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This report discusses the relationship between an architect and a behavioral scientist. Some of the discussion applies to this cooperative work for design of buildings. The bulk, however, relates to the cooperation of architect and behavioral scientist while conducting research. Examples from collaborative research at Alaskan military installations are cited which demonstrate the roles and contributions of the two disciplines.

PREFACE

This report was prepared by C. Burgess Ledbetter, Research Architect, of the Applied Research Branch, Experimental Engineering Division, U.S. Army Cold Regions Research and Engineering Laboratory. The research was funded by DA Project 4A762730AT42, *Design, Construction and Operations Technology for Cold Regions,* Technical Area A3, *Facilities Technology/Cold Regions,* Work Unit 005, *Habitability of Cold Regions Military Facilities.* This report is written for the architect and behavioral scientist engaged in or considering cooperative research.

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COLLABORATION OF ARCHITECT AND BEHAVIORAL SCIENTIST IN RESEARCH

C. Burgess Ledbetter

INTRODUCTION

Research in environmental design investigates the environment to develop fundamental knowledge, methods of investigation, or knowledge pertaining to specific environments. In this report the roles, approaches and contributions that the social scientist and architect are able to make to environmental design research will be examined.

Research is often classified as being either basic or applied, and the researchers in these areas often have fundamentally different views. The ramifications of this division are greater than many realize. Basic research in environmental design is concerned with the acquisition of knowledge and building theories that are applicable to many environmental circumstances. Applied research in environmental design is concerned with the investigation of an environment to obtain criteria for specific design applications.

Basic and applied research are not mutually exclusive. Much of the advancement in science has come from lessons learned from implementing applied research. Theories and methods of investigation provide the applied researcher with tools to do his work, guidelines for investigation, and ways to interpret what is observed.

PERSPECTIVE OF THE RESEARCHERS

Social science studies have been based on, for the most part, basic research and have been written as such. But social goals, best addressed by the social scientist, are sometimes incompatible with the traditional, structural, material, and esthetic goals of the designer. The designer requires applied research results written in a language that he can quickly understand. This discrepancy has been a major stumbling block to effective environmental design.

Altman[1] presents a three-dimensional framework in which the basic researcher (e.g. social scientist) and applied researcher (e.g. designer) operate. This framework consists of 1) a process-oriented vs criterion-oriented approach, 2) analysis vs synthesis, and 3) knowing and understanding vs doing and implementing.

Altman states that the architect and applied researcher are criterion or problem oriented. Their work begins with meeting the known requirements, such as a building to accommodate a given number of people. On the other hand, the basic researcher proceeds in a different way. He looks at the independent variables and works toward the dependent variables. The architect synthesizes different parameters, such as plumbing, building codes, psychology, etc., into a viable entity, whereas the basic researcher follows an analytical strategy and thus dimensionalizes phenomena. The architect is action-oriented to immediate goals, whereas the basic researcher devotes energies to understanding rather than action. The need for the basic and applied researchers to understand each other's frame of reference and to formulate a basis for communication has been recognized by many authorities including Bechtel,[7 8] Canter,[10] Conway,[12] and Ostrander and Groom.[26]

The translation of basic research findings to results of applied research requires, in most cases, new studies. The designer, trained to think in terms of physical space and to communicate primarily through visual means, finds great difficulty in dealing with the media of the social scientist. These media include the precise use of language aimed at minimizing ambiguity. (The word "aim" is used to indicate that the precision in social science communications is generally less than that of the natural sciences.)

According to Martin,[24] definition in the natural sciences is accomplished by divorcing phenomena from man's experience. Therefore, connotative meaning is excluded and denotative meaning is carefully transformed into quantitative form. In contrast, definition

in the social sciences is more difficult. Martin states that the social scientist must manipulate a complexity of relationships which are not as easily reducible as those in the natural sciences. The social scientist must accept the connotative activity of words and phenomena, define them as much as possible, and communicate by devices such as example and comparison.

