Necessity/Luxury rating. These ratings could be used to settle trade off clashes between activities in this component process. Having regard to the psychological and sociological make up of the housing process group behavior these input activities could be taken and formed into a typical time sequence network. Qualification by the size of the group and the age state of its evolution and allowance for necessary but not regular occurences, e.g., illness, parties etc., could be carried out and included in the network. Evaluation of percentage of total duration and a note of its position on the time cycle for each activity could be made. These housing behavioral activities could then be considered for their space requirements, again having regard to the make up and configuration of the housing group.

Not only must space for the activity be considered but space for equipment and furniture etc., must be included and access space (and time, see above) must be allowed for. In considering space it may be advantageous at this time to consider modularity as an aspect of human satisfaction (there being other advantages in other component processes e.g., construction costs, designing process, standardization, etc.).

Secondary activities which are necessary to support these behavioral activities should be generated and added to the list and built into the time and space requirement analysis. Desirability ratings and Necessity/Luxury ratings for these supporting activities should be derived from their source activities.

All of these processes could carefully consider the psychological and sociological characteristics of the profiles from which the behavioral activities are derived. These correlations could be then normalized via feedback loops before the output from this component process is passed on to the next.

By this time in this series of component processes there will probably be a need for clear descriptive definitions of such activities and these could be created, evaluated and crystallized at this stage.

Output from this component process will comprise a list or lists of Behavioral Activities and Supporting Activities. Each one of which would have listed alongside its definition, previously set Desirability Rating and Necessity/Luxury rating and the Duration usage percentage and Place on the Time Cycle from the time network and its Space Requirements. It would be of advantage in the next component process if the appropriate Supporting Activities were listed immediately after their generating Behavioral Activities.

An example of Supporting Activities is that there is (or may be) the Housing Behavioral Activity of Eating which may generate the Supporting Activities of Food Preparation and Food Wash Up.

This output can be graphically represented as follows:

Housing Behavioral Activity and Supporting Activity	Definition	Desirability Rating	Necessity /Luxury Rating	Typical Duration	Place on the Time Cycle	Space Requirements

Translation of Housing Behavioral and Supporting Activities Into Environmental Needs

The input to this component process would be the list or lists of Behavioral and Supporting Activities each with its definition, desirability and necessity/luxury ratings, duration percentages and place on the time cycle and space requirements.

In this component process the purpose would be to begin to move from the housing process to the environmental characteristics which will best clothe that process in housing.

Each of these activities could be taken individually and assessed as to what is the best type of environment required for its execution. This could be done in one or two stages. If in two stages the examination of each behavioral activity would firstly comprise a general description of the environment with a second stage of analysing this to its constituent characteristics. If in one stage the two stages of the above would be carried out in one process.

Examples of Environmental Needs could be along the lines of Protection, Support, Access, Movement, Air, Heat, Water, Light, Waste treatment, Power.

The types of roles involved in this evaluation work either singly or in a group could include people drawn from medicine, psychology, sociology and ergonomics (the last might be used in the preceding component process).

The results of this work could be in the form that for each Behavioral and Supporting Activity (i.e., input to this component process) there will be produced a list of the Environmental Needs or characteristics which are

required to enable such activity to take place with a minimum of discrepancy from its most ideal state.

For example, the behavioral activity of sleep might well require Protection, Support, Heat, Ventilation, Light (negative) etc. Each of these Environmental Needs will be required at a standard e.g., for sleeping, heat level will be best at a certain temperature range and Ventilation at a certain range of air changes, etc. The supporting activities for Sleep probably will have some of the same environmental needs as Sleep but perhaps with other standards and in addition probably have other environmental needs.

This process could be carried out for all listed Housing Behavioral Activities and their Supporting Activities. Once this has been done a Housing Activity Information Table can be drawn up along the following lines:

Housing Behavioral Activity and Supporting Activity	Definition	Desirability Rating	Necessity/Luxury Rating	Typical Duration	Place on the Time Cycle	Space Requirements	Environmental Needs	Definition	Criterion	Quality

It is obvious that the same Environmental Needs will appear against numerous Activities but it is highly likely that there will be differences in their required Quality measured on their fixed criterion. (It is axiomatic that if different measurement criteria have to be used then there is a difference in the Environmental Needs which predicates further investigation on such Environmental Needs to split out and clarify these needs). During this component process it would be wise to establish definitions and criteria for these Environmental Needs.

Before continuing to the next component process, feedback loops to the component process dealing with Time and Space Overlaps should be used. Their purpose would be to eliminate as unfeasible the qualities of Environmental Needs which, because of their quality divergence from each other and the necessity that they be carried out beside each other in Time and/or Space preclude the complete satisfaction of that quality level of such Environmental Needs. Such elimination may and probably would be softened by adjusting the quality of such Environmental Needs, to a quality compatible with that of the activities requiring the same Environmental Need contiguous in Time and/or Space to the one under consideration. In this process the use of the previously set Desirability Ratings and Necessity/Luxury Ratings could be used to proportion such changes in quality of Environmental Need as are required. The Typical Time Duration, Position on the Time Cycle and Space Requirements - all of which are derived from previous component processes - will be used in this normalizing process.

The complete compilation and feasibility checking of this table would be the function and output of this component process.

Such output (referring to the diagram in this component process) could be as follows:

Each Housing Behavioral and Supporting Activity with its Definition, Desirability Rating, Necessity/Luxury Rating, Typical Duration and Place on the Time Cycle, its Space Requirements and for each such Activity all the necessary Environmental Needs each with its Definition, Criterion and Quality (normalized by the last constituent in this component process).

Evaluation of Scope of Each Environmental Need

The output from the preceding component process was arranged (in information theory parlance "sorted") by Housing Behavioral and Supporting Activity i.e., all of the remaining information was arranged in an order using the appropriate activity as its source.

It is obvious that in such an arrangement the same Environmental Needs would appear many times (with like or different qualities) against different Activities.

The first constituent of this component process is to "resort" this input information using Environmental Need as the source of ordering. To enable the work of this component process to be executed the resorting of the information should be such as to produce the following presentation of the information:

Environmental Needs	Definition	Criterion	Quality	Typical Duration	Position on the Time Cycle	Space Requirements	Desirability Rating	Necessity/Luxury Rating	Housing Behavioral and Supporting Activity	Definition

From this sortation of the information the beginnings of an appraisal of the requirements of each Environmental Need could be made.

Quality by Typical Duration would give the duration over which the Environmental Need is required,

Quality by Position or Positions on Time Cycle would give the frequency of the required need and its necessary capacity to change and the speed of that change,

Quality by Space Requirements would give the Volume of the required need. By the confluence and summation of these derived durations, change frequency speed and volume of the Environmental Need there could be built up a Performance Requirement for that Environmental Need. In the trade offs of the above constituent the decisions could be based on the appropriate Desirability Rating and the Necessity/Luxury rating. It's probable that the required quality of certain constituents of each Environmental Need may have to be modified if they are considerably beyond a reasonable spread of the quality of the other constituents of that Environmental Need. This would probably result in feedback and normalization through preceding component processes.

The suitable spread of the Environmental Need which results could be expressed in the context of the criterion (i.e., measure) of that Environmental Need. This confluence of criterion and spread of Environmental Need upon that criterion, would produce the Performance Criterion for that Environmental Need.

For example, Heat may be measured in degrees Farenheit. The Environmental Need for Sleeping may be "Cool". The confluence of degrees Farenheit and "cool" could produce a temperature range of a few degrees Farenheit which will be the Performance Criterion for that Environmental Need.

Once this constituent of this component process has been carried out attention then could be paid to arranging the Environmental Needs as defined into a spectrum order. For example, it will be realized that certain Environmental Needs can be satisfied by the same medium e.g., air can convey both heat and ventilation and thus such Environmental Needs should be beside each other on the spectrum.

The output from this component process would be a table of Environmental Needs in spectrum order and alongside each one there would be its Performance Criterion and Performance Requirements as follows:

Environmental Need	Definition	Performance Criterion	Performance Requirements			
			Duration	Frequency	Change	Volume

The derivation of this table can be found by examining firstly the resorted information input to this component process and the work constituents of this component process.

It can be noted that of the above Performance Requirements - Frequency and Change would tend to be related to and derived from the overall housing solution rather than the individual chosen type of housing hardware sub system whereas Duration would appear to have the opposite tendency. Volume would appear to be derived from and influenced more from a confluence of both the overall housing solution and the individual chosen type of housing hardware.

Translation of Environmental Needs into Housing Hardware

Due to the complexity of the work of this component process, the descriptions of each constituent are separated by a space.

Up to now in this Part 2, all consideration has been to the source and content of the Behavioral Activities of the Housing User and an analysis of them to define what Environmental Needs would be required for such activities.

This is the first component process of this Part 2 which considers Housing Hardware.

An advantageous prerequisite to this constituent would be the listing of each hardware type within each Housing Hardware Major Sub System (see that axis of the Cost Allocation Matrix in Part 1) against the same Performance Criteria as that for Environmental Needs.

There are basically two ways of arranging the required information and either could be used (a) the input Environmental Needs and their Performance Criteria and Performance Requirements would be listed and against each Environmental Need would be listed all the Housing Hardware Major Sub System types which in principle could satisfy that Environmental Need or (b) the input Environmental Needs and their Performance Criteria and Performance Requirements would be on one list and the Housing Hardware Major Sub Systems (comprising each type of hardware sub system) with the

Performance Criteria which they could satisfy would be on another list.

This displays the alternative ways of arranging information - (a) is hierarchically arranged and (b) is arranged by a faceted structure.

The arrival at a desirable correlation between the Environmental Need and Housing Hardware Major Sub System types would be in (a) by a search process and in (b) by a matching process.

The latter process has advantages in that one organization could set up the information regarding Housing Hardware Major Sub Systems (and their constituent types) and what Performance Criteria each can satisfy. Other organizations carrying out housing projects could arrange their required Environmental Needs with their Performance Criteria and Performance Requirements (most of which probably would be different from one organization to another and from one housing project to another) and arrive at the most appropriate correlation by an information matching process between the respective Performance Criteria and Performance Requirements (which of course, must have similar scales of measurement to each other).

The next constituent would be to reduce this list of hardware sub system types by forming a list of those which appear most often i.e., "largest common denominator" list) but still covering the whole range of Environmental Needs.

Within this component process it will be realized that the constituents will require an array of feedback loops to carry out the work of this process.

Intermediate output at the end of this constituent is the list of each Environmental Need, its Performance Criterion, its Performance Requirement and the Housing Hardware Sub System and Type chosen to satisfy that Environmental Need. This can be displayed as follows:

Environmental Need	Performance Criterion	Performance Requirement				Chosen Housing Hardware Sub system	Chosen Type Housing Hardware
		Duration	Frequency	Change	Volume		

By resorting this information to an order of:

Chosen Housing Hardware Sub system	Chosen Type Housing Hardware Sub system	Performance Criterion	Performance Requirement				Environmental Need
			Duration	Frequency	Change	Volume	

there would be the capacity to sum the Performance Requirements constituents of each of Duration, Frequency, Change and Volume for each chosen hardware type to evaluate the required capacity and configuration of that type of hardware sub system. Following this evaluation there would probably be

feedbacks to allow for changes and trade off adjustments to be made. The output of this constituent would be the list of Housing Hardware types chosen along with their Performance Criterion and Requirements in total for the required project.

Due to the effect on each sub system type of its relationship with the others, further constituents are required in this component process before an integrated housing solution could be achieved while maintaining the goals of providing a satisfying clothing to the housing process.

Starting from the point of having each chosen sub system type defined by Performance Criterion and Performance Requirements and in the knowledge that each Hardware Type can provide the Required Performance (see above) and that each Required Performance satisfies the overall Environmental Needs (see previous component processes) there would be left the constituent of considering the effect of each chosen type of sub system **on each other chosen type of sub system. This could be carried out on an information layout along the following lines:**

Type Under Consideration							Remaining Types Effect					
SS	CT	PC	PR				CT R	0/1	PR - M			
			D	F	C	V			D	F	C	V
Chosen Housing Hardware Sub System	Chosen Type of Housing Hardware Sub	Performance Criterion	Performance Requirements				Each Other Chosen Type of Housing Hardware Sub	Change Effect	Nature and Extent of Change on Performance			
			Duration	Frequency	Change	Volume		0 or 1	Duration	Frequency	Change	Volume

The columns on the left hand side titled, "Type Under Consideration" would have their contents derived from the preceding constituent and would deal with each chosen type of housing hardware sub system one at a time.

Against each such individual chosen type of housing hardware sub system would be listed all of the remaining chosen types of housing hardware one at a time on the right hand side of the diagram. If any of these other chosen hardware types affected the former by more than a marginal degree, it woule be marked by placing a 1 in column 0/1, if there was no affect or only a marginal affect then a 0 would be placed in column 0/1.

Analysis of the nature and degree of the effect on the performance of the chosen type by the others would be listed in the right hand columns. Once this analysis had been carried out for each sub system type, the effect of all the remaining sub systems on it could be added together and the resultant total variation adjusted upon the original performance of the single chosen sub system type.

Comparison can then be made between the original performance of the single chosen sub system type and its performance as adjusted by its close interaction with the other chosen sub systems. From this comparison an assessment could be made whether the chosen type of sub system should be changed in its characteristics (or changed to another type for that sub system). This proceedure would be done for all of the chosen types of sub systems.

The aim of the process would be to normalize these variations by feedbacks and iterations to attempt to provide an integrated and satisfying total solution to clothe the housing process while causing as little

friction on the flow of that housing process as is possible.

Should some Performance Requirements prove to be impossible or very difficult to satisfy with hardware which exists this would expose areas which would require new hardware to be researched and developed. This is a important aspect of this work. The signals for this could be of a primary or secondary nature.

The primary nature would be if the sub system itself was difficult to find, the secondary nature would be if that sub system was the source of numerous changes in the other sub systems. In both cases it could be recognized by that sub system or type of sub system causing information feedback reverberations over the preceding constituents and component processes which produced wider and wider reverberations from the original Performance Requirements on the system outlined here.

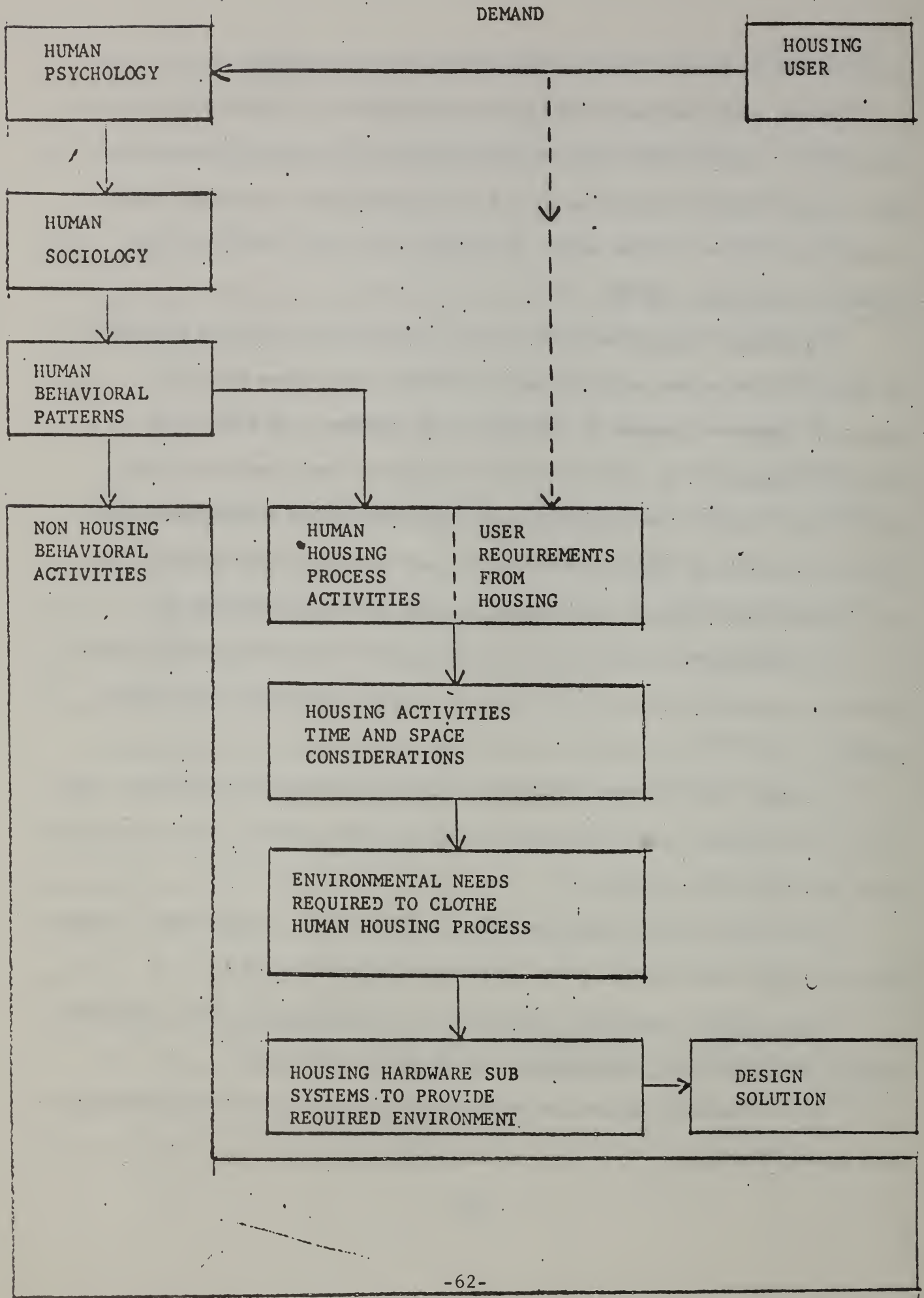
In other words instead of the reverberations becoming smaller thus leading to normalization of the solution the opposite would be taking place.

In most cases however, it would be the case that normalization takes place thus leading to an integrated total hardware solution which satisfies each Performance Requirement.

This would be the design solution which as best as possible "clothes the required human housing process with housing hardware".

<u>After having read Part 1 and Part 2, it is suggested that the reader should again read the Introduction and Overall structure.</u>

The following diagram can be examined in relation to the diagram at the end of Part 1.


DEMAND
HUMAN PSYCHOLOGY
HOUSING USER
HUMAN SOCIOLOGY
HUMAN BEHAVIORAL PATTERNS
NON HOUSING BEHAVIORAL ACTIVITIES
HUMAN HOUSING PROCESS ACTIVITIES
USER REQUIREMENTS FROM HOUSING
HOUSING ACTIVITIES TIME AND SPACE CONSIDERATIONS
ENVIRONMENTAL NEEDS REQUIRED TO CLOTHE HUMAN HOUSING PROCESS
HOUSING HARDWARE SUB SYSTEMS TO PROVIDE REQUIRED ENVIRONMENT
DESIGN SOLUTION

DOCUMENT B

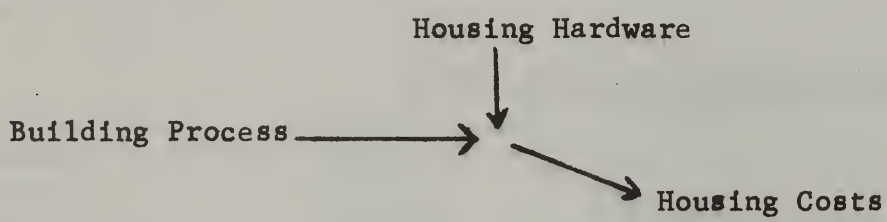
Outline of Cost Allocation System

Cost Allocation System

Introduction

Costs of Housing can be treated in many ways but the source of Housing Costs is the consumption of resources to create and sustain Housing Hardware.

The Housing Hardware is the end product and the Building Process is the production process. The interplay between these two factors produces Housing Costs.



How can such Housing Costs be allocated? They are required to be allocated to both Housing Hardware and Building Process - thus a matrix evolves.

	Housing Hardware
Building Process	Housing Costs

Housing Hardware deals with houses surrounded by their immediate environment (including other houses), the project site and community of which the above form part.

Building Process deals with the factors of housing production — the Prerequisites, the Buildings in their comparatively fixed cost component Materials and comparatively variable cost component Construction Resources and the Functioning of the building over its life time in its components of Maintainance and Operating.

Information (of which one type is cost) about all aspects of the Housing Hardware and Building Process can be treated on such a matrix if the axes are broken into their components and each component into its constituents in a rational and systematic manner.

This description of the Cost Allocation System will comprise three main parts:

(a) A description of the housing hardware breakdown; i.e., the end product of the building process in its major components and their constituent subsystems, their definitions and descriptions.

(b) A description of the building process; i.e., the process which creates, sustains, and ends the life cycle of the housing hardware end product. This will describe the major components of that axis of the matrix with their definitions and descriptions,

(c) A description of the matrix core, and its use as a performance benefit/cost appraisal and allocation system for the major sub systems of housing hardware as a system to satisfy the housing user. Reference should be made to the appropriate part of Document A Part 2.

The matrix mentioned above is that displayed on the next page.

ALLOCATION MATRIX

BUILDING PROCESS FACTORS → (columns) ; HOUSING HARDWARE ↓ (rows)

Group	No.	Housing Hardware	A Pre-requisites: Entrepreneurship	B Pre-requisites: Finance	C Pre-requisites: Land	D Pre-requisites: Planning	E Construction Process: Materials	F Construction Process: Construction Resources	G Present Value of Functioning	H Functioning: Maintenance	I Functioning: Operating	$ Housing Hardware Sub Systems Total Life Cycle Costs
INFRA-STRUCTURE	1	SUPPLY										
	2	REMOVAL										
	3	SOCIAL SERVICES										
	4	COMMUNICATIONS										
	5	CENTRAL SERVICES										
SITE	6	SERVICES										
	7	ROADS										
	8	LANDSCAPE										
LINK	9	EXCAVATIONS / FOUNDS										
	10	FABRIC										
	11	SERVICES										
FABRIC	12	STRUCTURAL										
	13	WALLS EXTERNAL										
	14	WALLS INTERNAL										
	15	OPENINGS (VISUAL & ACCESS)										
	16	SHAFTS										
	17	FLOORS										
	18	CEILINGS										
	19	ROOFS										
	20	FINISHES / DECORATIONS										
SERVICES	21	ACCESS SYSTEMS										
	22	AIR CONDITIONING										
	23	POWER & LIGHT										
	24	HEAT										
	25	COMMUNICATIONS										
	26	WATER										
	27	SANITARY FIXTURES										
	28	WASTE REMOVAL										
	29	INSTALLED EQUIPMENT										
	30	FURNITURE & FURNISHINGS										
	$	PROJECT BUILDING PROCESS TOTAL COSTS										

Housing Hardware

Housing Hardware can be defined as the end product of the Building Process and which comprises the major sub-systems to satisfy the clients requirements for housing commensurate with his affordable expenditure for housing. Such major sub-systems provide the "clothing" of the human user's housing process (e.g. physical protection, heat, light, sociological environment).

The major categorization is the split between Infrastructure and the other constituents. These other constituents are all within the geographical boundary of each and all housing projects, whereas Infrastructure is outside that geographical boundary.

Considering the constituents within the geographical boundary of each and all housing projects (i.e., Site, Link, Fabric, Services) the definition for such a breakdown is as follows:

Site: Within the geographical boundary of the project and outside the outer face of the buildings. The work involved in the construction and functioning of this area is of a considerably different nature to that of the other areas.

Link: Within the outerface of the buildings and beneath the datum floor level. There can be two buildings exactly the same as each other above this level but due to the constraint of the land beneath each, it is almost invariable that all the Link constituent of different buildings will vary one from another regardless of the similarity of such buildings above that level.

Fabric and Services: Within the outer wall face and above the Link there are two Constituents. Fabric and Services.

Fabric: The physical constituents of the building which can be geographically defined as to their position and whose function usually directly satisfies housing needs.

Services: The constituents of the building which due to their nature cannot be geographically defined as to their position and function (i.e., the same service runs across geographic definitions) and whose function is usually that of an intermediate agents for satisfying housing needs.

Infrastructure: The components of the community which are necessary but are provided to the people of the community outside the site (defined above). These will be grouped and defined later in this description but are mainly the marketing system for all goods and services required for life other than those for housing.

Major Sub Systems Definitions

Infrastructure Components (1-5)

1.--Supply The manufacture of goods, both consumer durables and non-durables, their transportation to the outlet/housing user interface and the services of professionals (e.g., the raising of cattle, their butchering, processing, transportation, storage and sale of steak in a supermarket. Purchase of an automobile or an airline ticket, the lawyer, his office and supporting staff).

2. Removal The removal and storage or consumption of humans when dead and similar services to their waste materials, both human and supporting goods (e.g. human bodies, graveyards or crematoria; sewage plants and incinerators; waste paper and Christman trees, private or community waste removers, trash dumps or incinerators).

3. Social Services Services for the benefit of housing users either supplied by society or for purchase by individuals (e.g., police, education, health, various forms of social aid advice).

4. Communications Provision of means of communicating between individuals or with groups, etc., by physical movement or verbal or visual means (e.g., roads, airports, for movement of people to facilitate their living, visual and physical contact and verbal communication).

5. Central Services The provision of either private or community services necessary for housing users to live, without themselves traveling for that service and the source creation of services

consumed in the houses (e.g., postal services, sewage, electric, gas and water plants and their transport media to the boundary of the housing site.

An exception to this group is Furniture and Furnishings for the housing and these are considered as below.

30. Furniture and Furnishings Due to the variability of degree of finish across types of housing the inclusion of this category completes housing hardware right to the human housing user.

Site Components (6-8)

6. Services (in and Out) forming a link between services of the Infrastructure and Buildings (e.g., electricity mains), Communications (Movement and Words), forming a link between communications of the Infrastructure and the Building (e.g., telephone wires, drain connections).

7. Roads The roads and paths, etc., within the site for transportation services.

8. Landscape The restructuring of the site either temporarily or permanently, and the resurfacing and planting on the site.

Link Components (9-11)

9. Excavations and Foundations The components of the link which are mostly influenced by the site beneath the building (e.g., digging, piling, foundations, etc.).

10. Fabric The components of the link which are mostly influenced by the Building above the link and are as of the Fabric of the Building but within the geographical confines of the Link.

11. Services The components of the link which are mostly influenced by

the Building above the link and are as of the Services of the Building but within the geographical confines of the Link.

Fabric Components

12 Structural	The parts of the fabric whose function is that of supporting the loads of the building (e.g., reinforced concrete beams and columns).
13 Walls External	The parts of a building which comprise the vertical constituent of the envelope (e.g., external brick walls, curtain walling).
14 Walls Internal	The partitions between rooms (e.g., timber framing, insulation, lath and plaster, demountable partitioning)
15 Openings (visual and access)	Doors and windows in walls, floors and roofs (e.g., windows and their glass)
16 Shafts	The walls which surround shafts for vertical access and vertical services mains. If these walls comprise part of external or internal walling then treat as Shafts (e.g., reinforces concrete walls surrounding elevators).
17 Floors	The structural components and their infilling and finishes which are positioned between the underside of the structural floor and the finished surface of the floor and are a contiguous part of the floor (e.g., prestressed concrete floor slabs, wax finish on timber floors)

18	Ceilings	The components which comprise the horizontal surface of the ceilings and all their supporting apparatus but minus any outlets of services such as lighting (e.g., wood fibre tiles and aluminum rails and hangers).
19	Roofs	The parts of a building which comprise the horizontal constituent of the envelope (e.g., timber rafters, boarding and slates, asphalt roofing materials)
20	Finishes/Decorations	The timber and metal finishes trims and the painting of all exposed surfaces. (e.g. paint on walls)

Services Components (21-29)

21 Access Systems	The means for vertical transport of people and objects within the building (e.g., elevator systems including cars, motor guides, special doors, stairs of timber and concrete).
22 Air Conditioning	The conditioning, movement and control of air within the building (e.g., motors, ducts, pumps, outlets).
23 Power and Light	The provision of power and light within the building by a suitable means and outlets (e.g., electricity mains, ducting cables, outlets)
24 Heat	The provision of heat by a suitable means (e.g., by sub system of the air conditioning, by electricity, by water)
25 Communications	The connections within the building for human communication (e.g., telephone cables)
26 Water	The provision of adequate water at required positions within the building (e.g., water piping, storage tanks, heaters)
27 Sanitary Fixtures	The fixtures which provide the receptacle for receipt of water and wastes and usually for ablutionary functions (e.g., baths, wash basins)
28 Waste Removal	The removal of wastes from sanitary fittings and the means of removal of solid household wastes to outside the building (e.g., single stack plumbing systems, trash ducts and bins

		and incinerators)
29	Installed Equipment	Equipment which is considered as consumer durable but is included in the housing (e.g., refrigerator, storage fitments)

The Building Process

The building process can be defined as the life cycle of housing with its component processes spanning from its creation to the final demise of that project.

The main categorization is between those components which are comparatively first or capital costs and those which are comparatively derived from processes which are carried out over a long period of time and can be considered as annual functioning costs. To enable comparisons, calculations, etc., of like with like, etc., to be carried out, the axis of the matrix--the costs of constituent processes which are carried out over a long period of time--can be brought to a Present Value by Discounted Cash Flow treatment for equivalency to the capital costs.

These capital costs can be divided into two groups; i.e., Prerequisites and Construction Process.

Thus the building process comprises three main groups of activities, Prerequisites, Construction Process and Functioning, each of which is broken into two or more main components and each component comprises constituents from the life cycle of the housing process.

Considering the life cycle of each and all housing projects, the major componenets are Entrepreneurship, Finance, Land, Planning, Materials, Construction Resources, Maintenance and Operating. Each of these comprises a number of constituents which will be identified in the more detailed description of the life cycle of housing, and noted as to their relationship with the above major components.

Group Definitions

Prerequisites (A - D) Components which must be in existence before any housing project can be carried through.

Construction Process (E - F) The process of actually constructing the housing hardware.

Functioning (G - I) The process of maintaining and operating the housing hardware as a housing system.

Component Definitions

In these definitions Cost should be considered as the dollar equivalent of the expenditure of resources required to execute a function or functions.

A. Entrepreneurship - The cost of constituent process as of enterprise, risk evaluation, risk taking and efficiency orientated thinking and action with regard to the housing building process (e.g., Evaluation of profitability of a housing project before it begins).

B. Finance The cost of capital required for the various components and constituents of the housing building process (e.g., the interest rate cost for land purchase).

C. Land The cost of the land required for the housing project (e.g., dollar cost of the site).

D. Planning The cost of professional and consultant services required for the housing project (e.g., architect and engineers fees).

E. Materials The cost of the Materials to be incorporated in the housing hardware up to the point in time at which they are placed on the building site prior to erection, or fabrication and erection i.e. inclusive of factory manufacture costs and transportation etc. (e.g., bricks, doors, paint).

F. Construction Resources The costs of the resources required to fabricate and erect the housing hardware to its finished state including management resources. (e.g., tradesmen, tower cranes, computer time for network planning).

G. Maintenance The annual cost of maintaining the housing hardware in its finished state; i.e., in a state ready and fully capable of being operated (e.g., taxes, repairs, planned maintainance, replacing exhausted light bulbs).

H. Operating The annual cost of operating the fully maintained housing hardware to the reasonable satisfaction of the human housing user (e.g., management, rent collecting, arranging leases).

I. Present Value of Functioning The addition of the annual costs for Maintenance and Operating and the discounting of these cash flows to their present value.

Cost Allocation Matrix Core

The core elements of the matrix are derived from the intercepts of the components of each axis defined as described above.

It is important to realize that the area of the matrix core Prerequisites by Link, Fabric, Services, etc. is redundant and thus void and that all considerations of Prerequisites for each whole housing Project are satisfied within the area Prerequisites by Site (each prerequisite being defined by Site in Total).

The use of the matrix is mainly in translating information, inputting information at its or any appropriate point on any of the four sides of the matrix and translating it into the desired alternative output on another side of the matrix.

Another major use of the matrix is as an information correlating tool for searching for cost variance sources and adjusting these to provide a better fit for these types of information--one to another and each to reality.

On the line of translation, Housing Hardware major sub systems to the Total Life Cycle Cost of each major sub system, the function can be either (a) analysis of a proposed housing hardware solution into its major sub systems, budget cost them through the matrix and produce the total cost of each, then the total cost of the whole project for passing on to the next component process for appraisal; or (b) taking the total budget or total amount affordable for a housing project, allocating it across the total life cycle cost of each major sub system, breaking down each of these figures over capital and functioning costs, and then into each component of such categories and the subsequent hardware appraisal of what type and capacity of physical hardware sub system can be obtained for these costs, to enable the next

component process of evaluation to be made.

The building process is a production process and on the axis Building Process to the total cost of each major component in the building process, the function can be the evaluation of cost comparisons between the major components of that process.

The major categorization is the cost ratio of Construction to Present Value of Functioning for each total project and each major sub system within each project.

By Comparing the cost results of different projects on this basis, one can examine the effect on the total life cycle cost by adjusting the balance of the ratio, the life duration and/or interest rates (with their reverberations in other component processes), to evaluate its effect on the total life cycle cost of each sub system and the whole project with the aim of its reduction.

These total life cycle costs of each project for construction process and functioning can then form a ratio with the Prefequisite costs to examine variations of one project to another in its cost validity, to expose which projects have better entrepreneurship, land siteing, and financing, and then search why this is so. These processes are a crude type of "ratio analysis" of the production and sustainance of construction projects but are derived from the same principles of company financial reports ratio analyses which are a major tool in management accountancy.

More detailed use of the matrix can be for studying the cost incidence in each hardware major sub system. Is the major part of the money spent on the materials and transporting to the site, or is it spent on the on site fabricating and erecting of the sub system? In the functioning of the system is the money spent in keeping the sub system in working order, i.e.,

maintenance, or is it spent on the cost of the service throughput of the sub system?

It should be noted that by their very nature the maintenance costs and operating costs of certain of the sub systems cannot be directly attributed to them but must be treated by allocation from the source cost (just as in any real world cost accounting process). Such sub systems are mainly those which provide their service directly to the user; e.g., structure, floors, external walls, etc.,

Examples of maintenance costs are management costs, cleaning, etc. The maintenance and operating of sub systems whose function is usually that of an intermediate agent, e.g., Air conditioning, Power and Light, can usually be costed directly because of the singularity of source of maintenance and that the operating throughput service can be metered.

In considering the use of the matrix up to now the aim has been to evaluate information change passing directly through the matrix in parallel lines and in total from one side of the matrix to its opposite.

However, the use of the matrix can be by enquiring at one point, i.e., one core element, of the matrix and focussing on that aspect (of say the housing hardware) to derive all the cost information and general information (building codes, standards, design specifications and performance specifications provided that they are all structured in the matrix manner) for examination of the interrelationships between these factors (e.g., because of particularly severe codes the cost may be high; because of lack of performance specifications, standards may have to be unnecessarily detailed). The effect of all of these types of information on the building process itself may produce deviations from the most efficient possible thus causing higher costs. Such issues can only be resolved if the different types of information can be isolated by common

boundaries (e.g., the matrix).

The use of the matrix as an information correlating tool can greatly facilitate efficiency both in all aspects of the building process and in the increasing fit of the housing hardware to the requirements of the housing user.

The matrix can form the tool for statistical analysis of "typical life cycle cost profiles" for housing projects with many variable characteristics.

The same matrix can be used for the projects of different types of housing, (e.g., high rise, single family), different geographical areas (e.g., by cities or counties), different sizes of housing (e.g., say by number of apartments), different periods in time (e.g., by construction duration in calendar time). The ability to study, from the same datum, the "cost spread" for all these major variations in types of housing (examples above) enables the user to expose such variations. Once these are exposed the user can then examine the constituents for their causes with the aim of reducing such high costs in the future by eliminating their source causes (not only on that type of housing but also perhaps flooding over to other types of housing which contain that same source cause). This process can be greatly aided by the use of the matrix as an information tool for, say codes and standards (see above).

Subsequent to such evaluation of past housing cost spreads, budgets can be set to which future housing projects can be designed or as a basis for allocation of funds can be made.

This discipline will exert a pressure on entrepreneurs to meet such cost spread targets and thus provide a cost datum for housing.

Due to the necessity to introduce this over a period of time, it is best to set these cost spread targets at a reasonable level but maintain it at that level in the face of inflationary drift.

There are three main benefits of such an introductory process: (a) it gives time to learn to use the tool; (b) it gives time to build up sufficient records to validate the cost level (or adjust the initial set level to a valid level) and (c) the maintenance of that cost level in the face of inflation means a gradual introduction of its controlling effect which removes the traumatic effect of the sudden introduction to both the controllers and the controlled.

It should be appreciated that this is only a very brief outline of what can be done with such a Cost Allocation System.

DOCUMENT C

OUTLINE OF HOUSING HARDWARE LIFE CYCLE

(related to the Building Process)

Housing Hardware Life Cycle

It will be appreciated that the life cycle of Housing Hardware is made up of a large number of component processes, not all of which are necessary for each project, and which appear in a variety of sequences for different housing projects. In addition, some component processes are executed over a short time span (sometimes signified by a point in time) while others are executed over a long time span (sometimes repetitive, sometimes not), etc.

The above complexities are due mainly to the facts that the overall process involves different humans fulfilling roles which themselves are changeable, the continually changing market place and changing environments.

In order to describe this life cycle, it has been necessary to first identify these component processes, then define them and link them to their appropriate category on the building process axis of the matrix.

Furthermore, due to the close interrelationships between the component processes, the life cycle will be of an iterative nature, especially in its early stages.

Due to the market place origin of the creative spark which begins a housing project, the sequence of such component processes varies; e.g., the entrepreneur may begin considering a housing project because he recognized a demand for housing; he may create the demand; he may own surplus land; he may own a construction organization; he may have surplus funds; he may own a housing management organization, etc. By starting at each of the above positions, the sequence through the component processes will be different from the others. However, the component processes will be contained in the following list of what might be described in operational research terms as activities in a dynamic programming network for the life cycle of a housing project.

The code letter after each title refers to the appropriate summary category on the Building Process axis of the Cost Allocation Matrix, and the costs incurred in executing each component process on the list should be allocated to that summary category on the matrix.

Entrepreneurial Appraisal (A) — The recognition of or creation of an imbalance in the economic/social/housing market which adjusts the ripeness or brings to fruition the development of the project, with the aim of creating a profit for the entrepreneur by his taking action to redress the imbalance (e.g., recognition of the demand for housing being greater than the supply in a particular area).

Entrepreneur's Tax Position (A) — His tax-paying rate will greatly affect his appraisal of a project (e.g., a high tax rate will create the desire to turn income into capital gains which will affect his investment breakeven point).

Broad Market Survey (A) — The appraisal of the environment to establish whether or not an imbalance exists for housing, by analyzing that environment for what it contains and what it does not contain (e.g., evaluation of population trends and housing available and planned in an area).

Overall Project Feasibility (A) — Examination of the possible return (income and capital gains) on capital invested in a housing project compared with possible returns (income and capital gains) from other opportunities of investment (e.g., close appraisal of the money market, stock market, potential capital gains in buying "Old Masters" paintings, etc.).

Overall Finance (A) The cost of overall finance or finance rates for land purchase, construction loans, long term mortgages, mortgage insurances, and grossing up these in the appropriate proportions for the project (e.g., close appraisal of money market for construction loans).

Narrow Market Survey (A) The definition of the particular components within a housing project required to make it a feasible physical project (e.g., from experience or survey, the components of houses required to entice a housing user (buyer or renter) to want that house; say, wall-to-wall carpeting).

Land Search (B) The physical search for suitable land in packages or in total, and the putting together of the site (e.g., the search for owners of particular lots and the checking of zoning regulations of each package).

Land Finance(B) The purchase cost of the suitable land required for housing; the weighing of cost of alternative sites (e.g., appraisal of the land market regarding costs).

Marketing Survey Appraisal (A) The evaluation of the total economic and physical feasibility of the project and coming to a decision thereon (e.g., appraisal and evaluation of all costs, potential incomes, income/capital gain tradeoff, overall feasibility, land and money available, construction feasibility, appropriate zoning, go/no-go decision).

Land Acquisition (B) The process of acquiring the land either in packages or in total (e.g., the legal duties to be performed in the transfer of titles, etc.).

Land Clearance (B) — The demolition of buildings standing on the building site, the removal of the rubble and the preparation of the site for building (e.g., building demolition).

Interim Land Use (B) — If the land is being acquired in separate packages, then it may be possible to use some of it for interim earnings, but to do so costs may be incurred (e.g., laying out asphalt surfacing for car parking facilities).

Assembling of Design Team (D) — The bringing together of the architects, engineers, etc., appraising them of requirements and enabling them to begin work (e.g., hiring an architect).

Compiling the Design Program (D) — The compilation of the design program by the entrepreneur, with or without the aid of the designer, usually to maximize on paper the income from the project, given the constraints of the market (e.g., maximizing number of apartments on the site having regard to zoning, spacing, requirements of particular market segmentation).

Project Internal Planning (D) — The graphical design of the whole project in two main sections: (1) Roads and services, and (2) Buildings, both of which are closely related (e.g., structural engineering, analyzing the structure of the buildings).

Project Internal Program Phasing (D) — Examination of the Project Internal Plan and making changes, if required to keep cash flow for Roads and Services and Construction at a minimum by phasing or smoothing out bottlenecks in the construction process (e.g. rearranging physical

layout to speed construction or enable earliest possible occupancy to certain parts of project before construction is complete on others).

Obtain Design Approval (D) — Obtain the approval of the appropriate authorities for the eventual final design (e.g., submission of drawings for approval).

Construction Finance (B) — Cost of construction loans for the project (e.g., dependent on the project in hand, cost of money in the market, credit rating of entrepreneur, duration of construction, etc.) This may be split into two separate sections for (1) site development and (2) building construction.

Hiring of Contractors (A) — The process of drawing up contract documents, obtaining bids, evaluating bids, and the awarding of the contract or contracts (e.g., writing the design specifications).

Construction of Roads and Services (E&F) — The construction of roads and services either for the total project or in phases. The construction itself can be broken into two components, i.e., initial excavations, laying of mains and sewers and bottoming only, with subsequent finishing work once buildings built (e.g., surfacing of roads).

Developed Land Taxes (H) — Taxes due to the local community for developed or improved land. These begin once the land has been improved (i.e., made ripe for building) and continue to be levied throughout the life of the project whether the project is operating

or not. They are a means of paying for Central Services provided by the community.
(e.g., electric-generating plants, communal roads, etc.).

Building Construction (E&F) The construction of the housing hardware either for the total project or in phases by the contractor and his subcontractor to a state where the building can be occupied (e.g., laying bricks).

Both Construction of Roads and Services and Building Construction are cost allocated to E & F (i.e., Materials and Construction Resources) and within the organizations carrying out such work it should be possible and advantageous to arrive at this cost split and the building client can also do this if he structures his bid documents in the appropriate way.

Building Inspection (D) The inspection of the construction work during its progress and at its completion by the agent of the community to ensure its compliance with codes and regulations and previously given approval (e.g., site inspections of construction).

Property Taxes (H) Taxes due to the local community levied on property erected in that area. These begin to be levied once the building is complete and continue to be levied throughout the life of the project, whether the project is operating or not. They are a means of paying for Social Services provided by the community (e.g., police, education, etc.).

Marketing the Project Packages (A) The processes of advertising, selling, renting, creating interest in the project and closing the deals with prospective customers (project packages being the units of

"housing"); (e.g., by the services of a real estate broker or agent).

Hiring Functioning Management Staff (A) The setting up and hiring of staff to manage the project through its life time (e.g., Hiring a manager and staff).

Project Packages Phased Completion Program (D) The programming of the phased completion of the project having regard to the short term demand for housing and the progress of the construction process (e.g., advanced planning of occupancy dates).

Rental Occupancy Commencement and Build-up (A) The process of moving in tenants over a period of time, and the tenant build-up to full occupancy and the loss of revenue due to partial occupancy over that time (e.g., programming arrivals of tenants).

Selling of Project Packages (A) If condominium envisaged, then the process of selling the housing units and closing the deals, etc. (e.g., legal aspects of title transfer).

Buyer Arranging His Long Term Finance (B) If condominium housing units or the total project is to be sold, a buyer will probably be involved in the process of arranging his long term finance and mortgage insurance, etc.(e.g., searching for cheapest source of finance to match his means and credit rating).

Housing Project Operating Process (I) The annual cost and process of operating the overall project while fully or nearly partly occupied (e.g., Janitor service, administration).

Housing Project Maintenance Process (H)

The annual cost and process of maintaining the project in a state ready for operating compatible to its earning power, i.e., minimizing the physical and functional erosion of the project (e.g., planned maintenance, replacing broken window blinds, etc.).

Adjusting to Occupancy Pattern Changes (I)

Over time it is probable that the pattern of occupants may change by age group, sex, ethnic group, employment, etc, and it is possible that the housing hardware, although not designed for a different function, may furnish not living accommodation but, say, office accommodation, due to a high demand for office space (e.g., recognition of such changes causing redundancy and the management adjusting to it if the change is important or desirable enough to warrant such change, due perhaps to economic necessity).

Rehabilitation

This is a whole Housing Hardware life cycle on its own, comprising many of the life cycle component processes described above, and these must be considered for each rehabilitation project on its own.

Repackaging of Land Acquisition (B)

It is doubtful whether the costs of this component process will be borne by the housing hardware life cycle that we are considering--rather it will be considered part of the life cycle of the next project. However, it does mark the beginning of the end of the project under consideration, and will be a part of Land Acquisition described above for that next project.

Demolition (F) The demolishing of the housing hardware of the project which has been being considered, the removal of the rubble, and the fencing off of the area. This again is part of the next project, but marks the end of the life cycle of the housing hardware which has been described.

APPENDIX B

HOUSING OF INDIANS ON RESERVATIONS AND OF ALASKAN NATIVES

by

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APPENDIX B

CONTENTS

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HOUSING OF INDIANS ON RESERVATIONS AND OF ALASKAN NATIVES

I. Executive Summary

The principal objective of the study of housing for the Indians and Alaskan natives was to determine how housing performance requirements for these people differed from housing performance requirements for the underprivileged urban and rural populations. Other objectives included determination of the differences in economic structure, in traditions, in technological level, in the relation of health to housing, and to the types of financial assistance available to prospective home buyers.

In order to carry out these objectives, a study was made of the literature. Discussions were held with representatives of the Department of Housing and Urban Development (HUD), of the Bureau of Indian Affairs (BIA), and of the Association on American Indian Affairs. Consultations were held with Mr. Philleo Nash, former Administrator of the BIA, and Dr. William Fenton, anthropologist, at the University of the State of New York, at Albany, New York, regarding Eastern Indians and a housing development that occurred in the Seneca Nation. Visits were also made to the following seven western reservations, where discussions were held with local representatives of the BIA, with the tribal leaders, and with home owners and housewives who had recently purchased homes under the existing financial structure available to these people.

Western Reservations

1. Navajo (Arizona, New Mexico)
2. Zuni (New Mexico)
3. Blackfoot (Montana)
4. Rocky Boys* (Montana)
5. Crow (Montana)
6. Northern Cheyenne (Montana)
7. Rosebud** (South Dakota)

* Cree and Chippewa Indians
** Sioux Indians

A short visit was made to Alaska, principally for another purpose, but discussions were held with representatives of the local office of BIA, and visits were made to settlements of the Alaskan natives to observe housing conditions first hand.

Performance requirements of housing for the Indians and Alaskan natives must be considered in the framework of how they now live, the economic structure of their living areas, their traditions, present desires, and the urgency of their housing needs. Abstract performance requirements without

consideration of these factors would be unrealistic and would not serve to alleviate the difficult situation that now exists. It soon became apparent in the study, for example, that it was unrealistic to talk about washing machines and dryers for the Alaskan natives, when their housing is grossly inadequate and the primary need is to find means for immediate housing which can keep these people warm and reduce the spread of disease.

The study showed, furthermore, that the degree of acculturation, technological level, and desires, differed greatly in different areas of the United States. In certain areas the Indians were well prepared to assist in the building of their homes; in others they were less skilled, but eager to try. In certain areas, they retained many of the traditions and taboos of the past; in others their development was such that almost the same performance requirements identified for urban and rural housing were applicable. The most apparent difference existed between the Alaskan natives and the Indians in other parts of the United States. As a result of these findings, it was virtually impossible to recommend performance requirements applicable for universal use.

Some of the principal conclusions regarding the housing needs of the Indians and the Alaskan natives may be summarized as follows:

1. The demand for housing greatly exceeds the supply. At the present rate of progress, in relation to population growth, Indian and Alaskan native housing will remain grossly inadequate.

2. The financial arrangement now used by the tribes and by the housing applicants has many good features, but does have serious gaps. For example, it is difficult for a young couple to obtain private financing for construction on a reservation because the financing institution can not exercise foreclosure on reservation land.

3. Most Indian families have a strong desire to live in separate houses rather than apartments.

4. Many Indian and Alaskan native families are large and live in very crowded and unhealthful conditions. Diseases such as tuberculosis, pneumonia, influenza and diarrhea are affected materially by environment, of which housing is a large factor.

5. The heating problem is one of the most serious problems in the housing situation.

   Where electricity or natural gas are not available, liquid propane is often used, at considerable expense. In Alaska, fuel oil is used primarily, but transportation difficulties force the cost to an unreasonably high level. The ultimate answer appears to be cheap electrical energy, supplied by either water power or atomic energy plants.