The distinction between basic and applied research is vitally important to a novice architect or social scientist. The architect is accustomed to translating literature from the natural sciences into terms of physical space: formulas for calculating building loads and characteristics of building materials are stated in quantitative terms. Ironically, in an attempt to simplify complex phenomena, the social scientist has produced a literature that is too esoteric for most architects to understand, much less to utilize in their work.

Most research in environmental design has been written as basic research. Consequently the architect-practitioner, as well as architect-researcher, have had considerable difficulty understanding the significance of basic research studies. Reizenstein[28] concluded from her random survey of 144 architects and planners that 78% were aware of the field of environment-behavior research and 87% felt the field dealt with material of professional concern to them. However, 79% felt that the research information was *not* in a form helpful for decision-making. The significance of the problem is evident.

IMPACT OF DESIGN ON BEHAVIOR

For a variety of reasons interest in incorporating social and psychological concerns into architecture is increasing. The man-made environment encapsulates society for the major part of each day. Man-made environments in severe climates are particularly good illustrations of how these structures influence the users' behavior. Withdrawal, alcoholism, marital problems and other symptoms of what cold region inhabitants call "cabin fever" flourish in the arctic communities[20] (the "cabin" in this term refers to any shelter used by man). Other isolated and confined environments tend to create behavioral problems similar to those found in cold regions.[20]

While management of these environments probably contributes more than design to the welfare of the inhabitants, it has been found that management itself is influenced by architecture. For example, formal and impersonal organizational management is often cited as a major cause of employee behavioral problems.[22] [27] When the inhabitants of a community do not have contact with those who manage them, formalism and impersonal management of that community often result. In these instances, achieving a sense of community is very difficult. This can be alleviated by constructing informal gathering areas that managers must pass through to go about their daily activities. These areas greatly increase the chances for informal management by allowing frequent contact between the managers and their subordinates, allowing business to be conducted more informally. In settings not accommodating such meeting opportunities, it is up to the managers to seek out the inhabitants to achieve the informal contact. Architectural spaces fostering such meetings will be explained in greater detail below.

The impact of architecture on inhabitants has been recognized, but architects are not yet fully addressing the issue. Architectural programmers* are establishing design guidelines related to organizational behavior, and furniture suppliers are providing engineering guidelines based on human factors. Architects are being pressured by these groups to consider the guidelines, but are resisting these pressures. At a 1975 AIA conference in Aspen, for instance, the consensus was that guidelines were not including related attributes affecting the physical space in question.

Architects would be more satisfied with the work in this area if it were done by more design-oriented people. One solution emerging is the growing number of architectural schools that are expanding their focus from "architecture" to "environmental design." Conway[12] states that concern with the fine art of style and aesthetics is waning in academic settings, and that architecture is being viewed as a social art which has significant impact on human behavior and attitudes. He also states that, since environmental design is considered a social art with a limited background of design theories, it requires further research.

A second solution to the problem of unifying the effects of social scientists and architects is a byproduct of the recent economic slump: the necessity for many architectural firms to consider research as a way of providing income. Research is becoming a lucrative field for architects, with funds available from the government and a variety of foundations.

**Architectural programming is the initial state of design planning in which the management, operations, human needs and goals of the client organization are developed. Design is based upon this program.*

HOW SOCIETY IS CONCEPTUALIZED

The growing importance of environmental design requires development of new theories and methodologies based on research. This research, utilizing the social sciences, is beginning to explore the conceptual relationships between society and environment. It has also called for a re-examination of the concepts that affect the development of these techniques.

According to Altman,[1] environmental research is influenced by four "models of man": 1) the mechanistic model, 2) the perceptual-cognitive-motivational model, 3) the behavioral model, and 4) the social systems and ecological model.