6. The tribal traditions of the past are important, but the Indians in the United States apparently are accepting the modern, suburban type house. An exception, perhaps, is the housing for the Pueblo tribes, who, if some accommodation were made to tradition, would accept apartments.

7. Many Indian families are in a state of change between their ancient tribal culture and the culture of the surrounding community. As a result, it is possible that in 25 years many young couples will be willing to live in low-cost community dwellings.

8. New construction techniques such as prefabricated housing methods are now being used and should find increased favor by the tribal authorities as the years pass.

9. The cost of transporting building materials seriously inhibits construction, particularly in Alaska.

10. Adequate low-cost houses have not been designed for the very cold climates which are experienced by the Alaskan natives.

11. Many Indian families wish to combine some of their tribal practices with modern features in new housing.

12. The choice between accepting life on a reservation under the leadership of the Tribal Authority or adjusting to the life and economic challenge of the surrounding community is a difficult and disturbing choice for the young Indian family. Usually the Indian chooses the reservation because the way of life in the reservation is more familiar. In many cases, when he leaves, he return for the same reason.

13. Notwithstanding the changes that are everywhere evident, the tribal customs must be respected. It is important that no new housing design be imposed upon any group of people. This is particularly true in Alaska, where the acculturation of the peoples has not reached the same level as that for the Indians in the rest of the United States. Further, the designer might not understand the problems that occur in cold and difficult climates.

14. Building codes offer no serious problems to the Indian housing authorities. The tribes use existing State and National codes as model codes for framing their own codes, but see no threat from outside jurisdictions resisting the use of new innovative materials.

15. Financing plans which involve help from the Indians in building are successful in varying degrees. Regular, remunerative employment for Indians is, more often than not, unavailable. They work on roads, do firefighting, and work on dams, factors which make it difficult to fulfill their labor obligations in self-help housing. At the same time, the Indian male, through tradition, is not

accustomed to reporting to work on a regular daily schedule. Nonetheless, in general this technique can be considered successful.

16. To meet the urgent needs for housing, it is important in some situations that a mass of low-cost "transitional" houses be constructed. Such houses may not have all the refinements that exist in the suburbia-type houses, and may not meet FHA requirements, but they are so much better than the shacks, Quonset huts, tents, and cabins the people are now using, that they will be a great improvement with respect to comfort and health. Care must be taken that transitional houses do not become permanent houses.

II. Introduction

Performance requirements are needed for the newly constructed houses that are appearing on Indian reservations and for those which will be constructed in the next 25 years. These requirements should be prepared with the needs of the users--the Indians--in mind, as well as the maintenance personnel, whether it be the Indians who own the houses or centrally located personnel who are hired by the tribe. The requirements should be applicable, as nearly as possible, for the future, with accommodations made for population growth, changing tribal customs, and the increasing technological level of the people.

The background and the values of the Indians on reservations are different from ours, and it is sometimes difficult to understand their desires with respect to housing. In the past, and oftentimes even in the last few years, programs for "bettering" the conditions of the Indians have not been effective because of lack of understanding. Important legislation has been passed, for example, where rewards were given for assuming responsibility of small acreages so that the Indian could develop an individual farm, but such efforts have not produced the desired results [1].[1/] Mistakes have been made in approaches to education, in housing, in land rights, and in settlement of lawsuits with the Government. The white men in their complex civilization find it difficult sometimes to understand the Indians' simple customs. As a result many misunderstandings have occurred. Edward T. Hall cites examples [2]. In one case a number of years ago, the Indian Service employees tried to bring democracy to the Indians by having an election. Because many were illiterate, various candidates for the Tribal Council were assigned colors for the ballots. Since blue is a good color and red a bad one, the result was to prejudice the election in favor of some candidates and against others.

Methods of operation of the Tribes are different from those of non-Indians. Many parts of their past cultures are still retained. They tend to think more of the welfare of their tribe than they do of their individual welfare [1]. The Indian tribes have their own tribal courts, police departments [1], and in most places, housing authorities. Some of the attitudes that remain impressed into their culture, such as indifference to time schedules, are the result of hundreds of years of a hunting existence where haste comes only when a herd of buffalo or other game animals is nearby.

Yet, it is surprising how many benefits of our civilization they are willing and eager to accept. Television, automobiles, movies, occasional industrial plants with assembly lines, and modern housing, are examples. Of these, modern housing seems most noteworthy because of the important changes that have occurred in the last 15 years. Although there are not nearly enough modern houses, on almost every reservation in the United States there are 20 to 400 of these structures in the $3000 to $9000 bracket (without land), most of which are complete with kitchen stove, refrigerator, kitchen cabinets, kitchen sink, bathroom facilities, and heating systems. Families are buying them, when they can afford them in accordance with the financing systems established by the Government, and in many cases, they take pride

[1/] Numbers in brackets indicate references listed at end of text.

in them, much the same as couples in the suburbs of Washington, Denver, and Chicago are doing.

The economic situation of the Indians on the reservations is complex. Pastoral pursuits of the past still exist alongside of tourist attractions, relatively new attempts at industrialization, and people living on welfare. This situation greatly affects the ability of the family to purchase its home, and to some degree, what it wants in a home. Its resolution will affect the type of houses which should be constructed in the next 25 years. On the Navajo Reservation, many families still live out in the hills in their hogans and make a large share of their living by sheep-grazing; yet many other breadwinners on the same reservation work in the large lumber mill owned by the Tribe, in the Fairchild Electronics plant, in the offices of the Bureau of Indian Affairs or Public Health Services, or in garages and restaurants in neighboring towns. Many are on welfare a good share of the year. The same pattern, more or less, prevails on smaller reservations.

Visitors to the reservations are usually struck with the great difference between the economic pattern of these reservations and that of the rest of the United States. It is as though each is a foreign structure, isolated from the U. S. economy, with different degrees of development, but all suffering from impoverishment. One is also impressed with the tenacity of purpose of the increasingly capable tribal leaders in their efforts to improve the situation against difficult odds.

The stimulus for growth of housing is not the same as it is in the more complex economic structure outside the reservation. A young couple who together have sufficient income for payments on a house are not able to borrow money from a bank because of the difficulty of foreclosure proceedings against the land on the reservation. The initiative usually comes from tribal requests, with the help of the Bureau of Indian Affairs, to the Housing Assistance Administration, an agency of the Department of Housing and Urban Development. The money available for loan or indirect subsidy depends on the political climate in the Federal Government and other factors, such as the level in understanding the problems and needs of the Indians. On the other hand, a young white couple living outside of the reservation, if they have sufficient credit, can go to a bank or finance company and borrow the money for a house in the matter of a few days. The general prosperity of the white community primarily governs the growth of housing.

Generally, the people want individual houses and would dislike community dwellings or community eating places. The individual houses, both new and old, are often centered in the small communities typical of each reservation, but in other cases they are isolated out in the almost-deserted areas. In some cases, small clusters of houses exist for members of a clan or a closely knit group of Indians, such as members of the same family. The Pueblo tribes, such as the Zuni tribe, are exceptions to this preference for individual housing. Their homes are built close to each other, and it is probable that they would accept low-cost community structures or even apartments. Furthermore, there are indications that, in the future, some of the younger people of the tribes would be perfectly willing to set up housekeeping in apartments.

Despite the marked change in the housing situation on the reservations, the need for improved homes is still serious. Applications for housing far exceed the supply. At the present time, 50,000 to 60,000 units are needed, and only about 1500 to 2500 units are under construction. With the appreciable growth in population on the reservations and with the appearance of 1000 new households [3] (newly married couples, people returning to the reservations, etc.), it is apparent that at the present rate of construction, the problem will never be resolved. One tribe showed a 40% increase in ten years. Not only is the birthrate increasing on some reservations, but health conditions are also improving. Added to this is the tendency for young people who have tried to live off the reservation to return. As housing conditions improve and the chances to make a living increase, the influx of young people will probably increase even more. There are now approximately 500,000 Indians in the United States, excluding Alaska. Of these, about 120,000 are on the Navajo reservation. In Alaska there are about 55,000. This last figure includes Eskimos and Aleuts.

Many people are living in tar-paper shacks, small cabins, hogans, converted chicken coops, Quonset huts, and a few in tents. The situation in Alaska is a good deal worse than in the rest of the United States. The crowded living conditions on most of the reservations and in the Alaskan villages has promoted the spread of tuberculosis. Where unsanitary plumbing facilities are common, diarrhea is prevalent. Diarrhea has been known to cause mental difficulties in children [4]. Another serious and prevalent environmental disease is trachoma, which can lead to blindness. Still another is otitus media, which affects the hearing of children. The Association on American Indian Affairs reported that one out of three Indian children have trachoma [3], and that in one BIA school, 40% of the children suffered significant hearing loss due to otitus media [3]. A high incidence of pneumonia occurs among all tribes [4], a situation which is related to poor housing conditions. Other information on the relation of the environment of the Indians to health can be obtained from the Association on American Indian Affairs [4,5]. The cost to the Government because of the hospitalization of the patients with these diseases by Public Health Service would undoubtedly be lessened in the long run by improving housing conditions.

Paralleling the start in providing better housing for the Indians is the work being done by the Public Health Service, which provides water facilities and sewage facilities for the new houses. The housing effort is further complemented by the Office of Economic Opportunity, which offers training to the Indians in carpentry and electrical work and related trades so they can help in the building of their houses; and by the County agencies which help with home improvement and assist in other ways; and other organizations.

III. Performance Requirements Common to those in Urban Areas and Rural Areas

Most requirements for houses on reservations are the same as for housing elsewhere. The occupants need warmth in winter and protection from the rain in summer; they require about the same kinds of cooking and sanitary facilities; and they deserve the same degree of safety as do people elsewhere in the United States. Accordingly, the houses should have adequate heating systems; thermal capacity in the structures; insulation in ceilings, walls and floors; adequate cooking facilities; adequate bathroom facilities, as well as water supply systems; and they should provide adequate safety from fire, floods, and other catastrophic events, with proper exits so that everyone can be moved out quickly in the event of catastrophe. They should have sufficient ventilation, and should be spacious enough to meetsnormal health requirements. Dwelling sites should be well landscaped, with lawns and shrubbery, as a means for the elimination of tracking mud or sand into the house and for improving the appearance of the house. They should provide enough room for study by the school children.

IV. Performance Requirements Specific to Indian Needs and Background

1. Facilities and Requirements not in Demand at the Present Time

At the present level of cultural and economic development, some requirements which are considered almost a necessity for new homes in other areas are not considered necessary on the reservation. Air conditioning for the summer months is an example. Even on the reservations of the Sioux tribes in South Dakota, where temperatures sometimes exceed 100 °F, the Indians generally have not requested devices for cooling. Another example is showers in the bathrooms. Another is exhaust fans over the kitchen stoves. Most houses provide only space for a washing machine or a dryer, and the Indians buy their own when they can; still there is no large demand for such appurtenances to come with the house. The housing situation for the Alaskan natives is so bad that consideration of washing machines or dryers at this time is out of the question. This is not to say that the kinds of facilities discussed above should not be included on a list of required items for all these people in the future. It is probable that the Indians on the Southern reservations would be interested in and would need methods for summer air conditioning very soon.

2. Performance Requirements

(1) Accommodation to the Cultural Background of the Indians

A paramount performance requirement is that a building program should be accommodated to the cultural background of the Indians. The construction of houses, however, is affected somewhat less than one might expect by such background. The new houses erected in the last 15 years attest to this. They usually appear without special cultural requirements, much as they do in housing developments at an Air Force Base. There is no requirement on the Navajo reservations, as many

people expected, that new houses face East as the hogans must do because of religious precepts. There seem to be no tribal constraints on the type of community to be established. The preference for houses rather than multi-family dwellings, however, is probably a reflection of the tribal background, where it is customary to keep families separate from each other. The taboo against building houses close to a cemetery, which occurs in some places, is a product of their culture. Stories are heard about Indians slaughtering a steer on a kitchen floor, or not wanting to sleep in a room where a person has died; but these happenings, if true, are not common and have little effect on performance requirements for modern houses.

Twenty years ago the Indians resisted the added expense involved in building a bathroom with all the necessary plumbing. This occurs only infrequently today. People are proud of their new sanitary facilities and are aware of the improvement that these things have brought to their health.

There are varying degrees of acculturation among the Indian tribes. Some, because of isolation, retain almost the same cultural patterns of 200 years ago. Others, however, because of television, close proximity to cities or towns, or the advent of rapid means of travel, have adjusted more to the surrounding culture. As a result, the tastes in types of houses are different. Some tribes are willing to accept houses relatively close together, but some want variety in style with less standardization. Some want an architectural motif that reflects the art and handicrafts used for generations. Yet considering all the reservations and all the cultures, the evidence shows that with time, the housing desired will not differ much from that outside the reservation. An exception is the Pueblo tribes. In this case, the evidence shows that the people of these tribes cling to the old type housing. A plan for bringing the new-type housing in harmony with Pueblo dwellings is given in the publication "Zuni Pueblo 1985" [6], a report of a planning project conducted by the Department of Architecture, University of Utah, in collaboration with the Zuni people.

(2) Durability

The houses for the Indians must be particularly durable, principally because of the large families. It is not unusual for a dwelling to house ten people, mostly children. Another factor is the lack of appreciation of upkeep, according to our standards, and a lack of understanding of the use of switches, cooking facilities, bathroom plumbing, electrical appliances and other accessories in a house. Following are performance requirements related to durability:

a) Houses should be sturdy and able to resist the rough treatment afforded by children. The walls should be at least as durable as gypsum board. Floors should have wear resistance at least equivalent to that of vinyl asbestos tile. The Indians like this tile. It is sturdy, permanent and easy to wash.

Indoor paint should be washable so that pencil and crayon marks made by children can be removed. Porches should be constructed of solid, heavy members. Furnishings, such as curtain rods, should be simple and without ropes and strings that children can pull on. (Traverse rods have caused considerable difficulty on at least one reservation because of children tampering with them. Housewives have preferred the simple old-fashioned rod.) Screen doors should be sturdy enough to resist heavy use by a large number of people and the punishment occasioned by children's play. Some housing people have shown a preference for wooden screen doors over aluminum. They seemed to last longer and are cheaper to replace.

b) Accessories in the house, including the oven, cook stove, plumbing equipment, and components of the electrical wiring system, should be sturdy and simple, and able to resist wear brought about by possible misuse. Most accessories should last at least five years, and the mechanism for flushing the water closet should remain in operation without repair for a year or more. Because of the lack of familiarity with plumbing fixtures, the sanitary plumbing drain shall be of sufficient size to carry an overload of waste matter. For this reason, four-inch soil stacks and main building drains are recommended. It is difficult for outside engineers to understand, but when some families come into a new house, they know nothing about how to turn on the lights, turn the switch on a circuit breaker, flush the toilet, operate the kitchen stove, or use faucets. Consequently, everything should be assimple to operate and foolproof as possible. Electrical fuses, for example, would not fulfill this requirement because their protection can be subverted by inserting coins under a burned-out fuse. Circuit breakers are much better. The Navajo Tribe plans to institute a training program for new occupants, where careful instruction is given in the use of these accessories. Sessions will occur more than once. The occupants are apparently pleased with the proposed program.

c) The houses should be well protected from the elements. This requirement is necessary for urban houses, but even more rigorous for rural houses and houses on reservations. Many of the houses are in open space, in Northern climates, and are subjected to heavy winds, hail storms and snow storms. At the Blackfoot reservation in Northwestern Montana, next to the Canadian border, the winds reach 40 miles per hour at temperatures well below 0 °F. Windbreaks against the prevailing winds should be provided next to the porches of houses at reservations in these cold areas. The windbreaks should be fabricated of a material with a heavy mass, such as reinforced concrete, or reinforced brick masonry. Other methods might be devised which would suit the purpose better than windbreaks. Also, the mechanisms used to vent the attic spaces should be designed to provide sufficient ventilation, but at the same time, preclude the entrance of snow or sleet

into the attic space which might cause damage to the walls and ceilings when it melts. Automatic closure of attic and crawl space vents during heavy winds and storms would be desirable.

Performance requirements developed for other housing for durability of roofing material, wall covering, and insulating material, are probably adequate for these houses.

The houses should be capable of withstanding the heavy winds without noise, vibration, or noticeable movement.

(3) Style of Housing

The style of the housing should be suitable to the needs and traditions of the tribe. The style of housing varies with the different reservations. The needs of the tribe are a contributing factor; i.e., one tribe is embarked on a program for tourist trade, and has a ski-lift with a lake where camping, fishing, and canoeing are encouraged. Log-cabin type dwellings for these Indians might best fit into the program planning. Another factor is tradition; This same tribe may have used cabins for dwellings for hundreds of years. To encourage this type of structure makes sense, if they are economical to build and effective in use. Styles should, if possible, reflect the ancient culture of the tribe. They should allow for stylization characteristics of the people. The style of the Navajo and Zuni houses will probably be different from the houses for the Onandaga and Seminole Indians.

(4) Transportation Constraints

The construction of the houses should be compatible with the difficult transportation requirements encountered on reservations. Often a house is constructed miles away from a paved road and many miles away from a building supply company. This house can be constructed of native material such as adobe, logs, or stone. But sometimes these materials are not available nearby. A solution might be to haul prefabricated walls, window frames, floors, trusses, stud material (or large component parts made of any suitable materials) from a central site on the reservation where transportation is available. Such procedures were followed satisfactorily at the Rosebud Reservation of Sioux Indians where 375 transitional houses were constructed.

(5) Use of Indigenous Materials

If possible, houses should be constructed of materials indigenous to the area of the reservation. In some reservations, lumber is plentiful and saw mills, operated either by the tribe or by private industry, are available. In such cases, use of this lumber by the Tribal Housing Authority, the contractors, or the prefabrication manufacturers should be encouraged. Savings to the home

buyers can be obtained in this way--or at least increased revenues will accrue to the tribe. The Navajo tribe has made wide use of this technique. On some reservations, a good grade of sandstone is available. Use of this material is usually ruled out because of the high cost of quarrying and hauling it to the site. The Zuni reservation has an abundance of this material and has used it in the past 50 years or more for their structures, but because of expense, is beginning to abandon its use for new houses. Yet thought should be given to the possibility of new techniques, hitherto unknown, which may make its use possible.

Every effort should be made to develop new materials such as fiber-reinforced plastics which could utilize indigenous materials. One manufacturer has discussed the possibility of conducting a research program on this type of plastic, using cactus plants for the fibre. This plant is indigenous to the Southwest area where the Navajo, Zuni, Ute, and other tribes are located.

(6) Modern Landscaping

Lawns and landscaping are requirements. Many reservations, because of inability to obtain frunds from the Housing Assistance Administration (HAA) for lawns or landscaping, or the difficulty of growing lawns on the native soil, experience mud or sand throughout the reservation. Such lawns and landscaping would alleviate the difficulties the housewives are having with people tracking mud and sand into their houses. It is also difficult to keep mud out of the BIA and PHS offices.

Pride in their new homes is another factor. There is evidence that the Indians' care of their property will increase markedly if they are provided with the correct incentives. Once it becomes possible for one family in a community to have a green lawn and some trees or shrubs, the neighbors begin to fix their homes in this way. Finally, the entire neighborhood gets the idea, and everybody beautifies the outside of his house. Lack of care of their homes, which is often the case among Indians, is not necessarily due to their intrinsic qualities. It is more often due to lack of funds to improve the houses, discouragement from the impossibility of keeping them from deteriorating, and the low priority of keeping things neat when living is difficult. The following case is cited in the town of Navajo, showing that the Indian will improve his house if the environmental and psychological conditions are right. Not more than two weeks after families had moved into a new development, the women all had curtains in the windows, the yards were clean, and a few were trying to plant a lawn, a difficult task in Navajo country because of the ever-blowing sand.

A manual prepared by the Branch of Land Management, BIA, Dept. of the Interior, Littleton, Colorado, entitled "Landscaping Development," gives useful information on the value of landscaping and on methods for installing and maintaining the landscaping.

(7) Ample Storage Space.

Due to the fact that the Indians have large families and have furniture and other household items left from their old homes, the new houses should have ample storage spaces.

(8) Heating Requirements.

The houses should be comfortably heated in winter and with less expense than is required at the present time. Where natural gas or electricity are not on the reservation, liquid propane is used for heating. Fuel oil and wood are used elsewhere, principally by the Alaskan natives. The expense of these fuels is a burden for the Indian. It is difficult enough for him to make the payments on his house, to say nothing of the added expense of buying propane. The combination wood stove and propane burner now used on some reservations is not the final answer, but is a step in the right direction. Wood is often difficult to obtain, and even when obtainable, it is difficult to heat an entire house with a wood burner. A method for providing heating energy that is economically in reach of the homeowner is of prime necessity. If water-powered or nuclear-powered generating stations are adequately developed to provide low-cost electrical energy for heating houses on reservations, it would be an ideal solution to the problem of fuel cost. The thermal requirements cited in other parts of the Report, such as a low rate of heat transfer through the walls, ceiling and floor of the buildings, and the proper heat capacity for sufficient heat storage, are mandatory. On certain reservations, housewives have stated that the floors in the new houses are cold in the coldest winter months.

(9) Water Supply.

There should be provision for plenty of hot water. Because of the large families, a method for providing a sufficient amount of hot water quickly after a heavy usage should be supplied.

(10) Maintenance

A central maintenance advisory body should be provided on each reservation. The Indians usually do not have adequate knowledge to maintain their houses economically and efficiently, and the housing officers do not have time to assist them properly. The advisory body might be combined with the maintenance staff that is already on the reservation for taking care of the low rental developments. Such an advisory body could maintain a library of papers and manuals on construction and maintenance published by the National Bureau of Standards, the National Research Council, and others. The BIA housing officers and Tribal Housing Authorities are usually not aware of these documents.

(11) Roads, sidewalks, car ports.

Reservation roads in the housing development should be wide enough to provide parking space on both sides of the road, and, at the same time, to allow room for traffic going in both directions. The roads should be of all-weather construction. Sidewalks should be provided in the housing developments. Carports or driveways or some means for properly parking the cars should be provided. Where they are not provided in the new developments, the homeowners often park their cars on the grounds, a situation which is unsightly and which contributes to the muddy and sandy conditions so prevalent on the reservation.

(12) Protection of cars from extreme cold and from snowdrifts.

In the Northern reservations, means should be provided to protect the car from excessive cold and from snowdrifts so the homeowner can start his car after a cold night. Electrical outlets on the outside of the houses to provide energy to keep the motors warm in the night are used satisfactorily in many places.

(13) Study space.

Ample study space with adequate lighting should be provided for the children.

(14) Low Rental Housing.

Low rental housing plays a significant role on the reservations, and performance requirements are about the same as for the privately-owned houses. It should be added that on some reservations there is resistance to renting. There is evidence to show, however, that such resistance comes about partly because of inadequate explanation to the Indian about what the rental covers, such as free maintenance and community collection of waste. The rental structure of this method of housing will be discussed later.

(15) Homes for the Aged.

Housing for the aged should be provided. While some Tribal Authorities have considered the possibility of institution-type buildings, other authorities and BIA officials have expressed misgivings. One building at Rosebud, appearing much like a motel, is accepted, but it was built on a hill with steps to the street. This keeps the old people quartered there isolated for long periods during the winter months. More information on the needs of the elderly is required.

(16) Safety.

Where there is electricity, there should be sufficient power, wiring, and fusing available. The electrical system should be capable of safely handling, over and above the normal load of lights, dryers, toasters, etc., from one to four 1500-watt heaters. Due to the fact that the heating systems for the new housing are sometimes not as efficient as the central heating systems in the cities, and do not transfer heat effectively to the extremities of the house, the Indians often supplement their heating with electrical heaters. Often the bedrooms in a house are cold, and they place a heater in each bedroom. The load is further increased in many houses with the use of "Headbolt" heaters for keeping their cars from freezing on cold nights.

More than one exit should be required in the houses they build or renovate themselves, sometimes with BIA-HAA money. One-door structures have been built for generations by some tribes. In many cases where new houses have basements, some of the children have beds in these basements, and there is but one exit available.

There have been instances of explosions of liquid propane installations. The necessary installation precautions are outlined in BIA Manual Release No. 25-3, dated October 13, 1965-25 IAM-13, Safety Standards.

Many Indians have lost their lives by fire because of the rise in use of portable kerosene heaters, which can be knocked over easily by children. The best remedy is to provide ample heating so that families will not be required to use auxiliary heaters.

(17) Community waste disposal systems.

Most existing houses on the reservations, both old and new, are in small communities. It is necessary that the garbage, waste-paper, and solid matter be collected and disposed of in an efficient manner which does not jeopardize the health of the people in the communities. Sometimes sewage from the old houses which do not have sanitary facilities is placed in lagoons which then become offensive. Different means should be found for disposing of the sewage from these old houses.

(18) Modern sanitary plumbing systems and sources of potable water.

Consistent with the program which is being followed by the Public Health Service, all financing for new construction programs should include funding for providing inside bathrooms, water closets, sinks, tubs, and plumbing necessary thereto. Showers are sometimes desirable. Where possible, potable water should be supplied

through pipelines into the house. Where not possible, potable water should be supplied at locations which are reasonably close to every house in a village or community so that the household members are not required to walk more than about the distance equivalent to a city block for that water.

(19) The Alaskan Indians, Eskimos, and Aleuts.

The performance requirements listed for housing of Indians in the rest of the United States are usually applicable for housing the above classes. Situations differ, however, and an element of urgency is involved. Some of the requirements which would be applicable eventually are not feasible now because of the existing poor housing, difference in economic situation, degree of acculturation, and transportation difficulties. The extreme cold weather adds to the problem also. A good study of the housing needs of the Alaskan Indians is contained in a report by Abrams [7]. These people live in very crowded conditions in frame shacks made of discarded packing cases and driftwood, small cabins chinked with moss, and tents in the summer. Except for Southeast Alaska, there are few new houses and, even here, the number in the villages is not nearly as large as in the communities of typical reservations in the Western states.

The Alaskan natives are more impoverished than the Indians in the other states. Disease, related to environment and lack of adequate housing, is high. C. C. Johnson, Division of Indian Health, Washington [5], reported that the mortality from influenza and pneumonia among Alaskan natives is three times as high as in the United States as a whole. Dr. Carl Muschenheim [4] states that tuberculosis is at a level 21 times higher than that of the general population of Alaska.

There is little industry except for the canneries near the coast, and livelihood is obtained only by fishing, walrus hunting, seal hunting, handicrafts, migratory work in the canneries, fighting fires, and other temporary occupations. It is a case of a natural resources economy existing side-by-side with a "dollar and cents" economy," and adjustment is not easy. Inflation is also at a high level throughout Alaska. Technologically, the people are not advanced. Still, experience has shown that they are able to adjust themselves to new techniques quickly, and that they would accept new homes and learn to help in their construction. The transportation problem is one of their most difficult problems. Most live in the interior of the state; consequently, construction material, food, and fuel must be transported by plane or snowmobile. Building materials, food from outside sources, and heating are expensive. Fuel oil is usually used and many gallons are needed. Cold weather poses problems of insulation, condensation, foundations, and plumbing and disposal of wastes as well.

Following are additional performance requirements specific to the needs of the Alaskan natives:

a) Heating

Methods for keeping the new houses at a comfortable temperature and at a price that is in reach of the homeowner is one of the requirements that is urgent. Because of transportation problems, fuel oil or liquid propane is too expensive. The burning of wood is not usually satisfactory because there is no longer ample firewood close to the settlements. The distance from the edge of a settlement to an ample supply of firewood is becoming increasingly large, with a radius of a mile or so now. Generally, electricity or gas lines are not available. It was stated by one BIA official that people in the Arctic area remain in bed to keep warm most of the 24-hour day during the period of the year that the sun is down 20 hours a day. In the few places where there is electricity, the price is about 10 cents per KWH. In some of the remote Alaskan villages the cost of operating small generating plants is up to 22 cents per KWH. Fuel oil costs about 50 cents per gallon in the interior.

b) Plumbing and Sanitary Facilities

At present, many of the villages do not have running water or sewers. In some instances, running water is not wanted because of the problems of maintaining plumbing systems in freezing weather. Nevertheless, adequate plumbing and sanitary facilities are urgently needed because of the high incidence of disease among the Alaskan natives. In the Northern areas where there is permafrost, ordinary piping for supply or water drainage will not last due to expansion and contraction. One temporary method suggested for solving this problem for new houses is to provide large wooden tanks within the house and to deliver water to the homeowner. Showers and spigots would be connected to the tanks.

Disposal of sewage and wastes of other kinds is difficult Because of the permafrost, it cannot be buried, and often it is collected in 50 gal. drums, placed on an ice floe, and allowed to sink when the floe melts. Chemical toilets or even large cans have been used, but disposal of the filled toilet cans has been a problem. Development of a cheaper and more adequate means for waste disposal is a requirement.

c) Adequate Insulation and Means for Prevention of Condensation

Because of the cold weather, new houses must offer heavy insulation and adequate heat capacity, and provide means for precluding condensation. A summary of housing

conditions in Alaska is given by a report by Mizen [8] made for the Committee on Appropriations of the United States Senate in 1966. This report gives a good picture of how uncomfortable some of the houses are in winter. It states, for example, that near Nome "most houses are one-room frame construction without insulation and sanitation facilities . . . In the treeless tundra the fuel problem is acute and the drafty uninsulated houses are small."

d) Construction Methods

Means of transportation of the materials for construction of the houses must be found so that the Indian or Eskimo can have the benefits of the houses of the type now appearing on reservations in other parts of the United States. Such radical approaches as transportation by helicopter could be investigated.

A corollary requirement is development of economical means of assembling the component parts that have been transported into the region.

e) The need for biomedical standards

A research team composed of representatives of PHS, NBS, and others should make a thorough study of the relation between size of house, ventilation, heating and other factors, and the health of the Alaskan Indians and Eskimos. The log houses with moss chinking, but with poor ventilation, that are now used are at least warm, but the crowded conditions aggravate the spread of tuberculosis among the people. Yet large houses without adequate heating have been known to bring on pneumonia [3]. Standards which yield neither to the danger of pneumonia or the danger of tuberculosis could be established by such a team. The incidence of tuberculosis among the Alaskan Indians and the Eskimos is much higher than in other parts of the United States.

f) The need for conformance to native traditions and desires

Perhaps more than in the case of the Indians on reservations elsewhere, it is necessary that the traditions and desires of the natives in the matter of housing be respected. Cases

have been cited where houses, comfortable and adequate by standards in the cities and rural areas of the U. S., have been placed in the villages only to find the natives move out or permit the houses to deteriorate because they did not like them. Sometimes even the reasons are unknown. It is incumbent upon those who are trying to help these people by designing better houses, to win their confidence and confer with them before the design becomes finalized.

(20) The Eastern Indians

There are but few reservations in the Eastern United States, and these do not all fall under the jurisdiction of the BIA. In New York State, at the reservations of the Iroquois nations, such as the Senecas and the Onandagas, the BIA maintains only small offices. Most contact between the tribes and the surrounding civilization is made with representatives of the State who handle education and welfare. The Cherokee Indians have a few small reservations under the BIA.

On these reservations, the beginning of new housing developments are appearing, but the type of developments and their economic basis varies. One of the most interesting is the development that occurred after 1964 on the Allegheny and Cattaraugus reservation near Salamanca, New York [9]. The U. S. Congress appropriated $12,000,000 for rehabilitation, among other funds, in compensation for the displacement of 130 families of the Seneca Nation for the construction of Kinzua Dam. The money appropriated was not given to the individual Indian families, as had been done in the past, but was given to the Seneca Nation for use in obtaining new improvements, including housing. The Seneca Nation Housing Enterprises recruited and trained their own work crews and established a purchasing system so they could build two entirely new communities. These were successfully built, albeit not without some false starts and mistakes, and the Indians are living there today in new $18,00 to $20,000 homes. There appears some dissatisfaction with these homes among the older prople, but the younger Indians are quite pleased and proud of these houses.

Generally, the Indians of the East are more technologically advanced than those from the plains and mountain states. They are closer to cities and towns. Many work in these cities or towns, and they can obtain credit from the banks. An example is the Indians on the Tonawanda Reservation near Buffalo, New York. Some work in the gypsum mines and in factories, and some have reached a high economic level in the neighboring communities. The houses on this reservation range from log houses built in the 18th century to expensive modern houses.

The fact remains, however, that housing for the Indians in the East is inadequate, and new programs are badly needed. The financing programs offered by the HAA and used by the Western tribes are available to the Eastern nations and tribes, as long as they meet the requirement of establishing a housing authority.

V. Financing of Dwellings

The financing of dwellings is closely related to the economic structure of the reservation. In a very few cases, reservations which have been blessed with natural resources such as coal, gas, lumber, oil, or minerals have some money available to help finance housing, but usually the tribes are not able to loan money without the help of the Government through such channels as the Housing Assistance Administration. Another factor is the ability or inability of people to make paymnets, or to pay rent in the low-cost rental dwellings.

An important performance requirement is that the financial needs of all strata of the population be met. There are four principal HAA programs being utilized at the present time by the tribes to provide stimuli for building houses on the reservations. These programs seem to meet most of the needs, but there are some gaps. The programs are:

1. Mutual Help Housing Program

This program was inaugurated as a means for providing the Indian with a low-cost house which he helps build. He is required to work a minimum number of hours for which he receives an equity in the house.

The program has three advantages: it assists him financially; it stimulates pride in the completed house; and it raises the technological level of the population. It has some disadvantages also. Due to the fact that the Indian must work when work is available at such jobs as fighting fires, on nearby dams, and on roads, he cannot work continuously on the house. Further, some men are not accustomed to regimented schedules and fail to appear on the job as promised. Yet the advantages appear to outweigh the disadvantages, and the program can be considered successful when the correct supervision is used, and the average participant is not expected to perform complicated tasks. Inside work, such as laying floors, placing of gypsum walls, and building concrete steps, appears to be successful. Many Indians, however, are highly skilled and can work on outside work or supervise others.

Houses on the reservations under this program cost about $9000 per year without land. It takes about 17 years to pay for them. Payments are based on the size of the family and run $7 to $30 per month. Land may be given outright by the tribe to the participant, or leased to him, or sometimes he owns it before construction of the house is started.

Literature on the Mutual Help Housing Program can be obtained from the BIA, Dept. of Interior, Branch of Plant Management, Littleton, Colo.

2. Turnkey III

An expanded volume of low-income housing is made possible through the enlistment of private enterprise. In this program, the participant receives his equity by maintaining his home. The name Turnkey is derived from the idea that the housing authority does not make any payment until the building has been completed, and the builder is ready to turn over the keys. This program is used in other areas besides reservations. The houses under this program usually cost about $9000, not including the land. The home buyer makes payments based on his annual income. There is a minimum rate, however, of about $30 per month. From these payments, funds are established which are applied to his equity so long as he keeps up the maintenance on his home. If he does not, he loses the benefits of these funds.

The Turnkey houses offer possibilities for new manufacturing procedures, such as prefabrication, because contractors are often skilled in prefabrication techniques.

3. Low-rent Housing

Financing of a low-rent housing project is usually initiated by the tribe. Rents are dependent on the size of the family and range from about $30 to $60 per month. In some cases, an applicant who makes over $5000 per year is refused his request to move in, regardless of the size of the family. Most houses are in the $9000 class, not considering land. Some low-rent houses adjoin one another.

4. Transitional Housing

When a great bulk of the population on a reservation cannot afford the Mutual Help or Turnkey Houses, the Transitional House is a possibility. These houses, without land, cost about $3,000. The development at the Rosebud reservation is an example. In this case, a house with modern range, cookstove, refrigerator, spaceheater, and bathroom facilities was designed by the Battelle Memorial Institute. It does not fulfill all of the FHA requirements, but it is an improvement over the dilapidated houses that the people lived in previously, and meets their needs very well.

Another program for moderate income houses (22103 of the Federal Housing Administration) is being used more extensively than before.

Besides these main programs there is the Home Improvement Program which was devised by the BIA, sometimes in cooperation with the Office of Economic Opportunity. Under this program some new transitional type houses have been built, and considerable assistance has been given to the Indians in rehabilitating their own houses by putting on new roofs, partitioning them, laying new floors, or providing sanitary facilities.

Each of these programs has a use. Under present financing available to the tribes, all or any combination of the programs can be used to fulfill the requirement that the financial capabilities of all strata of the population be taken into consideration. The Model Cities Program, used often in urban communities, may be utilized by the tribes. In this program, HUD helps the city or small community with its planning, and also supplies certain financing if the plans are approved.

A serious gap in the structure yet remains. With the economic change that is coming about in the reservations, there is an increasing number of couples who make $5000 to $10,000 between them. There is no ready means for them to buy a house on the reservation. The banks in towns near the reservation will not lend them money because of difficulties of foreclosure in case payment is not made. Reasons of prejudice also play a part. They may be eligible for the types of houses described above. If government financing could be made accessible to them, it would help to relieve the shortage of new homes that exists on every reservation. This shortage is acute on the Navajo reservation where the Fairchild Plant is located. People are required to commute unreasonably long distances to work because of lack of housing, and the expense of gasoline is important to them.

Another gap is a provision in the low-rent housing for the man who makes just a small amount over the maximum allowable to be able to rent, but who has a large number of children.

Tribal leaders have made known their needs for financing the building of special type housing. The Navajos have requested aid in financing the building of new hogans. Older people often want a hogan placed next to that used by their children. Sometimes a primitive and very inexpensive structure is needed to replace a hogan that is miles away from the principal communities. One must understand that the Navajo reservation is approximately as large as the state of West Virginia, and there are dwellings so far away from the main roads that it is difficult to transport materials for larger and more conventional housing. The Zuni Indians have requested a program for financing inexpensive structures for the shepherds to sleep in for a few days when they go in the hills to tend sheep. As it is now, they are forced to sleep in the open.

A difficulty often heard about the present financial structure is that involved for the tribal authorities in establishing a housing development. They cannot understand the necessity for all the paper work [10] and the long and difficult conversations with the regional offices of the HAA. Further, once they complete the forms, they do not understand the delays. In a typical office in an American city, if no answer to a request is received in a reasonable length of time, the person making the request will call by telephone to determine the difficulty. The Indian does not take this type of action, but gets impatient with the delay.

It is evident that new approaches must be explored if the necessary housing to fulfill the requirements of the Indians is to be provided in the next few years. An avenue of exploration is the possibility of giving the

Tribal Housing Authority gradual and increased freedom of action. The tribal leaders are showing increased competence. The experience of the building of two housing developments by the Seneca Nation without the help of outside contractors or the U. S. Government is an example of what can be done.

VI. State Codes and FHA Requirements

For most housing the Tribal Authorities accept state codes and FHA requirements. In many cases they have adopted the state codes as model codes, rather than writing codes of their own or contracting the writing elsewhere. Adherence to the FHA requirements is necessary to receive assistance from the HAA or FHA. There appears to be little worry on their part about conflict with the state codes should the tribe at a later date want to utilize new innovative materials not allowed by the state code.

There are many situations, however, where the state codes and the FHA requirements are not applicable, and the tribes do not want to adhere to them. Where there is an urgent need for transitional housing, there is justification for shortcutting some of the provisions in the codes and the requirements. Safety requirements, however, should not be relaxed. Also, care should be taken that the transitional houses do not become permanent houses.

VII. Recommended Research

1. Development of a low-cost house which will be suitable for Western and Eastern reservations; will have adequate thermal insulation, heat capacity, sturdiness; and, at the same time, will meet the special transportation requirements of construction materials for Indian housing.

2. Development of a low-cost house which will be suitable for the Alaskan natives. The final design will include provision for meeting the special requirements of insulation, plumbing and foundations which are problems in permafrost areas; as well as problems of condensation and infiltration of sleet and snow in attic vents. Special studies should be made of the problem of transporting building materials.

3. In collaboration with PHS, the National Bureau of Standards, or another qualified organization, should make a biomedical study of requirements for housing in Alaska. Consideration should be given to size, ventilation requirements, and other factors, and their relation to the incidence of diseases such as tuberculosis and pneumonia.

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APPENDIX C

CONCEPTUAL STRUCTURE OF LOW COST/LOW INCOME HOUSING

by

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FOREWORD

If the low income housing user knew what he required from housing and could afford to pay for that housing, there would be no problem. On his own, he does not know what he requires from housing, and it is improbable that he can afford to pay for it himself.

The problem is to find out what he requires from housing, how he can afford it, and how to make these two aspects compatible with each other.

D O C U M E N T A

CONCEPTUAL STRUCTURE OF

LOW COST/LOW INCOME HOUSING

(Introduction and Overall Structure)

Introduction

A major difficulty in this problem is understanding not only what are the major components for study and what are their size, shape and constituents, but also how each major component and its constituents interacts with the others.

What is the structure of the overall model which contains the end product of the building process, the building process itself, performance requirements, performance criteria, design specifications, housing costs, building regulations and codes, user requirements from housing in the form of the psychological needs of the housing user, the sociological needs of the housing user and society at large, the environmental characteristics of housing to satisfy these requirements, etc., etc.?

Once the concept of the problem and its component processes has been established, a clearer grasp can be made of the whole issue facing the requirements for low cost housing for low income people. Next an appraisal of what is known about each component process can be sought and the exposed discrepancy between what are the constitutents of the component process and what is known about that component process will provide required fields of research.

This will open up avenues of search for the necessary solutions while providing that such searches can be carried forward by experts in that field with the confidence that the results of all of their work are linked together in a manner to obtain the best overall solution or solutions within the present constraints of resources and time available.

Overall Structure

The starting point is the user of housing.

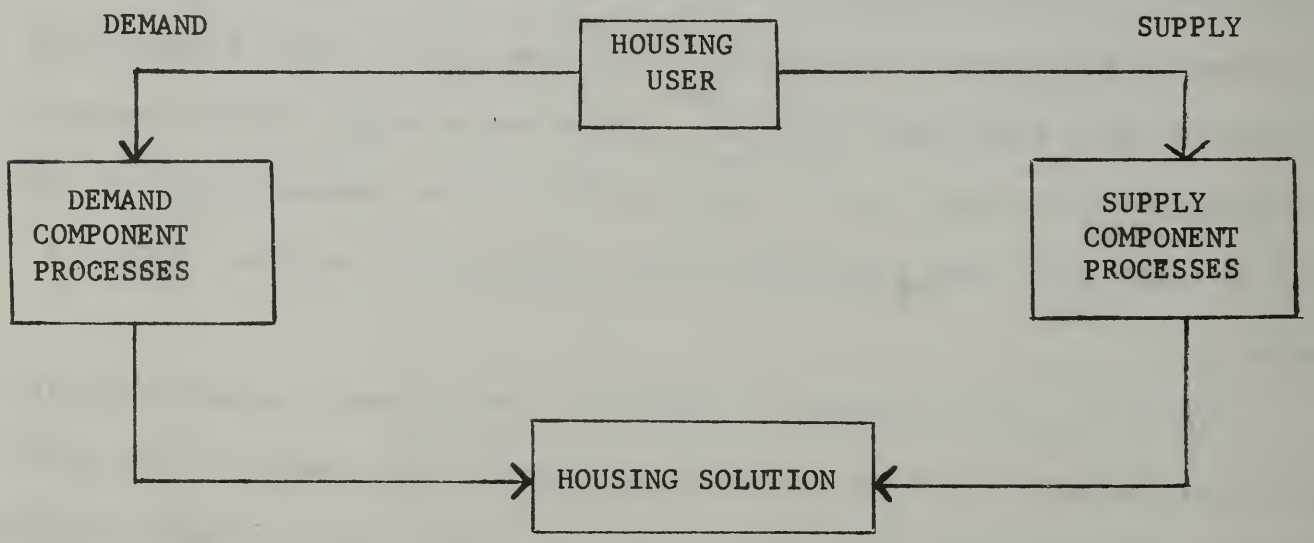
In considering the problems, one must not think of the housing user as a poor individual all on his own, but as an aggregation of poor individuals or family groups aided by the power of the government and leaders of the society of which that housing user is a member.

Basically the housing user can be considered as a two-sided equation:

(a) what the user requires FROM housing, and

(b) what the user can expend FOR housing.

The above can be considered as the housing user's **DEMAND** from housing for his satisfaction and his means at hand with which to **SUPPLY** the solution. Between these two are the trade-off processes which equates one with the other to produce the most appropriate fit between the two.



For example, by placing different types of housing users (e.g., urban ghetto dwellers of varying ethnic and national backgrounds, rural poor farm workers, itinerant fruit pickers, Indians on their tribal reservations etc., etc.), one type at a time, in the starting point of the model one could assess their demands from housing, their ability to supply their housing and their most appropriate housing solution.

The benefits of such a trade-off process are derived from the greater efficiency with which these two extremes can be traded off in the light of the total desires of the Housing User defined as above.

Such benefits, i.e., the results of such increased efficiency, can be the satisfaction of

more User Requirements from the same Expenditure (More from the Same) or

the same User Requirements from less Expenditure (Same from Less) or

more User Requirements from more Expenditure (More from More but with a beneficial ratio between the two) or

any other appropriate permutation of these two.

The increased efficiency is better housing performance per invested dollar, in other words the provision of a better performance by the housing in relation to its life cycle cost.

To examine what is housing performance per invested dollar, one must examine the housing users demand from housing in its component processes both as regards performance (then better performance) and dollars.

However, firstly there must be a clear concept of the problem, its component processes, and their constituents and interrelationships. This is what follows in two parts -- the Housing Supply Process and the User Requirements from Housing.

In cybernetic terms both parts are broken into a series of component processes (transformations) of constituents (transitions) where the input to each (operand) is acted upon by that component process (operator) to produce the output (transforms) which in turn becomes the input to the next component process.

In common language analogy, there are two chains made up of links each of which is of such size and shape that it connects with the links on either side of it. These chains of links form one circle. As with all chains the whole will only have the strength of the weakest link. An important criterion for research is the ordering of the component processes as to which are the weakest links in the chain and within each of these weakest links, which constituents are the weakest.

While the overall structure is described as two chains with a common source (the housing user) and common ending (the housing solution), the whole can and should be considered as a whole. The information can be reverberated in any direction to and fro round the circle until the best housing solution is reached and that this should come to rest (cybernetically - the sink) where the building process interacts with the housing hardware (i.e., the allocation matrix) because that is where the crystallized housing solution is translated into reality.

It will be realized that the constituents throughout these component processes are not related to each other in an hierarchical manner. This is due to the close interrelationships of such constituents within each component process (i.e., links in the chain). The output resulting from each component process should be completed before passing it on to the next component process for manipulation. This overall structure is true of any system which is cybernetically sound and proven.

This does not preclude the tracing of the effect of one value (rather than another) of one constituent upon the component process or the chain of component processes in either direction or in a reverberating movement round the circle.

The main benefit of such an open system is that while the values of each constituent or component process may change (e.g., different initial types of housing users), the system can carry the full range of information possibilities within the overall structure of this concept of the issue of Low Cost Housing for Low Income people.

All of the various integral constituents of the problem mentioned in the Introduction will be displayed in their appropriate position and context within the following conceptual model of the problem.

Part 1 - Housing Supply Process

Assessment of Annual Amount Affordable For Housing	An evaluation of how much the housing user can earn by considering his geographical location and its employment prospects and the earning capacity of the housing group (be it a family or not) with subsequent evaluation of the latter into the amount affordable for housing and the amount for all other activities.
Transfer of Annual Amount Affordable to Present Value	The use of Discounted Cash Flow process to translate annual amount affordable for housing to a present value capital sum affordable for housing which enforces consideration of the appropriate interest rates and life span of housing and the capacity of the lender to maintain loan payments.
Allocation of Capital Sum for Housing Hardware to Major Sub Systems of Housing Hardware	The allocation of the present value capital sum across the major sub systems of housing hardware according to their life cycle cost profile and followed by a translation of such major sub system life cycle cost amounts to their components, e.g., construction and functioning etc., (and their breakdowns) for each major sub system. Consideration is also

given to the size and shape of a Cost Allocation Matrix of Housing Hardware by Building Process (which is described and defined in detail in another document).

Appraisal of Life Duration and Quality of Housing Affordable

Given housing with an overall cost profile derived in the previous component process the assessment of the life of each major sub system and the optimization of the longevity of all major sub systems, i.e., the total housing hardware and an evaluation of the performance of that financially affordable housing regarding its physical and social/environmental life. In other words what is the best housing hardware that can be financially afforded. By the end of this component process the annual amount affordable per housing has been translated into housing hardware which can be afforded, performance evaluated, life duration measured and costed.

Constraints on Optimal Solution by National Geographical Position and Codes, Standards and Zoning Regulations	For various reasons national geographical position will require different housing hardware profiles and the solution of the preceding component process should be able to be adjusted accordingly. The requirements for safety, health and welfare etc., will vary with geographical position etc., and thus the housing hardware solution must conform to these local requirements (but these local requirements should match rationally their local needs to be fully effective). The output of this component process is to clarify the boundaries within which the affordable housing solutions can be designed.
Design Solution	The component processes in this chain, up to this point, have all considered the "constraints of the real world market place on housing". It's within these constraints that housing solutions have to be designed. These constraints may be too severe in places and too lax in others - such boundaries should be correlated with reality of their environment while ensuring sufficient scope for individual variety as between housing solutions.

The National Advisory Commission on Rural Poverty, in attacking rural poverty, placed special emphasis on programs which would provide rent supplements for the rural poor. It further recommended that a single unified housing agency to be made responsible for housing programs in rural areas and that credit terms be loosened further--probably with government backing.