The mechanistic model of man is found in human engineering (sometimes referred to as human factors) research. The user is viewed as a task-oriented organism. In this model the environment is designed to fit the user's capabilities for sensing, processing, evaluating, interpreting, and responding to environmental cues. Motivational and emotional states are of secondary importance and are treated as factors which affect the person's "system-like functioning." This model of man is very useful for design of machinery and instruments with which the user must have a close relationship. The operator is in fact designed into the operation of a machine. Such concern also should be considered an integral part of the design of all building hardware such as bathroom facilities, door handles, handrails, etc. An example of this type of architectural research is Kira's study of the bathroom.[19]

The perceptual-cognitive-motivational model of man[24] currently dominates environmental design research. Its roots are in the early days of psychology when "introspection" research was introduced. Here man is conceptualized in terms of internal processes which include 1) perceptual reactions to the environment, 2) motivational and emotional status, and 3) cognitive responses. Architects with inclinations toward research are quick to adopt this model because of the abundance of measurement techniques and theories.[7 33] Furthermore, the model is attractive for it appears to offer an understanding of personality. However, predictions of behavior based upon this model are only slightly better than predictions by chance.[15] Measurements of the modal personality of a culture seldom represent more than 35-40% of the population.[32] The descriptive, objective physical dimensions are more accurate indicators of environmental influence on behavior than the "phenomenological or personalistic" terms.[33] Application of the semantic differential[11 13 16 29] and cognitive mapping[14 23] are examples of research using this model.

The third model of man,[1] the behavioral model, emphasizes overt as well as internal (subjective) states of behavior. Detailed observations and catalogs of people's movements and activities in the environment are made. Barker,[3] Barker and Gump,[4] Barker and Wright,[5] and Sommer[31] are noted for research on this model. Examples in the next two sections will demonstrate research representative of this and the fourth model.

The fourth model of man is the social systems and ecological model. Here, environment and behavior are viewed as being closely interrelated and mutually impacting on each other. This model also describes dynamic man-environment relationships that occur at several levels of behavioral functioning, including all those of the previous models.

COLLABORATION IN RESEARCH

If one assumes that the quality of research is a function of its scientific validity, and the utility of research is a function of its applicability, there exists a dilemma. The dilemma concerns the differing philosophical orientations to environmental issues of the social scientist (basic research oriented) and the architectural researcher (applied research oriented). This results in different approaches to a problem. The social scientist follows an analytic strategy, breaking down the whole into individual parameters which are studied in detail; the architect synthesizes various parameters (criteria requirements) to create a whole. Altman's three-dimensional framework explains these differences in orientation.

This framework suggests a pattern for environmental design research that could provide criteria for both scientific validity and application of results. Ideally this pattern requires research collaboration by the social scientist and architect-researcher, or at least the development of a workable theory or concept by the architect-researcher for specific design application.

Evidence is accumulating that supports the value of this collaboration.[2 12 25] However, seldom have the collaborative experiences of a social scientist and architect been documented for the novice architect and social scientist to help them understand the process. This is the objective of the following example of research conducted by an architect in collaboration with a social scientist.[9 21]

AN EXAMPLE OF COLLABORATIVE RESEARCH

A research project, conducted jointly by the author and R. Bechtel,* focused on habitability of cold regions

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**President of the Environmental Research and Development Foundation, Kansas City, Missouri.*

military and civilian communities.[9] Habitability for this study was concerned with those environmental factors that influence the physical and emotional well-being of the inhabitants. The environmental factors included the interrelated parameters of building design and layout, management of the community and its various organizations, and operation of the facilities.

The methodologies used in the habitability study came from Altman's "behavioral model of man" category[1] and Barker's behavior settings.[3] The application of these methodologies dimensionalized the environment into distinct units of behavior settings. This allowed the environment to be studied analytically. Settings were characterized by the people involved in the setting, and the times that the setting occurred. Overlap of the settings was measured, and the degree of this overlap determined whether two potential settings were separate settings.

As the first step for basic research and also the most fruitful step for applied research, it was necessary to determine the desirable characteristics of a military cold region community so that a design could be developed for enhancing those characteristics. The community needed to be dimensionalized, each part being investigated and the whole reassembled. Only in this way could the fundamental characteristics of a cold region community be recognized and significant factors isolated.