8. Special Problems. Water, health, sanitation, waste disposal.

One of the most important differences between the urban and rural approaches to housing is in the emphasis they place on water sources, and the plumbing and sanitary equipment which is involved. Rural homes must often lean heavily on wells, springs and surface waters for their water and, in such cases, their plumbing will be quite different. Since sanitation, health, and "better living" are generally involved, relevant rural codes and standards need special orientation. Wells which are big enough to serve several families or small communities or for individual home use need attention in their own right.

Incidentally, it is obvious that the same performance standards will not apply in all rural areas. In many locations throughout the country plumbing is highly inadequate, and so also are sanitary conveniences. The local people might resent the extra cost involved in being forced to accept the same "sophisticated" levels which are satisfactory for more affluent people. Of course, it is conceivable that the human factors which come into play may be such that just the converse may be true.

In many areas it is desirable to try to trap rainwater because of water shortage, or prolonged dry seasons, or for other reasons. Gutters for trapping rainwater for storage or use would then have to be considered and it may be necessary to design plumbing and sanitation equipment to minimize water consumption.

In many areas water has a definite agricultural or animal use, and every attempt must be made to conserve water. Local codes must have these needs in mind. If chemical toilets for home use appears desirable the codes should fit them in.

One of the main factors militating against large scale housing in many rural communities is the lack of adequate or central water systems or sewage disposal systems. Funds have been appropriated by HUD under their community renewal program for the development of central water supplys and sewage systems. Even the Farmers Home Administration and the Office of Economic Opportunity have programs aimed at alleviating these problems.

These agencies should encourage performance codes and practices which will maximize the return on such programs. The pretreatment of water for reasons of health and sanitation involves special approaches in rural areas. Federal agencies may have to encourage new and better means for water re-use--both for individual homes and for the community. Many homes and many communities are chronically plagued with seasonal water shortages and these needs on codes and standards would have to differ from the urban equivalents.

Building refuse and debris disposal problems will be more acute in rural areas since the community itself cannot often accommodate individual home owners in such removal.

9. Special Problems. Community services and protection

In rural areas, and especially in those areas fairly remote from a community police or fire force, it is incumbent upon the home owner or renter to provide for himself maximum protection by whatever means he may have at his disposal or can develop. This additional rural need should somehow be reflected in certain housing plans specifically geared towards meeting these safety objectives--both for the individual or the community generally. The additional need for safeguarding home and property must somehow be reflected in codes and standards which are to be developed and which will not be identical in nature to those deemed suitable for urban areas or centers.

10. Indigenous Energy Sources

Rural homes, especially farm homes, are more lived in during the colder months than are urban homes. Heating of these homes takes on increased importance therefore, particularly in the more northern states and at higher altitudes. Fireplaces may be very desirable if a good supply of wood is available, and might readily be worthwhile designing into low cost homes to be built at such locales. This we would probably not think of doing for low cost urban homes. Rural fireplaces might use corncobs if freely available or some other carboniferous product of the farm or country.

We might also reorient our thinking to other fuels not too popular in urban areas. LP gas and kerosene as examples, find much more use in the country. We need standards covering their use as well as for equipment and storage tanks.

There is no point in stressing the importance of electricity as an indispensable aid to modern living, even in low cost housing. It is generally appreciated that its cost varies quite appreciably from locale to locale. The cheaper it is the more it can be used as a primary energy source. Many locations where hydroelectric power is furnishing cheap electricity have, in fact, gone over to the "all electric" home, with real economy resulting therefrom.

A point to be stressed, however, is that even though some homes may be run primarily by cheap electricity it may be desirable that low cost rural homes not be guided by the same electrical standards and codes that have been accepted for urban areas--and for the many reasons noted elsewhere. They may be too complicated, restrictive, and self-defeating. The home owner who must depend on his own resources out in the country may become quite frustrated with them.

Electrical equipment and installations in rural areas should call for less maintenance and replacement than in urban areas because of the difficulty in obtaining new equivalents, skilled repairmen, and knowledgeable dealers or representatives. The home owner has to depend more on his own resources. Additionally, local suppliers are further away and generally are less able to be of constructive help than such people would be in the city.

11. Indigenous Raw Materials and Fabricated Basic Products

When there is a good local supply of raw materials such as stone available for building purposes it is very poor economy to allow mass planning to overlook them. What we are saying is that local conditions must first be studied in regard to labor and specialized situations before anything is used for low cost housing. Often we will find one or more large factories in rural areas which, while manufacturing on a national scale, are more than happy to give local builders a real price break. It is quite possible to overlook the price advantages of indigenous materials in urban centers but it is wasteful and unduly expensive to do so in rural areas.

12. Types of Dwellings and Appurtenances

As localized housing conditions are less understood and observable in rural areas it is important that a study be made of housing as it exists today. To what extent is it substandard? What proportion is abandoned but worth saving? If worth saving, does a local market exist? Have technological changes resulted in a major shift in the population away or to that market? Many other questions need answers.

It is also desirable to understand the nature and factors which lead to abandonment. Can new concepts in rural housing codes influence these factors? It is known that abandonment runs higher in rural areas. The reasons are many but whatever they are, can renovation of abandoned or substandard houses fit into a low cost housing program for a given region? User standards would be different. It is necessary to know what constitutes a minimum acceptable level of renovation for poor and poverty-poor. It certainly varies. The Kentucky poor may be happy with far less in their houses than the Delaware poor for example. Might we not need to have some flexible user standards for such houses, based upon local consideration?

A realistic appraisal of rural housing conditions must take into account certain unique characteristics of rural living. For instance, estimates have been made that about 50% of the really substandard homes are lived in rent free in rural areas because of some owner- "renter" understanding. Very often this is usually to the effect that when the owner wishes help he is entitled to it from occupants of his home before they can offer their services to others. Further, living in such homes keeps the insurance in effect. Lack of tenancy might mean cancellation of fire coverage. This could be a serious handicap, especially in isolated areas where fires, once started, cannot be easily controlled.

The fact that the rural population is shrinking in relation to the urban population should not in itself be considered too significant a factor. The greater extent and rate of dilapidation of rural homes may more than offset this shrinkage. Further, it is important to realize that the population shift is of statistical significance only. Housing is essential for the needy of any given area, and it makes little difference to them that statisticians reclassify their area from rural to urban.

13. Type of Dwelling and Appurtenances. Miscellaneous

The need for auxiliary buildings is greater in rural areas. Animals often play a large part in the existence of rural families and, therefore, catering to their needs is quite important. We are not now thinking strictly of farms where the need for such buildings, and standards for them, are obvious.

Many rural families carry on a semi-farm type of operation or try to be more self-sufficient in their nutritional needs. Many, for example, raise chickens or have small vegetable plots and need facilities for storing food obtained from such sources--sometimes for many months at a time. These needs still exist in the country but they can be ruled out of urban living. Some rural sanitation and health provisions may have to be developed to cover the facilities which would be needed.

14. Specialized Rooms and Specialized Inclinations for Conventional Rooms

Since shopping is generally less convenient in rural areas there is a noticeable tendency for shoppers to make each trip more meaningful by accomplishing more per trip, that is, by taking more home each time. How does this affect their storage needs at home? Do they want larger pantries, larger refrigerators or freezers? Do they want larger kitchens so that they may prepare larger quantities of food either for immediate use or for storage, including possibly canning of produce when it is in season or preservation of meat and poultry to tide them over the winter months? Some of these questions if answered in the affirmative should be dealt with accordingly in the construction and design of low cost rural housing. Such considerations would not be necessary in urban low cost planning.

Mud rooms, clean-up rooms, or family entranceways would be especially desirable for farm homes and many rural homes, especially in locations where considerable mud and dirt may be brought in. Such rooms might contain two or three fixtures, drinking fountain, laundry-sink tub or even urinals since privacy is less a problem. Bedrooms and bathrooms may be given a more open location for the same reason. This is practically never so for urban houses.

Leisure time for the inhabitants of low cost homes must frequently be used for chores about the home. It is used for carpentry, plumbing, repairs modenization, sewing, redecorating, etc. Since rural shopping is done less often than urban shopping and additionally, is generally less productive because stores do not have the same inventory, greater emphasis must be placed on facilities about the home. This being so, perhaps a small workshop area may be designed into small rural homes which would be considered an extravagence in urban houses. Standards would have to be developed for such a shop area since they are not customary at present.

15. Conclusions

While it has been most difficult to evaluate the host of variables directly pertinent to the development of new performance standards for rural housing, we would hope that a careful analysis of these many variables would yield information which architects and planners could use at a considerable saving of time, money, labor, and materials, and that this would enable them to plan and design the least number of houses for the largest number of poor and poverty-poor people in rural America.

We would fervently hope that while urban housing is given all the attention it deserves, rural housing will not be neglected. We can foresee increased understanding of the user requirements of the rural poor for low cost housing and a program of planned research into the development and promulgation of a new series of performance criteria, standards and codes which will meet their needs.

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APPENDIX D

NATURE OF THE PROBLEM

by

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City Planner

THE PROBLEM OF HOUSING

A. GENERATION OF PROBLEM MODEL

1. Operating Rules for Research Study
2. Issues and Appositions
3. Six Aspects of Problem Model

B. USE OF PROBLEM MODEL

1. Description of Basic Research Structure
2. Analysis of Relationships within Problem
3. Prescription of Needed Research
4. Operating Framework for Research Projects
5. Basis for Research Evaluation and Application

CHARTS

I. THE PROBLEM OF HOUSING

As individual users we relate to housing in very direct and specific ways. We have a basic need for physical shelter plus certain needs related to the activities we wish to pursue in and around the place where we live.

Despite the fact that we are each housing "experts" as individual users, we should not be surprised to find that the total system of housing is a very complex and complicated thing indeed.

To realize and identify that some parts of this system are not working well is the first step toward aiding them. In working out the details of such positive action, however, it is necessary first to be at ease with the basic fact that the problem occurs within the context of complex relations. What appear initially to be clear and reasonably simple answers may be misleading.

We feel that it is possible to lay out the relationships within the housing system and to work fruitfully at resolving various system dis-functions. Presented on the following pages is a description of how the team has gone

about this to date, how we think this understanding can best be applied to the problem, and by what operational procedures one can pursue a useful, inter-related set of programs.

Figure 1 shows the basic relationship between the users of housing (the people), the "housing system" as a thing that serves or fails to serve their needs, and what HUD and IAT are doing about the problems as they appear to be.

FIGURE 1: RELATION BETWEEN THE HOUSING PROBLEM AND A PROBLEM-SOLVING RESPONSE

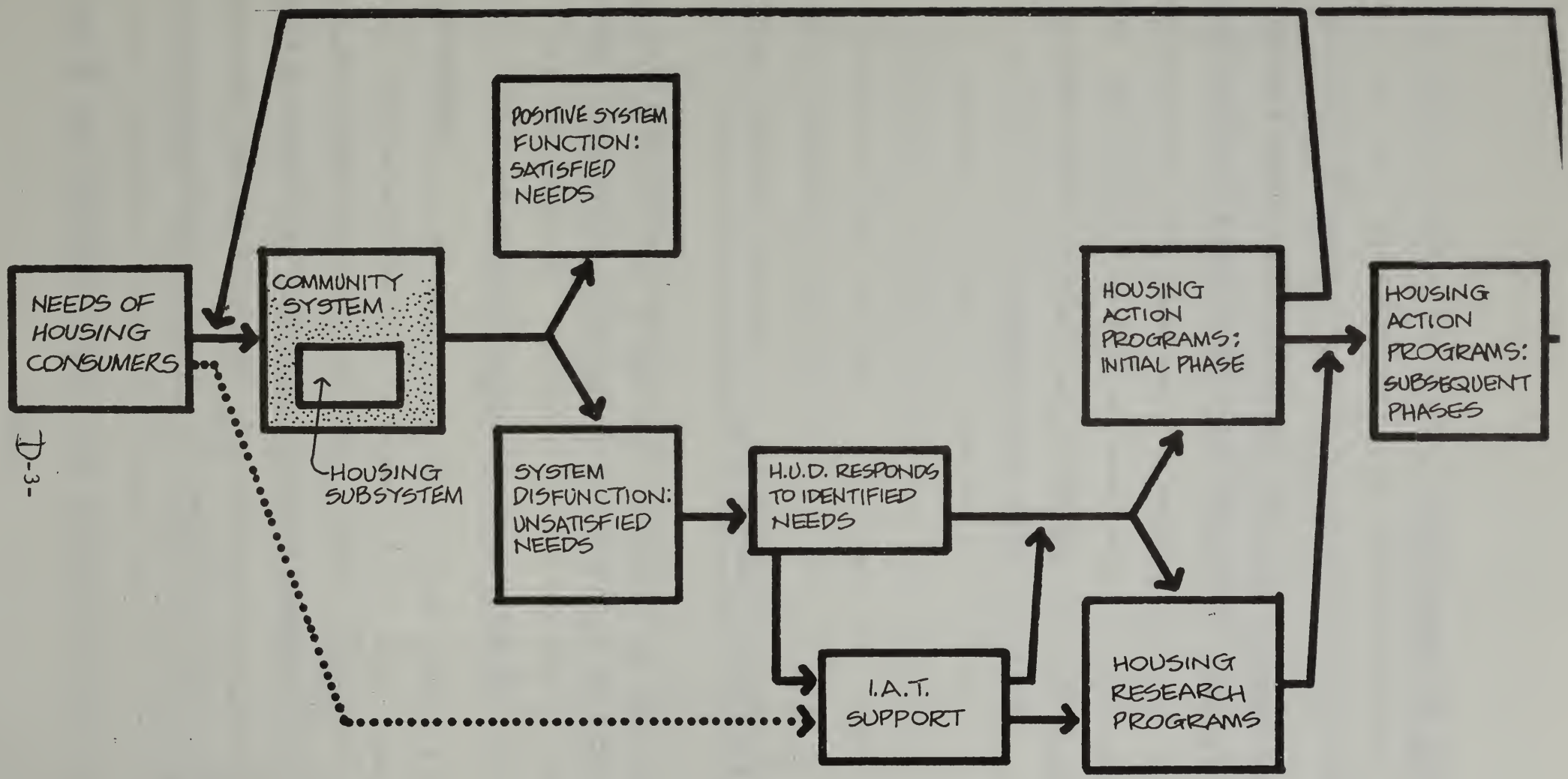

NEEDS OF HOUSING CONSUMERS
COMMUNITY SYSTEM
HOUSING SUBSYSTEM
POSITIVE SYSTEM FUNCTION: SATISFIED NEEDS
SYSTEM DISFUNCTION: UNSATISFIED NEEDS
H.U.D. RESPONDS TO IDENTIFIED NEEDS
I.A.T. SUPPORT
HOUSING ACTION PROGRAMS: INITIAL PHASE
HOUSING RESEARCH PROGRAMS
HOUSING ACTION PROGRAMS: SUBSEQUENT PHASES

FIGURE 1.

A. GENERATION OF PROBLEM MODEL

To facilitate specific, detailed investigations, a structure has been evolved to represent the various overall relationships in whatever depth is appropriate. Definite guidelines have been established and used to keep the focus of this model on central issues rather than ancillary ones. Within the model, however, there are elements of clear contrast. These are identified and their significance for the problem indicated.

1. Operating Rules for Research Study

The problem model was generated on the basis of six distinct principles relating to the characteristics of the real issues as the team sees them.

OPERATING RULES FOR RESEARCH STUDY

Rule 1. The various aspects of the "housing problem" or of particular housing issues should be fully stated prior to selecting specific research directions. Statement of the issues should not be artificially limited by current administrative limits of responsibility. This should hold true even though it may be useful at a later stage to select specific research projects which do in fact reflect current divisions of responsibility.

Rule 2. In a problem context where so much is unknown, it is a valid

technique simply to identify fundamental questions which need to be answered - whether or not such answers are known to be presently available. Too often the prescription of specific housing action has been premature, belying a shallow understanding of deep-seated problems. Every attempt will be made to derive action from the kind of questions which prove valid in relation to one another.

Rule 3. There are three distinct categories into which issues can fall:

technical - whether some course of action is possible

operational - whether it is practical and feasable

"political" - whether it is acceptable from the point-of-view of policy

In our expansion of the basic issues, every attempt will be made to examine these three categories on their own merits and not, for example, to limit in advance a technical discussion by a presently existing operational constraint.

Rule 4. The controlling purpose of study and research efforts will be firmly to qualify or dis-qualify various possible responses to the problems and issues that are identified. Accordingly it will be perfectly acceptable to arrive at "not possible" or "no fit" answers provided that such answers are well documented.

Rule 5. (a) At certain points some form of technical "solution" may be made mandatory to prove the incompatibility between a specific technical resolution and realistic, "real-world" action. These cases will be indicated by "re-cycle" loops within the program (Figure 6). (b) Behind this whole effort generally is a basic commitment to resolve the various issues that are identified. Solutions at the operational and political levels (as well as at the technical

level) are specifically desired as overall program output. Therefore (a) is a special case of (b) : resolution of the issues is the purpose of this program. To meet this requirement one should proceed as conventionally as it is possible to do in order still to resolve the issues. Faced with an impasse one should proceed from the least objectionable concepts towards the least acceptable, making only the minimum changes necessary to meet solution criteria.

Rule 6. In this program maximum use will be made of available information and research. Additional research should be generated (a) only when needed answers are not otherwise obtainable and (b) only in relation to the overall structure produced in response to Rule 1.

It is the nature of these principles that they guide not only the initial generation of the problem model, but the way it is used operationally, i.e., in the process of specifying and carrying out needed research. This use will become increasingly apparent as specific research tasks are developed.

2. Issues and Appositions

In studying housing, different points of emphasis are possible. In some previous studies what is really one among many possible points of view has unthinkingly been taken as the total scope of the problem. This is unfortunate because it misleads and misdirects investigation and corrective efforts.

In an attempt to avoid this in our study, all possible points of view have been called out first before any particular direction is fixed. This leads to what might be called structural comparisons - a review of all possible study directions apart from substantive or operational details.

Starting with the fact that there is a gap between what housing costs and what some people can afford to pay for it, one has choices on how to proceed. Problem-solving activity can either (1)seek to lower the cost of housing or (2) improve the consumer's capacity to pay for it. Although the specific research activity may be quite different (and may involve entirely different types of research teams) the basic objective is the same in both cases: to improve the consumer's position relative to the cost of the housing he needs.

In another approach it is possible to deal either (1) with the house as the physical thing through which symptoms of the so-called housing problem are manifest or (2) directly with the factors which seem to reinforce the visible characteristics of the problem. In the second case these factors may be approached by speaking of the process by which the housing of people is somehow accomplished with varying degrees of success and overall efficiency. If (1) is the product, then (2) is the production process which "makes" the product (not limiting this, of course, to the strictly physical manufacturing or construction processes per se).

A third contrast involves the basic premises of alternative housing studies. The housing problem can be approached either (1) by looking at the house as a physical thing, as an agglomeration of building materials which is part of larger community systems that are also physical in nature or (2)

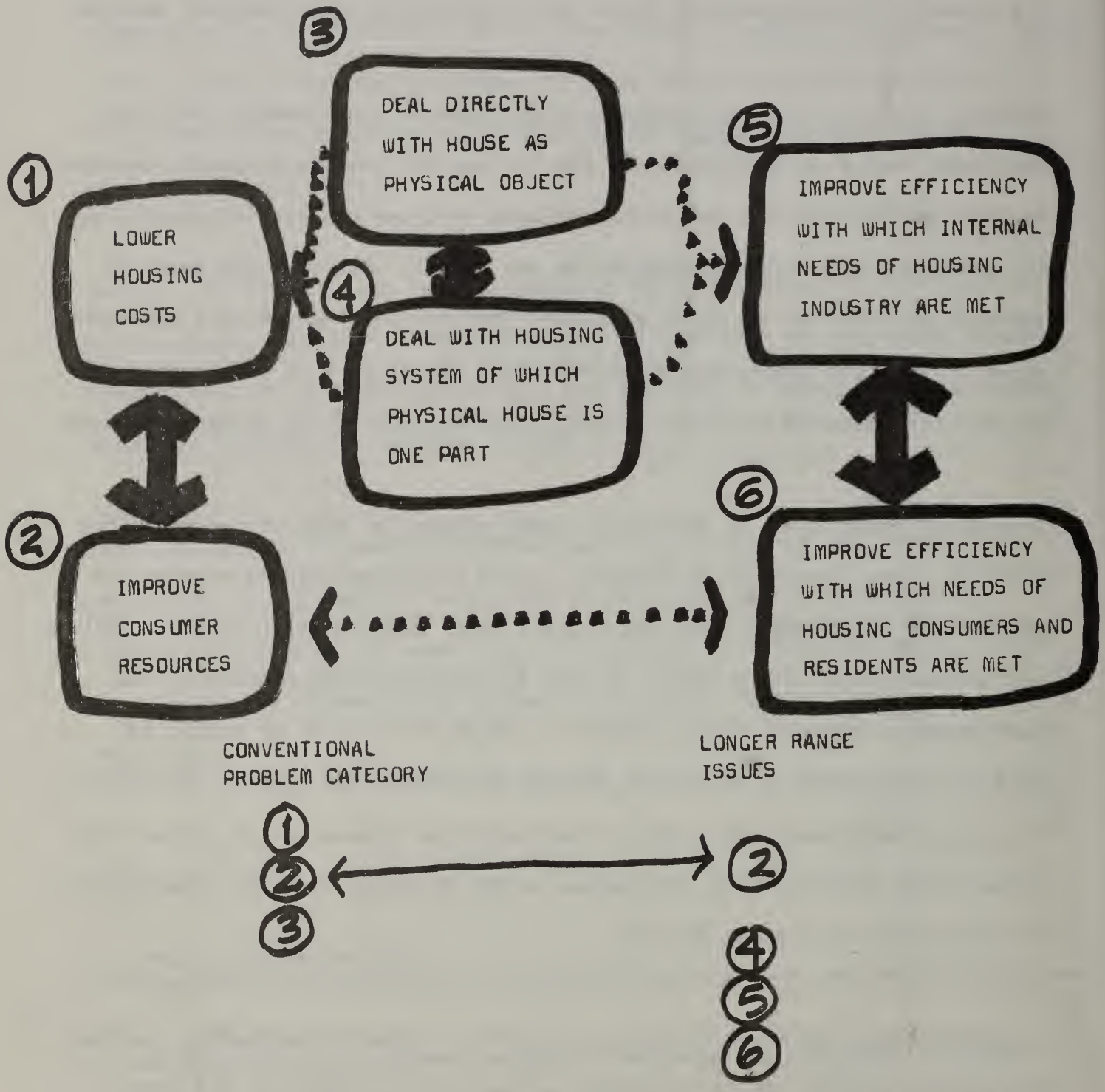


FIGURE 2: BASIC POSSIBLE CONTRASTS IN STUDIES OF HOUSING

by looking first at people who, as residents have a series of needs, some of which are met in the home, others of which are met elsewhere. In the one case success is measured by the efficiency with which physical materials are combined with one another, in the other, by the efficiency by which the total needs of residents are met. (Since this third pair of contrasts raises such intricate issues, it is useful here to point out that no value judgements about actual research are being made by this listing. This is simply an attempt to get the range of considerations before us. A rational selection process can come only after this groundwork has been laid.)

Finally there is the basic contrast between (1) a specifically problem-oriented approach to housing and (2) the commitment to working out positive performance of the housing system on a continuing basis. The first is essentially limited in time, associated with particular dis-functions, and is designed to go out of existence with the resolution of the particular problems at issue. The second is certainly involved with various current problems but within the context of future-oriented "preventive maintenance" for the housing system.

These four sets of contrasts are not mutually exclusive. They have what might be called lateral inter-relationships. These are indicated in Figure 2.