This first step demonstrated that, among a variety of community dimensions (including work, recreation, education, and housing) at a large military installation, it was family housing that stood out as having the greatest influence on habitability in a community. Arriving at this conclusion required an extensive behavior setting study which dimensionalized the entire community. When comparing all community settings it was found that most inhabitants spent the greatest amount of time in family housing; family housing was also found to be the richest setting. (Richness of setting is defined here as a measure of the varieties of behavior multiplied by the number of people times the responsibility levels of each of the occupants – richness is then a measure of the desirability of an environment.) The richness of family housing settings was twice that of the remainder of the post.

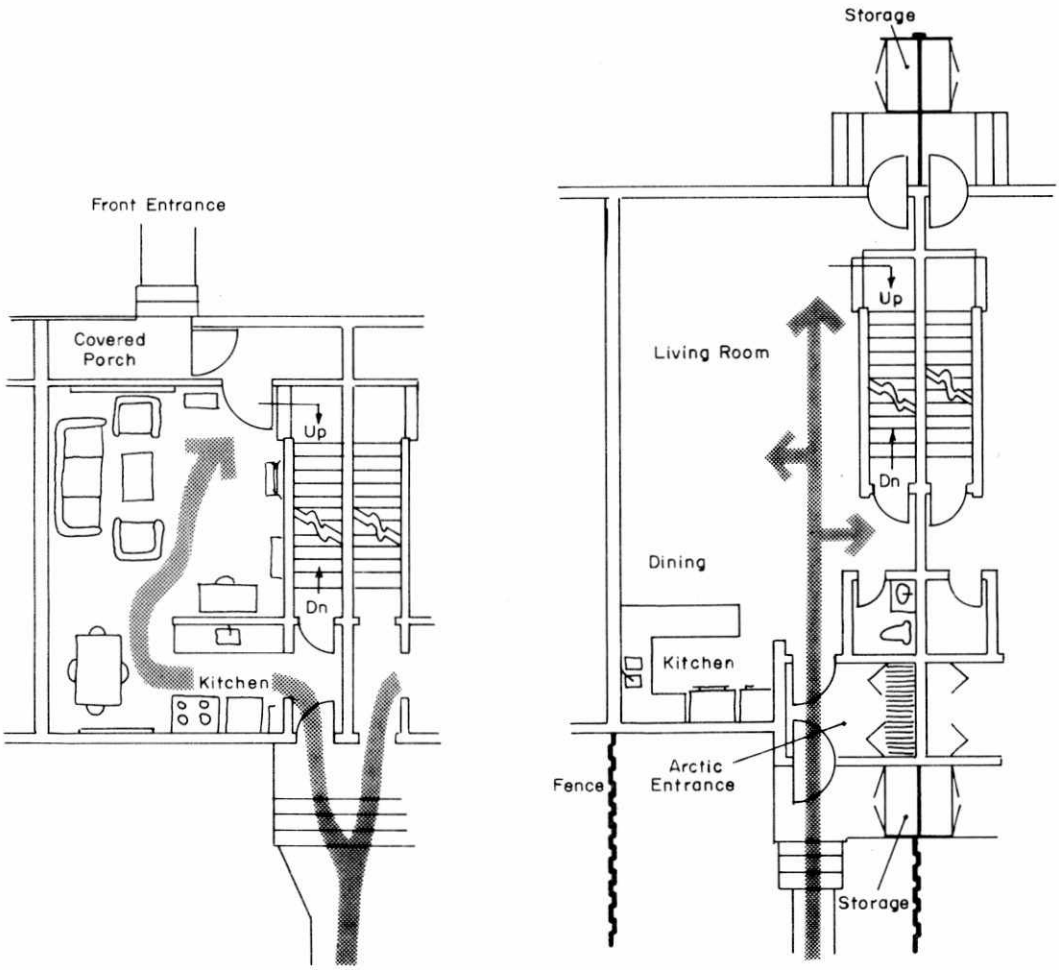
For analysis, the family housing settings of Fort Wainwright were removed from the composite score; this adjusted score was compared to the scores of small, remote and isolated civilian and military stations in rural Alaska. Only when the family housing settings of the large military installation were removed did the small isolated stations score greater in richness.

Further analysis of the data pointed out a significant aspect of family housing: recreation. This included hobbies, watching TV, entertaining visitors, etc. With only the family housing settings removed, the large military installation scored lower in recreation than the small isolated stations. Recreation within the home then was singled out as the most prominent aspect of family housing which accounted for habitability. There were also less prominent activities, such as home study (education) and the military man's preparation for field duty (professionalism).

Application of a social science methodology provided the guidelines for architectural research on family housing settings and recreation within the home. Architectural analysis of the family housing units revealed numerous barriers to recreation, including misplaced entrances, interruptive traffic patterns, and the absence of features fostering recreation. For example, family housing units at the large military installation were built so that visitors were compelled to enter the rear door, which was situated closest to the parking area (see Fig. 1a). This entry had no accommodation for hanging coats or removing boots. Visitors had to walk through the kitchen to reach the living room. Children requiring the bathroom also followed this path, crossing the middle of the living room to reach the stairs leading to the single bathroom upstairs. There was no space for a family room or hobby area.

The design shown in Figure 1b is offered as a possible solution to the problems of the family housing units. The rear entry is accepted as the primary entry, and an "arctic entrance" (a series of 2 doors enclosing the vestibule) with a closet is provided. The traffic flow skirts the kitchen and enters the living room along the same side as the stairs. The unused front entry, formerly containing a covered porch and "arctic entrance," is used to enlarge the living room, and a half-bath is provided on the first floor. The entry to the basement is made more accessible, thus allowing easier use of the basement as a family room when appropriately finished.

The analysis of housing to accommodate certain activities is within the professional designer's purview, but the isolation of those activities requiring special designs is beyond the technology of traditional architectural practice until training guides are available. In general the programmer and designer are interested in such information and how it applies to specific design projects.



a. Existing unit.

b. Proposed renovation.

Figure 1. First-floor plan for an existing family housing unit at a large military installation, and the design for its proposed renovation. Heavy lines indicate the typical family's traffic pattern.

The social scientist can caution the programmer and designer about architectural generalizations that might be incorporated too repetitively into settings. Using research results, he can establish the conditions under which the design guidelines are to be applied for certain social and behavioral situations. For example, the generalizations about design for recreation within family housing settings were applicable only to a specific cold region community. Although 78% of the military family's time in housing settings contained some form of recreation, only 24% of the time for occupants of family housing in small, remote civilian stations was occupied in this way. The remote site civilians were cold region volunteers whose use of outdoor space and participation in community affairs were significantly greater than those of the temporary military inhabitants. It is interesting to note, however, that the interiors of the military family units were very similar to those of the remote civilian inhabitants.

RELATIONSHIP OF RESEARCH AND METHODOLOGY

Although methodology usually determines the process of investigation, research can often influence methodology. In the cold regions investigation, Barker's behavior setting survey[3] with data gathered primarily from observation would have been impractical. The research method that was finally selected emphasized interview data, records data and random sampling, in addition to limited observation. This significantly shortened the data collection procedure and increased the number of communities possible to study within a limited budget.

The modifications of the behavior setting survey were allowed because the level of detail of the methodology originally specified was not required for this application. In other words, to determine factors for habitability, the degree of data specificity was less than that required for Barker's work. For example, if utilization

of an activity at one location is 21 times greater than that of a similar activity at another location, the significance to the architect of that variation is the same as if the difference were only 20 times. Here, the significant factor is the *reason* for the variance, not its precise value.