3. Six Aspects of Problem Model

By applying the six operating principles to the structure of contrasting

Definition of what type of housing has the lowest absolute costs

Identification of how housing can be afforded by those who need it

Identification of what technical methods it is possible to use in order to obtain generally better housing per unit of investment

Definition of the characteristics of housing for low income people

Identification of what procedures can be used actually to <u>provide</u> the kind of housing that is needed to those who need it

Given the fact that housing is only one among many inter-related parts of the fully functioning community, identification of what requirements this interdependence may exert on housing per se

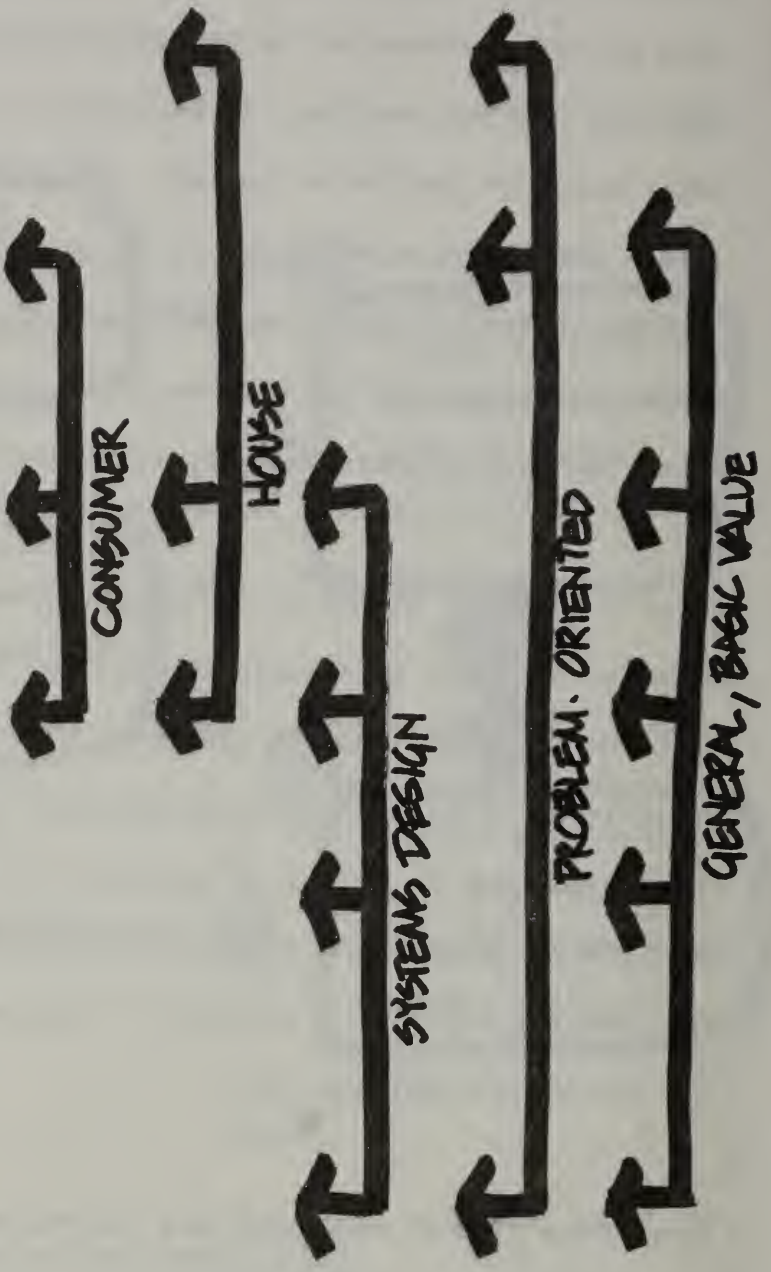


FIGURE 3: SIMILAR AND CONTRASTING ELEMENTS IN SIX ASPECTS OF PROBLEM MODEL

issues in Figure 2 we can generate a workable and practicable problem model. In order, this model would contain the six aspects shown in Figure 3.

To convert this basic problem model into a structure that is directly useful for research involves careful study and decisions. Rarely before has there been an opportunity to give this link in the problem-solving process the attention it deserves. The team felt that it was extremely important to do exactly this.

Accordingly the problem model was followed into its next several levels of detail.

"Lowest cost housing" is really the physical approach to the problem of housing. It states, in effect, that for some people there is a gap between the resources they have and the cost of the housing they need. The response to this situation is to attack the "house" side of the problem.

Various kinds of research have been occurring on the problem of housing costs. Some research is actually re-examining the basic relationships in housing that have gained traditional acceptance. In connection with these research efforts a number of ancillary relationships are also opened to re-examination. Generally, however, the useful application of such research is longer range than some of the other more conventional approaches.

There is a body of research along close-to-conventional lines that attempts to rid the house of superfluous and unnecessary costs through more complete knowledge of actual engineering requirements. The physical approach asks to what extent output from this research can help resolve the problem now identified.

An effort directed to enable people to afford the housing they need is, in effect, an economic or financial approach to the same problem. Cost-effective research on the physical aspects of housing may not be able to produce savings sufficient to remove the gap between consumer resources and housing costs. In fact one housing economist has made the point that even if the costs of the physical house itself could be reduced to zero, the overall reduction in cost to the consumer would still not be enough to make housing truly affordable.

It would be a liability, then, for a realistic effort at solving the housing problem to rely solely on identifying physical cost savings. There are a number of different strategies that could be investigated in order to solve the problem from the consumer's point of view. It is useful to identify the possibilities even if some of them, for one reason or another, do not fall within the mandate of the present problem-solving effort. It is necessary to note that it is the problem which is the real issue; the division of problem-oriented responsibilities between various agencies is largely an artificial one which should respond to real needs.

A concern with achieving better housing generally (measured by the benefit returned per unit of investment) is a concern that goes beyond particular

problem areas. The performance design approach is one of the strongest procedures for dealing with all the user, material, and manufacturing factors that are involved in housing. Using this approach, various competing constraints and benefits can be measured not simply against one another but against a standard for overall performance and service in meeting the valid needs of housing consumers.

Even though the terms are often used interchangeably "housing for low income people" may well be quite a different thing from "low cost housing" per se. There are several possibilities that make it relevant to raise this question. Two of these are immediately obvious; the first is that the needs of low-income groups are so different (for whatever reasons) that to approach the problem of getting them low cost housing in the conventional sense will not at all solve their acknowledged housing problem. The second possibility is that conventional measures of "lowest cost" are not very well related to the problem of housing cost that various low income groups have. It is conceivable, certainly, that the cost of housing should not be measured by physical costs alone. It is also conceivable that it is not possible to measure the true cost of housing at the point of "consumption" alone. If there is a single strong point that stands out from systems analysis techniques it is that the most significant indicators of system performance and cost are overall measures(assuming all components perform at or above threshhold levels of value satisfaction). But to take measures of component performance as proxies for the service of the larger system is clearly misleading.

The challenge to define "housing for low income people", then, is basically a social approach to the problem of housing. But it is a social approach

that is based in the rational accounting procedure of performance design. This elevates what has become a more-or-less popular concern with the social role of housing to an entirely different plane of discussion. At this level competing and conflicting social values can be compared and resolved on the basis of their actual influence on a total concept of performance.

The fifth aspect implies quite clearly that it is not enough to identify the kind of housing that best reflects valid performance concepts. It is still necessary to consider how such housing can actually be made available to those who need it. As a result the question is raised about alternative ways to organize the entire process that generates residential environment. Are there alternative ways it could be organized which would effect significant cost savings or make for a better application of investment in housing?

The sixth and final aspect is specifically concerned with the functional connection between housing and the other operating parts or sub-systems of a community. If . . .

- the physical costs of housing were minimized
- economic and financial factors were adjusted to aid the housing consumer
- general benefits from various levels of investment in housing were maximized
- the special needs of particular consumers reflected fully in design requirements for housing
- and if the process which generates residential environment were coordinated for maximum efficiency and cost savings

one relationship <u>critical</u> to the solution of the housing problem would still

remain to be examined.

Clearly the implementation of research based on the first five aspects of the problem model will affect specifically those locations having either or both

(1)physical housing conditions considered to be a problem

(2)low income people needing adequate housing

and other parts of any given community as well. It is necessary to ask what the effect would be of completely "solving" the housing problem as measured by criteria derived from the previous five aspects of the problem model alone.

Some urban analysts feel that the use of recommendations suggested by these five aspects would actually occasion additional, perhaps still more severe problems in the community. It is axiomatic that a system responds systematically to change introduced at any point within it and transmits that change throughout all connections within the system. This holds true for that especially complex organism, the community, as well as for other systems whose workings are better understood.

The sub-system for "housing" is one sub-system among many in the overall community system. It is mandatory to know how this larger system will react in the face of what will be major, significant changes in the housing component of that system. We know now only that this larger system is not particularly well organized to mend the massive dis-function that we call the housing problem. On this basis alone we should expect that solution of the "housing problem" will precipitate the potential for other changes. In order actually to solve the housing problem, it seems of the highest importance to know

the nature, direction, and magnitude of these related changes.

This is the general domain for each of the six inter-related aspects of the problem model. The next step is to determine how the conceptual organization in Figure 3 can be translated into an operational structure for research. The supporting detail in these last paragraphs will aid this process.

B. USE OF PROBLEM MODEL

The problem structure that the team has prepared is to be used not simply for making decisions about research (the most immediate need) but is to be used as well for evaluating and later applying workable research output. This extended application is derived from incorporating not one or two approaches to the housing problem but the six most fundamental aspects which adequately define the total scope of concern.

1. Description of Basic Research Structure

The six aspects in the problem model are given in the left column below as they were originally stated. Paired with them in the right column is the "short-hand" term which will now be used to represent these aspects.

Definition of what type of housing has the lowest absolute costs	physical approach
Identification of how housing can be afforded by those who need it	economic/financial approach
Identification of what technical methods it is possible to use in order to obtain generally better housing per unit of investment	performance design approach
Definition of the characteristics of housing for low income people	social approach
Identification of what procedures can be used actually to <u>provide</u> the kind of housing that is needed to those who need it	development process approach
Given the fact that housing is only one among many inter-related parts of the fully functioning community, identification of what requirements this interdependence may exert on housing per se	functional or operational approach

Using the several supporting paragraphs from section A-3 it is possible to translate this conceptual structure into an operational structure for research.

Figure 4 depicts the most basic operational relationships that link HUD's concern to actual areas of application using this program structure.

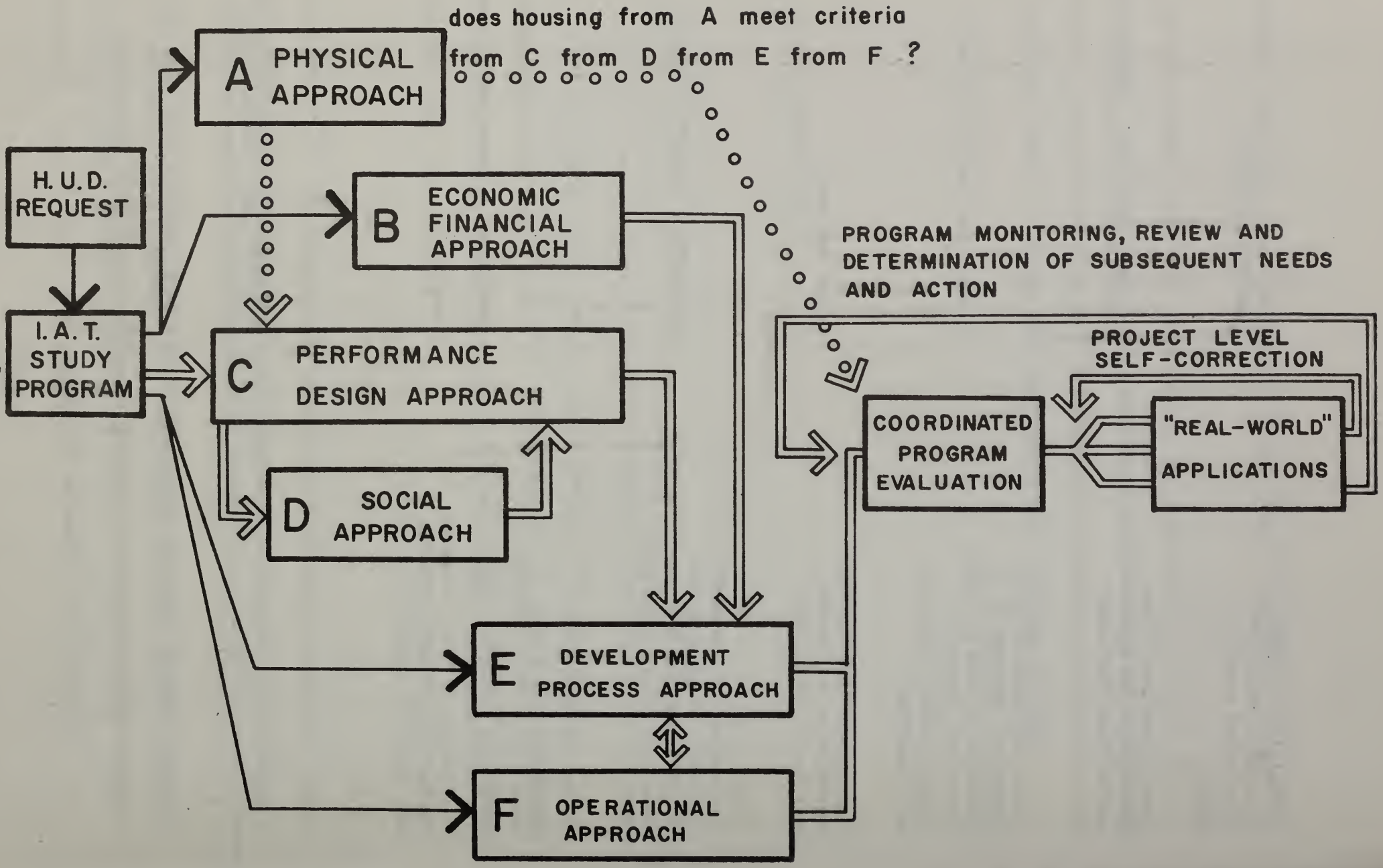

does housing from A meet criteria
from C from D from E from F ?
A PHYSICAL APPROACH
H. U. D. REQUEST
B ECONOMIC FINANCIAL APPROACH
PROGRAM MONITORING, REVIEW AND DETERMINATION OF SUBSEQUENT NEEDS AND ACTION
I. A. T. STUDY PROGRAM
C PERFORMANCE DESIGN APPROACH
PROJECT LEVEL SELF-CORRECTION
COORDINATED PROGRAM EVALUATION
"REAL-WORLD" APPLICATIONS
D SOCIAL APPROACH
E DEVELOPMENT PROCESS APPROACH
F OPERATIONAL APPROACH

FIGURE 1

2. Analysis of Relationships Within Problem

The next step in moving toward actual research efforts is to determine how issues are actually related to one another within each of these six aspects. What are the major "blocks" of considerations? For example there are many detailed questions about the use of different materials, yet all of these tend to be grouped together in relation to other major blocks - for instance, "user requirements" or "environmental factors" or "locational characteristics of the housing problem". If these major blocks can be identified and related properly to one another, then we can feel confident about the various detailed issues and questions on which judgements about research will be based.

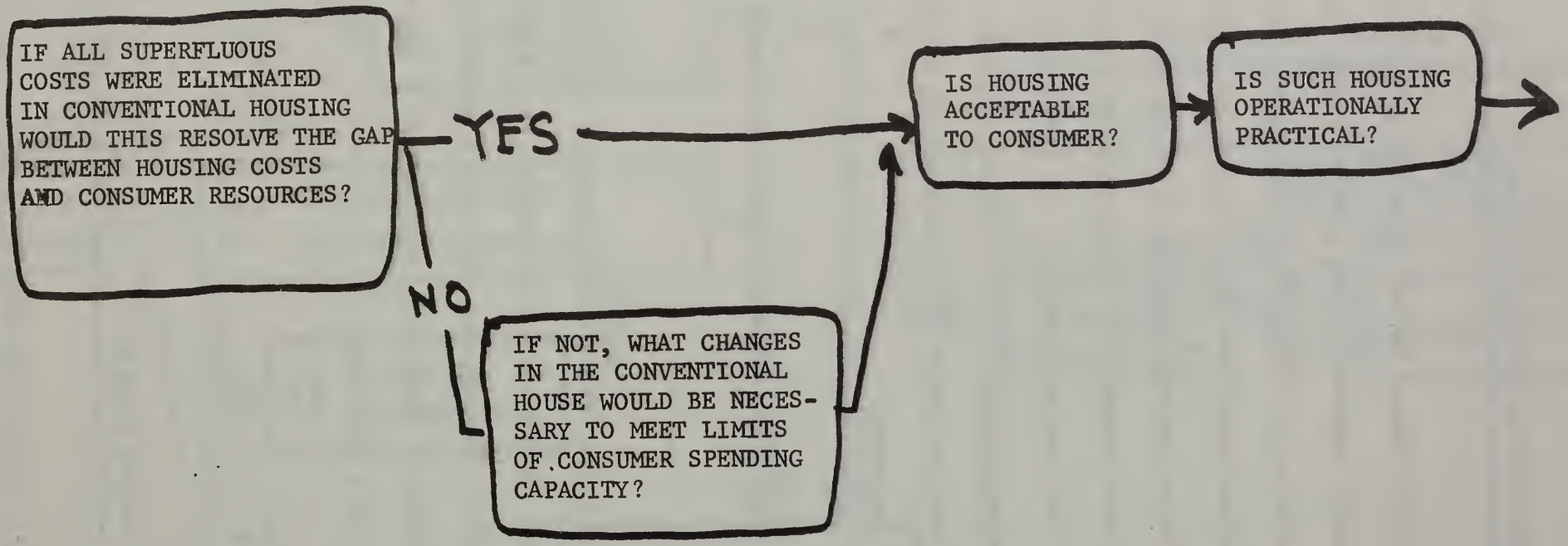
Figure 5 presents these major blocks for the six aspects of the program structure.

As we noted above, the next step in the sequence is to expand these major blocks into the fully developed program structure. Figure 6 is comprised of six separate charts, one for each of the six aspects, which contain this next level of detail. Operating rule number 2 was particularly effective in making this expansion.

(See Attached Charts).

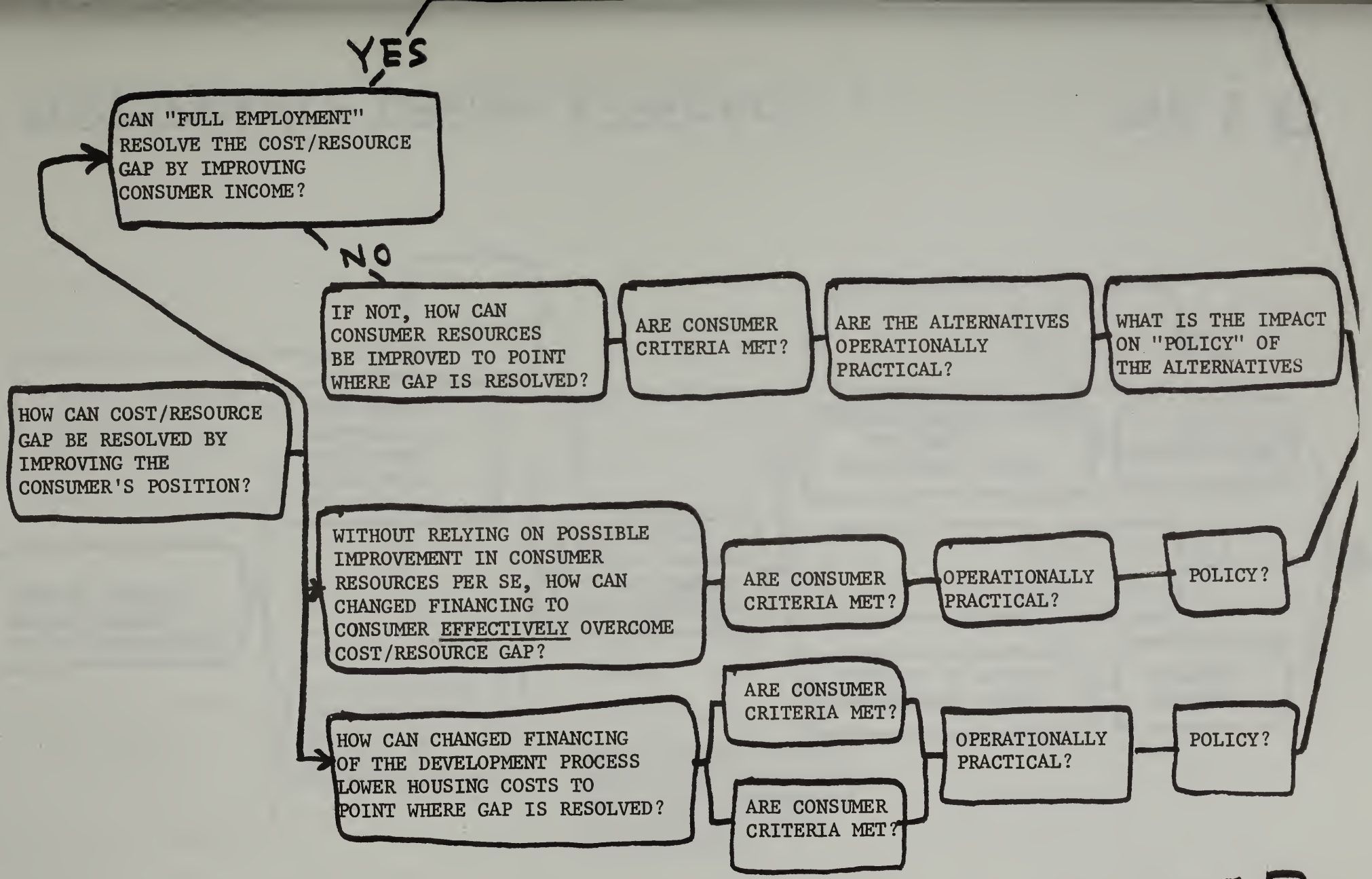
3. Prescription of Needed Research

Figure 6 was used as a working document by the team during its three month



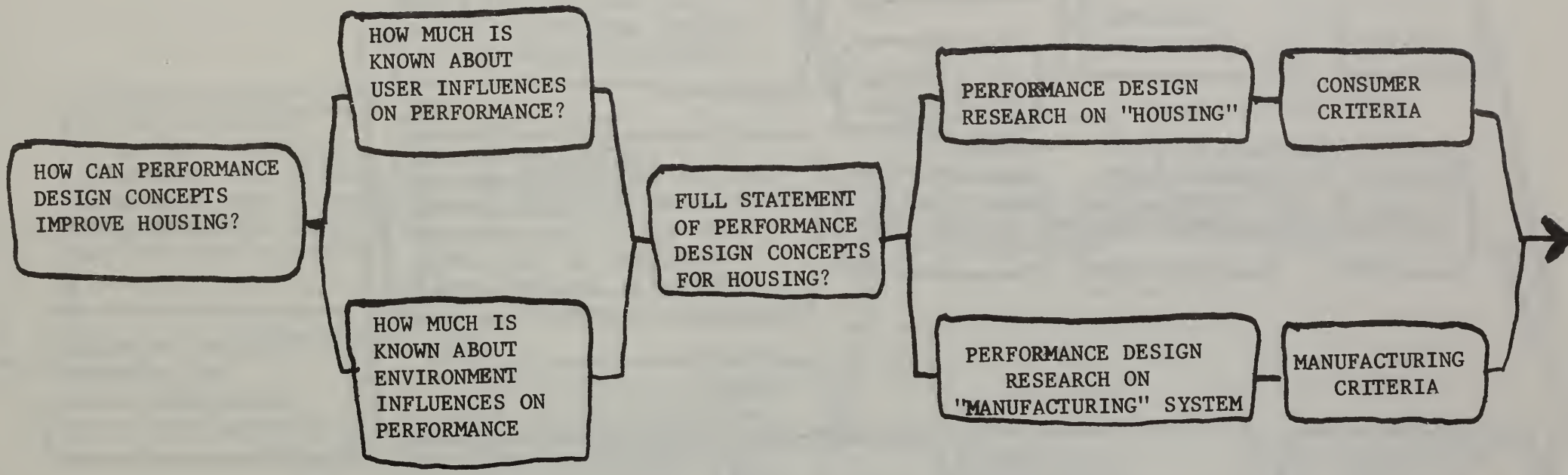
PHYSICAL APPROACH

FIG. 5 A



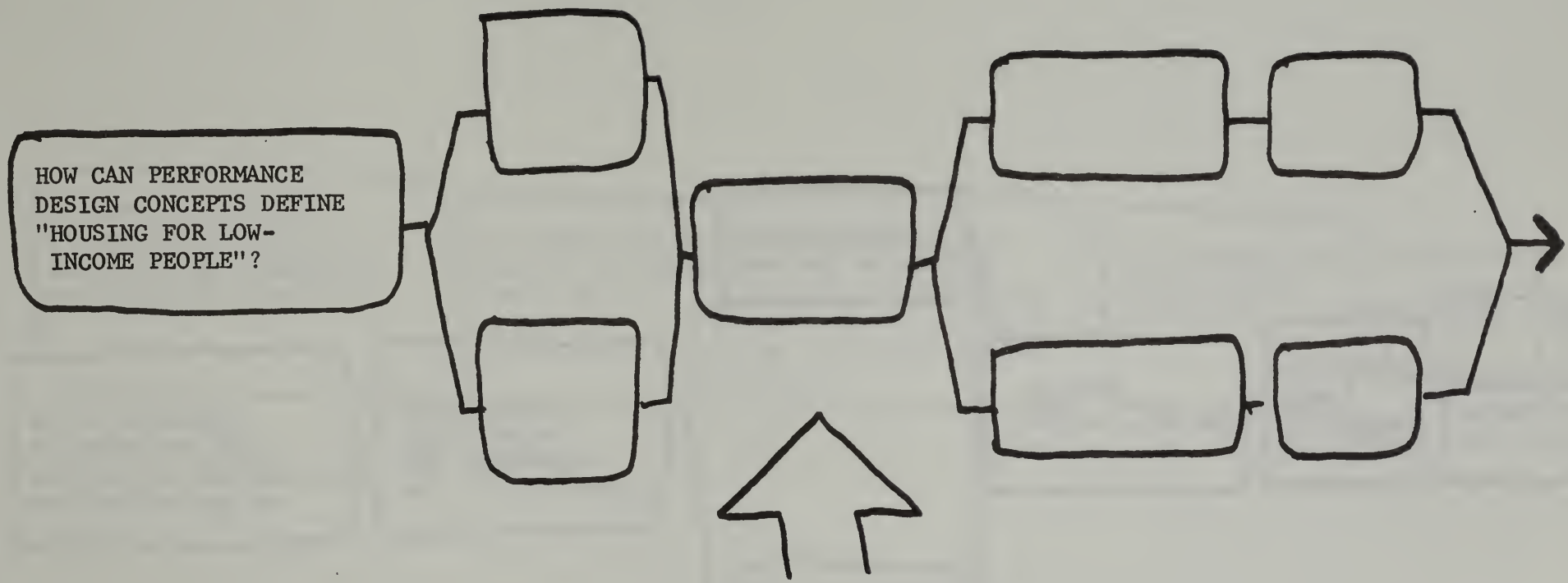
ECONOMIC/FINANCIAL APPROACH

FIG. 5 B



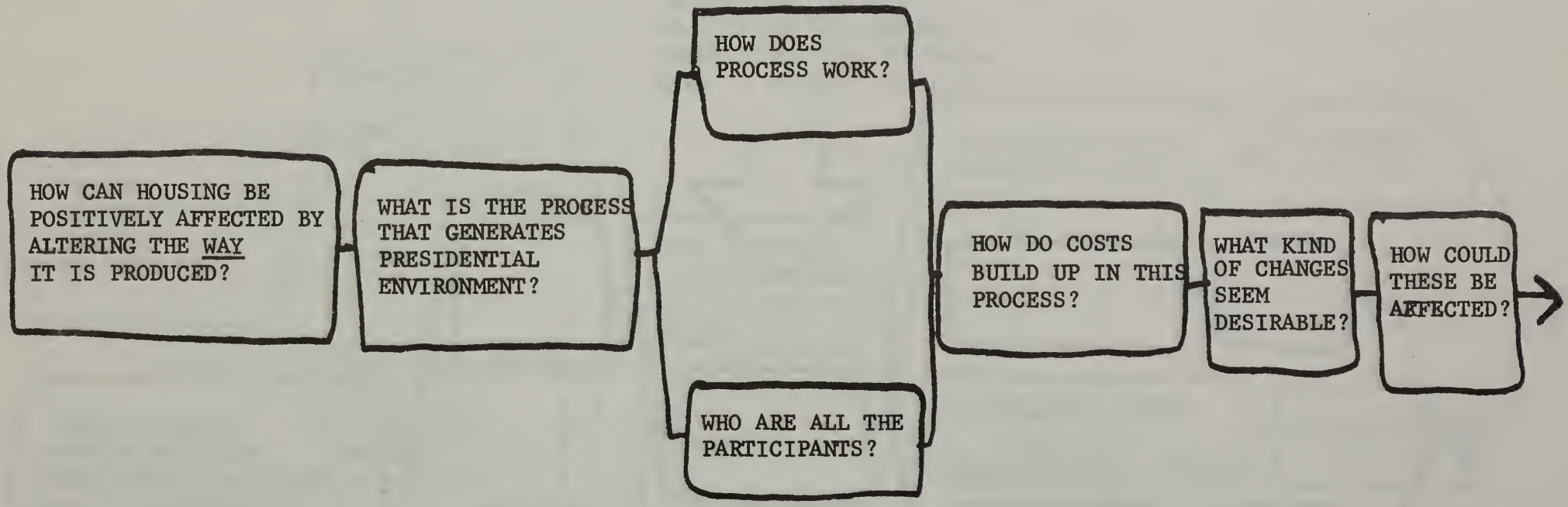
PERFORMANCE DESIGN APPROACH

FIG. 5



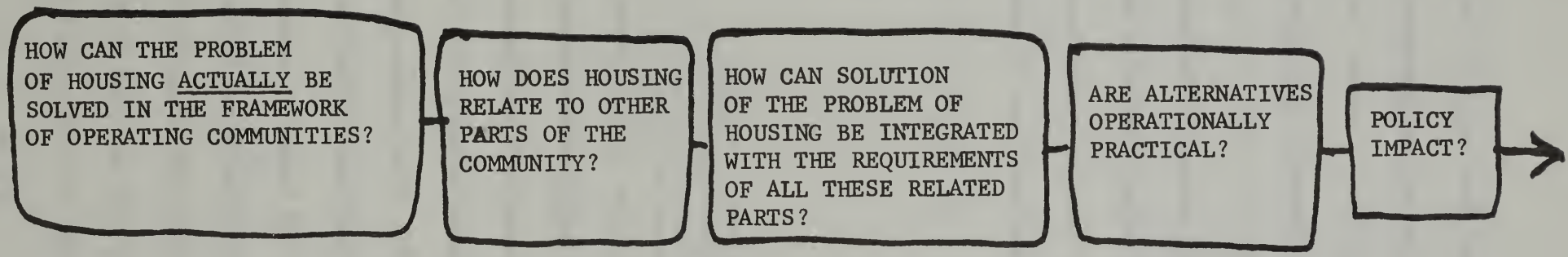
SOCIAL APPROACH

FIG. 5 D



DEVELOPMENT PROCESS APPROACH

FIG. 5 E



OPERATIONAL APPROACH

FIG 5 F

study. There are already answers for many of the questions raised in this series. Some of these are available from previous research while others come from practical experience. For certain other questions the team undertook specific studies in order to make useful decisions about needed research.

In the subsequent sections of this report the results of these detailed studies will be documented and related to this overall framework of issues. Once this has been done it will then be possible to prescribe exactly what answers are already available and what type of additional research may be required.

4. Operating Framework for Research Projects

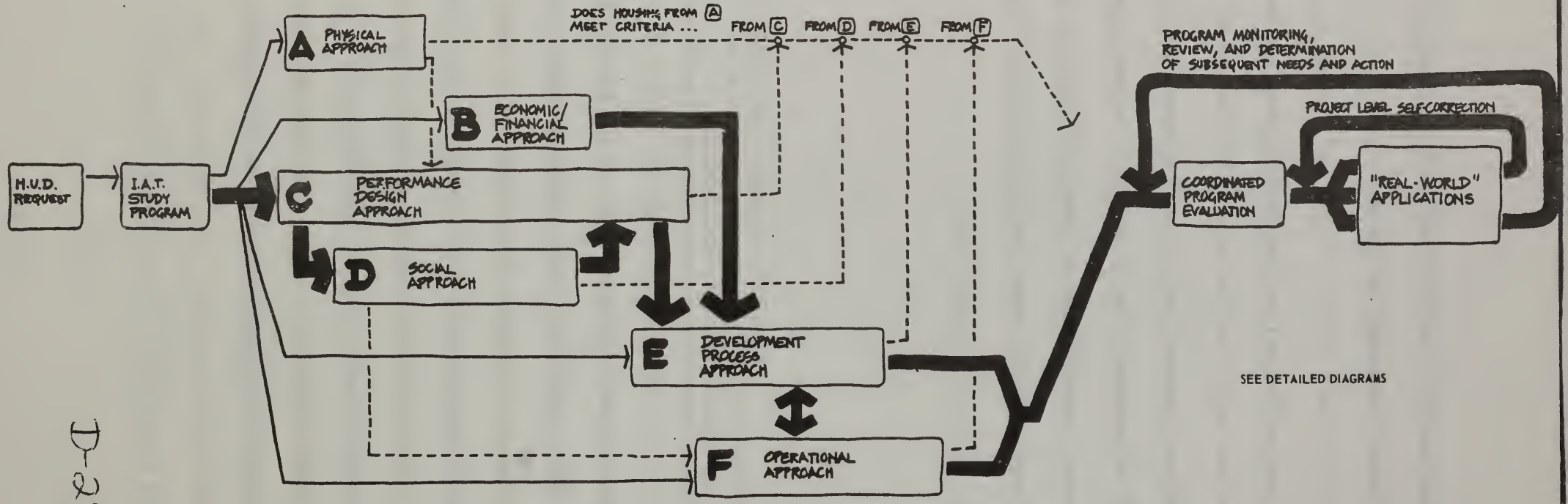
Figure 6 will have a direct relation to the research that will be required. Just as each level of detail in program development has been derived from the previous level, so will actual research programs be derived from the program structure in Figure 6. In order to administer a specific piece of research in a complex program, it is useful to prepare a task diagram using CPM techniques. If research were required to resolve the issues in one of the boxes in Figure 6, say box C-9, it would be possible to prepare a task diagram listing the specific tasks required to generate the answer and the sequence in which these tasks would occur. It is premature, of course, to expand Figure 6 into a detailed task diagram at this time, but it is clear (1) that this is a necessary step in making decisions about research

(writing RFP's and so forth), and (2) that such a step is entirely consistent with the material prepared to date.

A third point relating to the active research phase follows these two. Recommended research may well involve many different teams working individually on currently unresolved issues scattered throughout the program structure. Nevertheless it will be possible for a specific research project to be pursued in relation to a controlling framework (Figure 6) which closely corresponds to the "real-world" characteristics of the "housing problem". This is an extremely important capability.

5. Basis for Research Evaluation and Application

One final use of the program structure will be to evaluate the individual pieces of research with respect to their total potential impact on the problem. We recognize that in order for HUD to make realistic decisions about meeting housing needs, answers must exist for each of the questions raised in Figure 6. When all the research output is in hand it will then be useful to return to the basic issues identified in Figure 6. These issues should then be evaluated again as an integral part of the decision-making process leading to specific changes and action in the real world.


H.U.D. REQUEST
I.A.T. STUDY PROGRAM
A PHYSICAL APPROACH
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D SOCIAL APPROACH
E DEVELOPMENT PROCESS APPROACH
F OPERATIONAL APPROACH
DOES HOUSING FROM A MEET CRITERIA ...
FROM C
FROM D
FROM E
FROM F
PROGRAM MONITORING, REVIEW, AND DETERMINATION OF SUBSEQUENT NEEDS AND ACTION
PROJECT LEVEL SELF-CORRECTION
COORDINATED PROGRAM EVALUATION
"REAL-WORLD" APPLICATIONS
SEE DETAILED DIAGRAMS

APPENDIX E

IMPLEMENTATION OF THE PERFORMANCE CONCEPT IN REGULATORY AND ACCEPTANCE SYSTEMS SUCH AS THE MINIMUM PROPERTY STANDARDS

by

Russell W. Smith, Jr.

Building Research Division

National Bureau of Standards

CONTENTS

APPENDIX E

IMPLEMENTATION OF THE PERFORMANCE CONCEPT IN REGULATORY AND ACCEPTANCE SYSTEMS SUCH AS THE MINIMUM PROPERTY STANDARDS

INTRODUCTION

It is generally agreed that fully implemented performance-based systems for the regulation and/or acceptance of building products and procedures will speed the introduction of innovations and enhance the responsiveness of housing to user need satisfaction. Most proposals, to date, have viewed a performance-based regulatory/acceptance system as incompatible with its corresponding specification-based system and suggested that the one must be developed and implemented as an alternative to the other. Such total implementation has, of course, raised valid doubts that costs of development and implementation might outweigh advantages, and that problems of transition would be prohibitive.

This paper analyzes the functions and requirements of a sophisticated regulatory system, discusses the roles of performance in meeting these requirements, and attempts to show that an operational performance-based system is not an alternative to its equivalent existing specification system but a natural refinement and outgrowth of it.

Specifically, it identifies the various elements of a comprehensive performance-based regulatory system; identifies where performance criteria have, or do not have, a role in each element; and shows that existing specification systems are not only compatible with but have an essential function within the more inclusive performance-based system.

In essence, it suggests a step-by-step evolutionary growth from existing regulatory systems into a more sophisticated performance-based system as the proper implementation of the performance concept. The Minimum Property Standards regulatory system of HUD is examined as a proper vehicle for implementation and a phased program is suggested.

I. RATIONALE FOR PERFORMANCE CRITERIA

The over-riding objective for developing performance criteria is to enable the expression and measurement of both a requirement and of a solution in the same numerical terms. It is particularly valuable when:

1. there is need to examine existing or future solutions to determine how well they perform in meeting some specified requirement,

2. two or more unlike solutions must have their performance compared relative to some specified requirement,

3. a more precise (and economical) match is desired between a specified requirement and a solution's performance.

Each of the above objectives of performance criteria is valuable in the architectural framework, at points where choices between solutions logically occur. Thus, the importance of any performance criterion is dependent on the importance of the solution(s) it enables to be evaluated, and on the value to be derived by applying to the solution one of the above three evaluations. Obviously then, priority for the development of performance criteria resides in the importance of the item to be evaluated and/or in the need for the evaluation, within the existing architectural framework.

Requirements are normally generated from one or more of four basic sources which are:

1. Nature-oriented requirements imposed on the solution,

2. Community requirements imposed on the house (or housing) solution,

3. Occupancy requirements imposed on the solution,

4. Technical requirements imposed on the house (or housing) by the solution(s) selected to satisfy requirements 1, 2, and 3. These are essentially feedback requirements after solution selection

Requirements generated by each of these four basic sources may find application at different points, or levels, in the solution complex. For example, performance criteria for community generated requirements would generally contribute to evaluating total housing units; occupancy generated requirements generally to evaluating envelope and structure; and, technical requirements to widely dispersed points of system interface. Thus, possibilities will occur for evaluating the whole house, areas, rooms, systems, sybsystems, components, and interfaces, in terms of performance requirements. These requirements may deal with physiological, psychological, sociological, and technical needs.

II. RATIONALE FOR REGULATORY AND/OR ACCEPTANCE SYSTEMS

The over-riding objective of regulatory and acceptance systems such as building codes and FHA's Minimum Property Standards, is to attain solutions which correspond to or exceed requirements, whatever the intent of these requirements. Thus regulatory and acceptance systems and performance criteria share the same objective, which is the comparative evaluation of a solution in terms of a requirement as precisely as possible.

Where performance standards are available, and meet other regulatory constraints on their use, it is general practice that codes utilize them in their provision. Obviously, a numerical measurement of requirement and solution offers the most precise means of evaluating one with the other.

Where performance standards are not available, or there are constraints on their use, regulatory and acceptance systems attempt to specify solutions meeting the desired requirement by other means. Therefore, all regulatory or acceptance specifications which do not utilize performance standards may be thought of as substitutes which are used only in lieu of the availability of adequate performance criteria and their associated evaluative technique.

It would seem that it would be desirable, on a long term basis, to convert <u>all</u> regulation and acceptance provisions to performance specifications wherever possible. From the standpoint of fair and impartial evaluation of unlike or competing solutions this is probably true. However, from the standpoint of reasonable enforcement, such conversion to performance specifications is probably impractical in the forseeable future.

The question then becomes one of when, and where, it is desirable to introduce performance concepts into the regulatory and acceptance structure, assuming that the necessary performance criteria and evaluative techniques are, or can be made, available. Particularly important is the examination of this question in terms of the following separate and distinct functions:

1. fair and impartial initial evaluation,

2. establishing continuation of performance over time, and

3. enforcement.

A. <u>Use of performance concept for fair and impartial initial evaluation of the acceptability of solutions</u>.

It is patently obvious that performance criteria which express a requirement in terms of distinct performances with measurable numerical values, applicable to the solution, offer the optimal situation. Such criteria leave no place for arbitrary choice, and impose acceptance conditions in terms of accurately defined physical magnitudes.

While evaluative techniques that measure abstract performance requirements, such as health, safety, and welfare, are still not within our grasp, performance criteria can be developed to identify many of the major component requirements that comprise such concepts. Thus, these criteria are measurable with a measurement method that is directly applicable to evaluating solution compliance. For example, the requirement of safety and the safety performance of a house probably cannot yet be comparatively measured. It is possible, however, to measure in the same terms many, if not all, of the major contributing requirements of safety such as fire resistance, structural adequacy, etc. Performance criteria are, by definition in this report, criteria which identify these measurable attributes of a requirement.

Top priority should, therefore, be assigned to identifying and listing those performance requirements which in combination form the basic requirement objective of any given regulatory or acceptance system. Following this identification and listing of requirements, efforts should be directed toward developing performance criteria for each requirement, and evaluative techniques for each criterion, no matter how difficult or complex the measurement, either of the requirement, its criterion, or of the solution to be evaluated. This will result in the compilation of objectives, expressed as measurable requirements, which will serve as a "constitution" by which all other code functions of regulation and enforcement can be equitably judged.

With the formulation of a "constitution" stating objectives as requirements and incorporating performance evaluative techniques for each requirement, it will be possible to measure precisely the initial performance of any solution (whether system, component, or material). An innovation could, after an initial evaluation, be verified as meeting, or not meeting, at that time, all essential performance requirements of the system.

B. Use of performance concept to ascertain continuation of initial performance of solution over time.

After the initial verification of meeting requirements is made, it is then necessary to determine that the solution under evaluation will retain its performance acceptability over time. That all essential performances must continue over time is, of course, an inherent part of the regulatory function and is imposed on all regulatory requirements. Thus, durability is not a separate requirement, but is implicit in each and every other requirement to some degree.

Two possibilities occur for determining the durability of a required performance. One involves test procedures which accelerate the entire service environment which the solution being evaluated must face. The other involves test, or other procedures, which evaluate only those environmental factors and materials that are determined to be significant to the performance durability under consideration.

The first possibility implies the performance concept and is the more desirable since it simulates the entire environment and will uncover any performance deterioration or failure from unexpected and unpredictable causes. To be effective, however, tests must be available for the entire spectrum of environmental factors, whether significant for the solution under consideration or not. Anything short of a complete spectrum of tests would not suffice since each innovation brings with it individual characteristics, and thereby unexpected and unpredicted opportunities of performance deterioration. It is always possible a significant factor could be overlooked by a partial spectrum. Unfortunately a full spectrum of tests simulating total environment requires considerable test sophistication and will not be attainable for some time. Work directed toward this goal should be started immediately as a separate and distinct R&D effort of considerable magnitude.

Until the full spectrum of environmental tests is available, the precise overall evaluation of durability will not be possible. In the interim, the second alternative must be used and criteria selected on an ad hoc basis to predict the durability of required performances by predicting the durability characteristics of the properties and materials directly involved. Thus, interim criteria will relate more directly to the technology of the properties and materials than to an overall environmental technology.

Since the regulatory concern is that required performance be retained by the building, there are several approaches to evaluating and approving a solution relative to assuring its performance over time. These approaches involve:

1. determining that the solution will retain desired performances for the required time span, usually anticipated building life span.

2. determining that the solution will retain desired performance for the required time span, provided a program of periodic maintenance and repair can be assured.

3. determining that the desired performance can be retained for the required time span by periodic replacement of the solution.

1. <u>Solution oriented criteria for predicting performance continuity over building life span</u>.

Assuming all regulatory requirements have been met in an initial evaluation under consideration, it is necessary to establish, by additional criteria, that the performances will continue for the life of the building where failure would endanger the safety of the building. Performance over building lifetime is indicated for health and welfare performances where the solution is integrated in the building structure and inaccessible for individual consideration.

The criteria required to evaluate a solution's ability to retain a performance for full building life must relate to its use in the building and the availability of evaluative criteria to accelerate the aging process either for the total solution, or for its significant properties and materials.

Lacking the ability to reproduce physical tests for the total environment that a solution will encounter with a drastically accelerated time factor, some other type of evaluation criteria must be used.

Thus, the criteria that must be used to evaluate a solution's potential for retaining its performances on the basis of its composition, properties and materials will take one of three forms. It will:

a. provide evaluative techniques that simulate aging, such as accelerated aging tests correlated to specific compositions, properties, and materials,

b. provide specifications of durability based on empirical knowledge, or

c. be deduced by judgment from what is known within the innovation's technology.

The use of criteria of this type, individually or in combination, for the prediction of durability of required performance is the principal concern of the French and English "Agrement" systems and the Swedish "Declaration of Properties Committee."

2. Solution oriented criteria for determining capability for maintenance of performance of solution over time.

It is often impossible, or undesirable, to determine that a solution will continue its required performance over the full life of the building. When this is the case and the solution's performance can be reestablished by maintenance and repair, it is often more desirable from a regulatory standpoint to simply specify an inspection and maintenance routine which will maintain performance. Thus, maintainability and repairability may be substituted for building-life durability for any given required performance. This approach requires:

a. one of the three types of criteria used to predict building-lifetime performance continuity; used in this case to predict probable life expectancy or rate of performance deterioration, and thereby set maintenance and repair interval,

b. criteria for evaluating solution's in-place performance in terms of desired performance level; used to determine need for and/or effectiveness of maintenance and repair.

Obviously repair and maintenance can substitute for building-lifetime performance only where the solution is available for periodic inspection and the making of repairs will not endanger the safety of the building.

3. Solution oriented criteria for determining performance continuity by solution replacement.

Where the failure of a solution does not endanger safety, or is of a fail-safe design, complete replacement of the solution may be substituted for maintenance and repair. If performance failure is obvious, all dura-

bility requirements may be dispensed with and the solution simply evaluated for compliance with initial code performance requirements. If failure is not obvious, an inspection procedure may be required which will involve the same approach and criteria as for maintenance and repair discussed above.

C. Use of performance standards for enforcement.

Where performance standards utilize evaluative techniques that require a measurement or test method that is within the capability of the inspector to make accurately and easily, it is desirable that enforcement documents incorporate such performance standard. Where performance standards require complex measurements and test methods, the determination of a solution's acceptability should be made at a professional level where the highest accuracy is attainable. Specifications of the approved solution would then be provided the enforcement officials for direct comparison with construction being inspected.

The transition from performance to solution specification in the regulatory area is not unlike that which occurs in architectural design. Somewhere in the chain of design the architect translates the prose of performance objectives into rigid specifications, or blueprints. He chooses to do this at a fairly high professional level where the efficiencies of making the transition are highest, and below which the chances of misinterpretations and confusion are considerable.

If a steel erector would be hampered by a prose statement in lieu of a blueprint, so would a building inspector be hampered by a performance specification. Each need a detailed solution specification by which they can make a step-by-step comparison with the existing construction.

It can be established, then, that documents for regulatory enforcement must remain predominantly a compilation of specifications for acceptable solutions which can be used by local inspectors for comparative purposes. These criteria, to be useful as an enforcement tool should be as specific as possible and provide for as little interpretive judgment as possible. Inspectors should verify that solution specifications for materials and workmanship have been adhered to; they should not, as a rule, verify performance.

In essence, performance standards have no place at this level unless they can be certified by a simple, on site, evaluative procedure. If this is not possible, then the verification must be made at higher levels and a specification of the verified solution used as the enforcement criteria.

III. BASIC ELEMENTS OF A PERFORMANCE-BASED REGULATORY SYSTEM

As previously discussed, there are three major elements in a performance-based regulatory system. The first element establishes the initial conformance of a solution to objectives; the second evaluates the solution's continued conformance over time, and the third identifies acceptable solutions for enforcement purposes. Each of these major elements consists of several sub-elements which vary in complexity and the amount of research and development needed to introduce them into a comprehensive working system. An element-by-element analysis of a stylized system and a tentative classification of sub-elements follows:

A. MAJOR ELEMENT: Establishing initial conformance to regulatory objectives.

The major system element, establishing a solution's conformance to regulatory objectives, consists of a relative few requirements and performance criteria which make possible measuring each requirement as well as the response of the solution. The sub-elements, then, are:

1. listing of requirements, and

2. performance criteria that facilitate measuring each requirement in terms common to the solution.

Sub-element 1: listing of requirements

There are four main classifications of regulatory requirements which normally impinge on any housing solution. The first class includes those requirements which are imposed by the surrounding community and may relate to a total community complex, or relate to a single unit. The second class includes requirements imposed on a housing solution by the occupant, and the third class includes requirements imposed on the solution by nature, such as wind loads, etc.

The fourth class of requirements relates to the technical requirements of the solution(s) and may be thought of as a type of feed-back factor which varies from solution to solution. An example of a technical requirement would be where the decision to use a high pressure steam system produced, because of safety requirements related to protection from explosions, the requirement for a pressure release performance. A complication of technical requirements is that they often vary, as far as a single solution is concerned, with the other solutions with which it is used. Thus, the many interrelationships that occur between sub-systems all impose differing requirements on other solutions which must be taken into account in a feed-back network.