Therefore, the methodologist can assist the applied researcher by selecting the most appropriate methodology and by outlining the conditions under which it can be used. If the methodologist is unaware of the applied researcher's needs, this often leaves the applied researcher with the task of interpreting and modifying the methodology for more efficient and appropriate application. The same can occur in the use of theories or concepts, and unless the applied researcher is very careful, the results are the same – poor quality applied research.

The concept of office landscaping, introduced into the U.S. in 1964 by the Quikborner team, is an example of misapplication of theory. Howard[18] discusses how this management concept, facilitated by design, has been turned around to imply that design, with emphasis on hardware, determines management. According to Howard, the application of a concept intended to increase corporate reorganization and efficiency has been reduced to the notion of furniture's influencing work habits. As a result of the misapplication of the concept and its goals, Howard maintains that office landscaping is less effective.

It is not known whether the concept would have been distorted as much if it had been applied differently, but the lesson is obvious: the modifications of concepts, theories and methodologies should be closely qualified and monitored for their continuing reliability and validity. Also, reliability checks should be run constantly during field applications to verify the accurate use of the methodology, concept or theory, either modified or unmodified.

RESEARCH WITHOUT COLLABORATION

Previous discussion has concentrated on research collaboration of the architect and social scientist. Aside from social insight, the social scientist provides a scientific method for accurately obtaining a rich data base. The architect provides practical application experience of results. The combination of quality data and application experience usually results in greater utility. But what can be done by the social scientist who must work alone?

While theory building is the goal of most social scientists, the majority of those in environmental design could probably spend more time making the methodologies more applicable to architects and, in particular, to the needs of the architectural programmer. For example, the behavior setting survey was far too cumbersome to be used in the cold regions habitability research. Smith's review of behavior setting work in a comparative study of small communities[30] states that cost and labor are far too great in proportion to results obtained. Yet this methodology is important to the designer because it can account for the physical characteristics that the designer can control, as they relate to the needs of the occupants and their activities.[17] It provides information to the designer on how he should affect control of the physical characteristics.

Therefore, if a behavior setting survey can be shown to be a useful methodology, a social scientist can adapt it for more efficient application. Instead of forcing an architect to spend time in modifying the methodology, checking the modifications, and verifying results, this work can be done in advance by the social scientist.

An architect who must work alone can spend his time taking an environmental design theory or concept that has strong design applications and demonstrating, in publishable form, how it might be implemented. A concept that will suffice is Barker's focal point. The focal point is the most central behavior setting in the community. It is the place where the greatest variety of people naturally congregate, mingle, and therefore gain maximum interaction with others. Barker and Wright's study of a small town identifies a drugstore as the focal point, and a front porch is the focal point of the Friendly End Community Center in Bechtel's low income housing project.[6] In situations where it is not feasible to relate all community settings to the focal point, it may be necessary to portray them about two or more "micro-focal points."

At the three remote Alaskan military installations investigated in the cold regions habitability project, the officers' lounges functioned as micro-focal points. A comparison of the lounges reveals interesting data that the architect-researcher can develop for specific design situations encountered by the programmer and architect.

Comparing the occupancy time of the officers' lounges at these stations revealed a broad discrepancy. Although the lounges had similar potential populations, people did not spend a proportionate amount of time in them. After accounting for various factors, including seating capacity and cost of amenities, it was determined that orientation of the lounge to the hallways influenced its utilization.[21]

Figure 2 shows the location of the three lounges with respect to the hallways. All the lounges were within officers' quarters. One lounge was situated on the second