Each of the preceding four classes of requirements have identical sub-classes of requirements which are regulatory objectives such as health, safety, welfare, guaranteed value, or whatever the regulation seeks to achieve. They may be physiological, psychological, sociological or technical in nature. The format for classifying requirements which in essence forms a statement of objectives for any regulatory system is

shown below:

Classification Format for Regulatory and Acceptance System Requirements

I-Community oriented
- A-Health
- B-Safety
- C-Welfare
- D-Other

II-Occupant oriented
- A-Health
- B-Safety
- C-Welfare
- D-Other

III-Nature oriented
- A-Health
- B-Safety
- C-Welfare
- D-Other

IV-Technical (solution generated)
- A-Health
- B-Safety
- C-Welfare
- D-Other

The statement of nature oriented requirements in performance terms is a relatively simple task, occupant and community oriented somewhat more difficult, and technically oriented considerably more difficult. In the latter case, use of a computer is indicated and may be essential for effective introduction of this requirement into the overall system.

Sub Element 2: criteria for measuring requirements and solutions.

As previously stated, the effectiveness of a performance-based regulatory system rests on the ability to correlate a requirement and a solution by the use of a single compatible measurement. Thus, each requirement must be accompanied by performance criteria that are applicable to both the requirement and to the solution. The use and application of these criteria are adequately covered in Section I, Rationale for Performance Criteria, and elsewhere in this report.

The use of criteria at this level is to serve as the ultimate authority in determining the acceptability, relative to regulatory objectives, of any given building solution. Most evaluations will be in terms of total building systems or subsystems, and the associated test procedures will of necessity be extensive and expensive. Evaluation at this level will be confined to building systems of a specific type and the substitution of alternative components of such systems left to enforcement procedure. Exceptions will be when there is an appeal after

enforcement procedure rejects a component.

Another exception to the above statement is possible if Technical Requirements are developed to the extent where evaluative techniques are responsive to the effects of minor component variations. This of course presupposes extensive criteria and automatic data processing procedures build up over a long period of testing.

B. MAJOR ELEMENT: Evaluating a Solution's Continued Conformance over Time.

The major problem area in a performance-based regulatory system is in finding criteria to precisely determine the durability of a required performance once it has been initially determined to exist in a solution. The problem is increased because the element or component in a solution whose performance over time is questioned is often only a small part of the overall solution. Therefore, the development of criteria and evaluative techniques for the questioned innovation is seldom justified, unless it is generic in character.

The sub-elements of this major systems element are really alternatives for guaranteeing the continuation of required performance over time. They relate to: (1) predicting that the performance will continue over the required time interval, (2) determining that maintenance and repair will retain the performance and assuring that it will be accomplished, or (3) determining that replacement of the solution in question is feasible if its performance deteriorated.

Sub Element 1, predicting that the performance will continue over time is subdivided into three alternatives which are based on:

a. conformance of composition, properties and materials of solution to specifications known empirically to provide required durability,

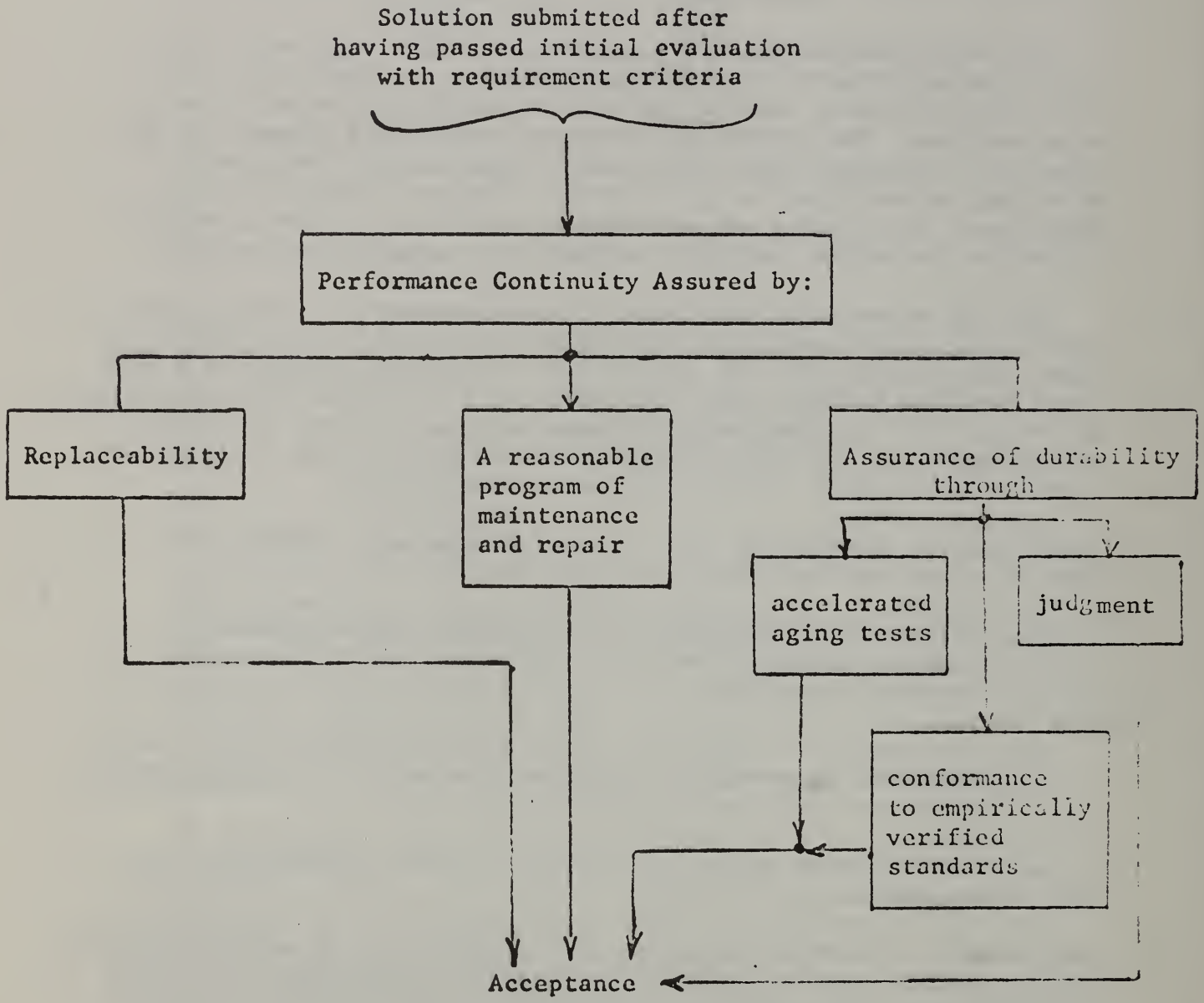
b. conformance to simulation criteria (accelerated aging tests) designed to establish requirement durability for the materials, properties and compositions involved, or

c. the composite judgment of experts in the technologies concerned.

Sub Element 2, determining performance continuity with maintenance and repair requires that in some way the required maintenance and repair be guaranteed. Thus this sub-element alternative requires that an estimated period of reasonable performance continuation be established on which is based, (1) a schedule of required maintenance and repair, or (2) a schedule of inspection to determine performance adequacy which presupposes criteria to test performance adequacy.

Sub Element 3 requires only determining that failure can be discerned when it occurs, since a requirement for this type approval is that failure not endanger safety.

A block diagram of the alternatives for the Major Element; Evaluating Continued Conformance Over Time, follows:



C. MAJOR ELEMENT: Identifying Acceptable Solutions for Enforcement Purposes.

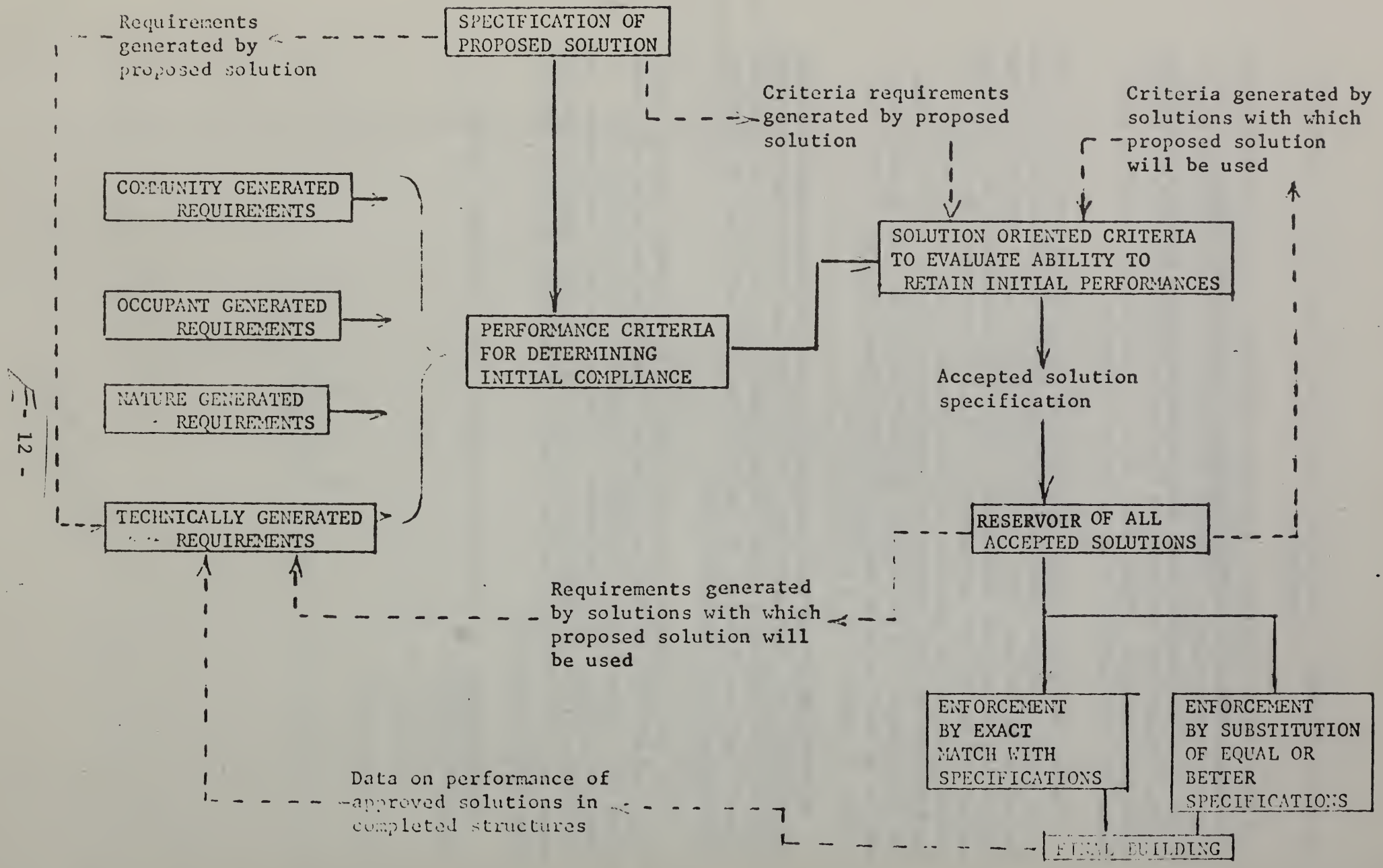
As in other regulatory systems, the product of a performance based regulatory system is a Specification of an Approved Solution. Such specifications provide detailed descriptions of the pertinent attributes of solutions that have been evaluated, with regard to meeting initial regulatory performances and the solution's ability to retain these performances. Thus, they serve as examples of approved solutions for the guidance of enforcement officials.

Deviations from the specification of an approved solution, in whole or in part, requires handling the deviation as an innovative solution. Two alternatives are open for the approval of such a deviation depending on its extent and character. The first alternative is, of course, subjecting it to full evaluation as a new and distinct solution. The second alternative involves the determination that the pertinent performance of the alternative solution is equal to or better than the performance of an already approved solution. The second alternative is particularly useful when the change involves a minor component or material in a complex system.

The determination that alternatives meet or exceed approved solutions can be the responsibility of the cognizant enforcement official. However, the innovator should always have recourse to a full evaluation if such an official did not feel the innovation met or exceeded existing approved specifications.

The specifications for enforcement of a performance-based regulatory system would not be too different from existing codes and specifications. The primary difference would be in the procedure for developing them. In a performance-based system both requirements and criteria would be established and published, giving manufacturers the opportunity to measure the development of their new products against them before submittal.

Relationships of the entire approval system are shown in the following diagram.


Requirements generated by proposed solution
SPECIFICATION OF PROPOSED SOLUTION
Criteria requirements generated by proposed solution
Criteria generated by solutions with which proposed solution will be used
COMMUNITY GENERATED REQUIREMENTS
OCCUPANT GENERATED REQUIREMENTS
NATURE GENERATED REQUIREMENTS
TECHNICALLY GENERATED REQUIREMENTS
PERFORMANCE CRITERIA FOR DETERMINING INITIAL COMPLIANCE
SOLUTION ORIENTED CRITERIA TO EVALUATE ABILITY TO RETAIN INITIAL PERFORMANCES
Accepted solution specification
RESERVOIR OF ALL ACCEPTED SOLUTIONS
Requirements generated by solutions with which proposed solution will be used
ENFORCEMENT BY EXACT MATCH WITH SPECIFICATIONS
ENFORCEMENT BY SUBSTITUTION OF EQUAL OR BETTER SPECIFICATIONS
Data on performance of approved solutions in completed structures
FINAL BUILDING

IV. TRANSITION FROM EXISTING TO PERFORMANCE-BASED REGULATORY SYSTEM.

While the rationale of a performance-based regulatory system is impeccably logical and desirable, its full implementation will result in a body of regulations of unknown and unproved effectiveness. Thus, there is the very real danger that some of the protection provided by existing code and other regulatory system specifications may be lost, at least initially, in a full transition.

A full transition will, in addition, require that all regulatory objectives and requirements be established by extensive systematic analysis; performance criteria developed to express each, and a capability established to evaluate both existing and potential solutions to generate a body of approved specifications.

One of the problems presented by a full transition is that present codes and national regulatory systems often deal with requirements that are known empirically to be problem areas, rather than with statements of general objectives. Because of this, the broad objectives of a performance system would have to be carefully correlated with existing requirements to ascertain that there would be a continuity of protection relative to these empirically determined trouble factors. This is illustrated by an estimate that 50% of some current code provisions are directed toward providing for the performance maintainability of existing systems, again empirically determined.

An alternative to full transition to a performance system is a gradual transition based on the existing system. In this approach the objective requirements are deduced from existing requirements and established for them, rather than independently established by extensive systems analysis. The objectives determined by this method relate only to existing regulatory provisions. In a full transition the objectives established would be ideal and might, or might not, relate to existing provisions. In essence a gradual transition establishes requirements and performance criteria for what is now regulated, while a full transition establishes requirements and criteria for what the regulatory system should regulate. The gradual transition progresses from the present state-of-the-art while the full transition progresses from the theoretical optimum.

Several distinct advantages are believed to accrue from a gradual transition. First, there is minimum disruption of administration; second, there is continuity of protection while the new system is being debugged; third, the objectives established relate only to what is now being regulated where ideal objectives might unnecessarily broaden the scope; fourth, analysis of existing practice is considerably less difficult and costly than analysis establishing a theoretical optimum; and fifth, only innovations seeking admittance to the system would have to be evaluated.

It is therefore recommended that a gradual transition be used which corresponds to the following step-by-step plan:

Step 1 - Systematically analyze existing code provisions item by item to identify the basic code requirements that each is intended to provide for.
Step 2 - Combine, condense, and classify the requirements identified in Step 1 to obtain a concise statement of code requirements.
Step 3 - Identify or develop performance criteria for each requirement identified in Step 2.
Step 4 - Establish evaluative procedure for processing innovations so that they may be evaluated in terms of regulatory requirements through established criteria.
Step 5 - Establish procedure for establishing over time continuity of performances approved through Step 4.
Step 6 - Establish procedure for disseminating and incorporating in enforcement procedure approved specifications.
Step 7 - Perform the necessary analysis to add those requirements which will complete the "constitution" of regulatory objectives into the theoretical optimum.

The chief advantage of this approach is thought to be in that it does not require the initial reevaluation of approved solutions or disrupt current enforcement of approved specifications. At the same time, it provides for the development of performance criteria from existing provisions and the equitable evaluation of new solutions submitted for approval.

This arrangement allows existing approved solutions to continue to be approved and provides the innovation with the same concessions to perfection that are granted existing solutions. However, this is on an interim basis and should not be construed as providing a "grandfather clause" which gives existing approved solutions continuing acceptance. In step 1 through 6, evaluation on a performance basis will be restricted to innovations and to those requirements now covered in provisions. With the implementation of step 7, not only innovations, but existing solution specifications as well, will have to be evaluated for conformance to all the broader, more scientific, performance based requirements. The transition can be a gradual, requirement by requirement, conversion related to effectiveness priorities and may, in fact, never require complete conversion.

A chart showing a suggested analysis procedure for accomplishing Step 1 and Step 2 is attached which provides for the possibility of automated data processing. This is intended to show a methodology for deducing objective requirements from existing provisions rather than as a proposed format. (See attached chart).

V. IMPLEMENTATION

It is believed that the FHA's MPS system could offer an excellent regulatory system for an extensive effort to develop a performance based approach. Steps 1, 2 and 3 can be completed in a short time. The

immediate pay-off of this effort would be the establishment of a "constitution" of performance requirements as a basis for all subsequent MPS approvals. Steps 4 and 6 could be contracted for, or accomplished by HUD, concurrently or could be deferred for sequential action if desired. Step 5 is of necessity sequential and must wait for the completion of Steps 1 through 4. In addition, the R&D associated with Step 5 will be highly dependent on the character of solutions submitted. Step 7 should be deferred until all other steps have been proved and are operational.

VI. CURRENT STATE OF ART

The state of the art relative to performance-based regulatory systems is currently focused almost exclusively in the European Agrément systems. These Agrément (translated approval) systems are designed for the assessment and approval, on an interim basis, of building innovations. In most countries that are members of the European Union of Agrément, the objective of Agrément Certification is an interim approval, usually three years, which is in lieu of and outside the normal approval systems.

Basically, the Agrément scheme is directed to products and components which are innovative and incorporate new materials or non-traditional procedures. Its Certificates are in effect performance ratings where the utilization, manufacture, and composition of the product, as well as the test methods and conditions are all rigidly specified.

Where there are sufficient approvals of a recurring or generic nature, criteria are established for both the significant performances and the evaluation tests and procedures. Such established criteria are then published to provide the basis for assessment. The European Union members publish adopted performance criteria as "Common Directives" which are mutually agreed to by all members.

When Common Directives are issued, they are used by all countries for evaluating related products and issuing certificates. This establishes a common evaluation method but does not insure approval by all countries since regulations and pass/fail limits vary from country to country.

The European Union has produced the following Common Directives to date:

Construction in large prefabricated heavy panels;
Flooring;
Housing in light construction;
Housing of light construction in wood;
Light cladding;
Non-traditional flooring in reinforced or prestressed concrete;
Plaster partitions; and
Windows

Working parties are currently drafting directives concerned with doors, partitions, roller shutters, and prefabricated chimneys. In

addition, assessment criteria are generated by the issue of any Agrément certificate since the procedure for appraisal is stated therein, whether it is covered by a Common Directive or not. Thus, criteria developed by the Agrément effort would find direct application in a performance based code system.

In addition, Agrément criteria would serve as a useful subject for analysis relative to identifying basic code requirements. Outside of the Agrément effort, little if any progress has been made in applying the performance concept to regulatory systems.

VII. AGRÉMENT AND ITS IMMEDIATE UTILIZATION POTENTIALS

The European Union of Agrément is a performance-based approval system, and as might be expected, the more significant European expertise and capability, relative to performance criteria, is expressed therein. Thus, the Agrément documents represent the foremost European state-of-the-art in the use of performance criteria for the approval of building materials, components, and systems.

Since the Agrément approval system has been proved viable and is operational throughout most of Europe, its performance-based approval criteria are available for immediate conversion, or incorporation, into performance-based acceptance standards for use in the United States. In many cases substitution of equivalent U. S. test methods and validation of acceptability limits is all that is required.

The most immediately useful performance standards of the Agrément system are the Common Directives, eight of which have already been adopted and four additional are undergoing adopting procedure.

The purpose of the Common Directives is to provide mutually agreed upon performance criteria for evaluating any building product falling within the Directive's category. Each participating country then follows the test procedure in these common directives in making evaluative assessments. This means that evaluation data generated in one country has equal value in all and enables transfer of approval data from one country to another with ease. Approval is not automatic, however, since Common Directive test methods simply provide a uniformly accepted method of rating performances. Each country retains the right to establish its own pass/fail limits on the approved rating scale. Thus, an acceptable rating in one country may not be acceptable in another. The Agrément system is used only to approve non-traditional methods and materials.

Another purpose of the Common Directive is to establish a standard published basis for assessment in order to give manufacturers an opportunity to measure the development of their new products against the performance requirements they must meet. It is estimated that any of the 12 Common Directives now available could be adapted for use in the U. S. in approximately six months and at nominal cost.

While only a few Common Directives have been adopted, a large number of approvals have been made and Agrément Certificates published. Each of these approvals has been based on meeting performance specifications which have been assembled, or developed, on an ad hoc basis to meet the evaluation requirements of the product under consideration. Thus, each approval has generated performance specifications, all of which have potential application in the U. S. Many of these specifications have relative narrow application, while others doubtless have wide application and will find their way into performance standards and ultimately into Common Directives.

Obviously, evaluation of these specifications for use in the U. S. will require careful study of both the criteria and of potential usage. Since this is true, they probably could not be made acceptable for use in much less than a year. Cost would be contingent on the amount of test development that was required to supplement that already available from Agrément for any given evaluation area.

Agrément certification, each containing data derived from some degree of performance specification, have been made in the following areas:

Partitions,
glues for inlaid floor,
light facade panels,
wall and ceiling plastering,
certain facades (rolling curtain sun shade),
water-proofing material,
walls,
timber flooring,
floors,
structural systems,
connections for rigid PVC sanitary distribution pipes,
flooring,
roofing,
pipes for sanitation and waste,
flues,
masonry,
houses,
wall cladding,
drying cabinet,
roof,
glues,
pipe (PVC),
equipment (sanitary)
interior wall covering,
trapped waste pipe for sink (polyethylene),
sanitary pipe joints,
elements for bearing walls and panel infilling,
leveling coat for flooring,
internal wall finish,
inlay floor underlayment,
parquet flooring,
glue for thin stone interior flooring,
windows,
bearing hollow floor block,

building system,
support for waterproofing,
joinery,
cross wall,
light house (polystyrene panel),
light wood house
industrial roofing,
kitchen sinks,
school building system,
skylights,
heating equipment,
etc.

Each of the preceding categories may contain from one to a hundred or more individual approval certifications. In some categories all products are evaluated on a more or less standard set of performance while in other categories performances tested vary widely with differences in individual products. Limitations on usage vary from product to product.

The Agrément System offers a valuable, and extensive, source of criteria, procedures and experience relative to the performance concept, much of which has some direct and immediate application in the U. S. While it is established to handle only the temporary approval of non-traditional innovations its evaluative techniques have much broader implications. Unquestionably it represents the largest resource of performance criteria for building available today.

At present the Agrément concept stands somewhere between a performance-based regulatory system (as discussed in this report) and existing specification type regulatory systems. While it performs in much the same way, and produces much the same type product, that the approval segment of a performance-based regulatory system would perform, it has not yet reached this status. This is because the Agrément evaluation is not based on any overall performance regulatory requirements nor does the approval certificate imply the meeting of all existing regulatory and/or approval requirements.

The product of the Agrément system is the approval certificate which rates a building product's performance capability, for a specified use, under specified limitations and control conditions. It neither implies that all required regulatory performances have been met nor does it imply that the performances would be equivalent for alternate uses and conditions. It does provide the necessary data for limited approval under specified conditions.

Possibilities for utilization of the present Agrément resource are:

1. The immediate adaptation and introduction of the 12 Common Directives as U. S. performance standards.

2. The compilation of additional criteria from approvals and its adaptation to formulate 10 to 20 additional performance standards and their introduction.

3. The adaptation of the Agrément system for U. S. approvals in essentially its present form.

   a. Study, adaptation, programming, and planning.

   b. Implementation

4. **The adaptation of the Agrement concept as the approval segment of a comprehensive performance-based regulatory system when done as** a part of the Performance Concept Building Code Implementation package proposed elsewhere in this report.

None of the four possibilities for utilization discussed above are mutually exclusive or would the costs of implementing all be cumulative. Implementation cost of possibility 1 or 2 would be included as a part of the cost of implementing possibility 3 and to a lesser degree as a part of 4. Simultaneous implementation of possibility 3 and 4 would incur a cost not significantly greater than that of implementing either separately.

In conclusion, the Agrément system is considered to offer the largest known resource of performance requirements, criteria, evaluative techniques, specifications and standards for building materials, components and systems. The early, and full, utilization of this resource as a base from which to develop U. S. performance-based standards, regulatory systems, and approval techniques should enhance their effectiveness and decrease both the time and cost of development. In addition, the procedural problems overcome, and lessons learned, in introducing the fully operational Agrément system can be invaluable.