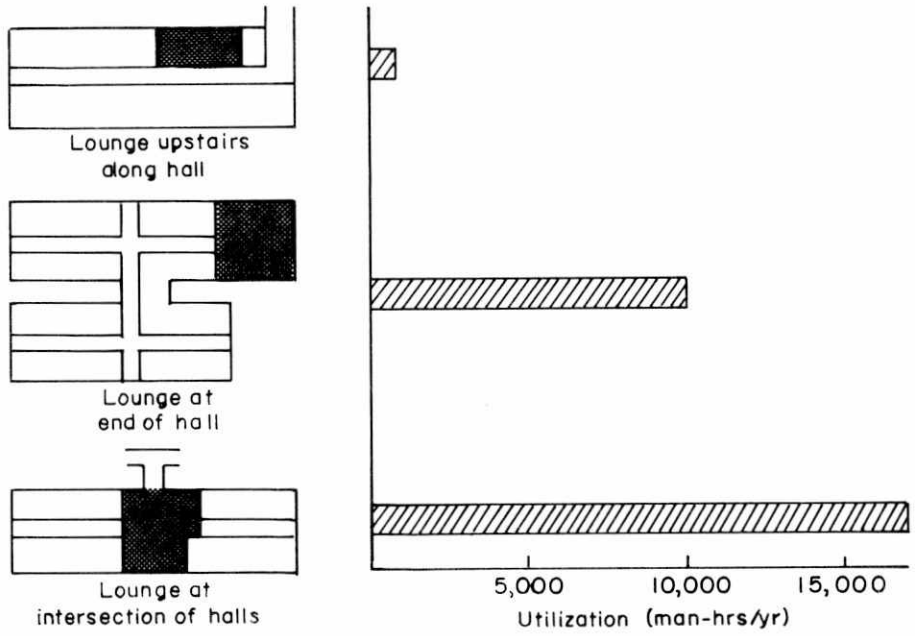


Figure 2. Utilization of officers' lounges at remote Air Force AC&W stations.

floor, another at the end of a corridor, and one at the intersection of several hallways. To the right of the drawings is a bar graph showing the total man-hours per year spent in each lounge. Orientation to hallways influenced informal contact and the opportunity to engage in conversation. In this case the lounge at the intersection of hallways was used 21 times more than the upstairs lounge. Although it took only a few seconds to walk across the lounge at the intersection, seldom would anyone pass through it without stopping to talk to others.

Using the concept of focal points, the architect-researcher can demonstrate to the programmer and architect the facility's potential utilization and its value to the users. From the prediction of behavior (in this case lounge utilization), furniture, materials, and the size and location of the space can be better determined.

The concept of focal points can have broad application to architectural design. The architect and programmer can advise a client as to placement of lounges, lunch counters, reception areas or other facilities to maximize their utilization. For example, the architect-researcher could select several motels from two of the major motel chains along interstate highways. The motels would have similar facilities such as a coffee shop, restaurant and bar, and they would service similar groups of people. Several hours of observation at different times of day might show broad discrepancies in utilization of the coffee shops. The number of customers entering the lobby but avoiding the coffee shop might be tabulated, and the following parameters could be used to account for any differences found: price of food, time required for service, access to the coffee shop, distance from lobby, and full or obscured view of the coffee shop from the lobby. If architectural features influence utilization, as the concept being described suggests, and support for this is presented with drawings and data, the value for design of specific buildings is significant.

However, architectural research is not always profitable. More than likely this type of investigation must be done to supplement regular work or as a student project. With emphasis on demonstrating the ways that theories and concepts can be applied to varying circumstances regularly encountered by programmers and

designers, the work of the theorist can begin to be utilized.

CONCLUSIONS

The quality and utility of research are related to the incorporation of sound scientific processes and the immediate application of findings. Quality and utility are best assured when members of the research team are well-trained in their respective areas. This is not to imply that architects should become social scientists or vice versa. Honikman[17] comments that the architect often finds it takes as long to become a competent researcher as it does to become an architect. It has been suggested that the architect associate with a social scientist to conduct research. In this way a complete cycle of research (basic → applied → application of results) can be achieved. Because the architect cannot always collaborate with a social scientist, it is suggested that the architect might adopt a practical theory or concept and demonstrate ways that the theory or concept can be applied to architectural circumstances. On the other hand, the social scientist working alone might profitably spend his time adapting useful methodologies to the needs of the architect.

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