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TO: Tom Davis

FROM: Alice Ray

SUBJECT: Second Summary Report of Work by the Library Research Center, University of Illinois, March-August, 1973, for the Construction Engineering Research Laboratory

DATE: November 9, 1973

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In March 1973 the Construction Engineering Research Laboratory (CERL), U.S. Army Corps of Engineers, contracted with the Library Research Center (LRC), University of Illinois, to test various methods of combining information from architecture and allied fields with data from the social sciences. At the outset of the project, CERL hoped to establish an information system based on the concept of a relationship sentence, a sentence which would state the degree of relationship or correlation between environmental and behavioral variables.[1] (See Appendix I) Design of the system was to incorporate suggestions made by Lane,[2] a consultant hired by CERL to review existing indexing tools and recommend methods for the proposed CERL system. It was understood that initial users of the information system would be researchers in the architecture branch at CERL, and in the future the system might be made available to other allied professionals. This report will outline work

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[1] David L. Dressel and Roger L. Brauer. Initial report on systemizing information to identify and relate behavioral and physical design parameters, Construction Engineering Research Laboratory, March 1973, 5 p.

[2] Nancy Lane. An evaluation of architectural information systems, Construction Engineering Research Laboratory, February, 1973, 160 pp.

done by the Library Research Center on the project, at each stage detailing objectives, procedures, and conclusions, and recommend an alternative format for an information system in the environmental psychology field.

PROGRESS OF WORK

I. Stage 1

A. Objective: to identify available literature sources on behavior and physical design and to recommend an optimal search procedure.

B. Procedure: During the period between March 1 and March 31, 1973, approximately 75 journals and 20 indexing and abstracting services were scanned for content relating to the relationship between human behavior and physical design. These materials all fell in the broad areas of architecture, engineering, and the social sciences. The journals and indexes for the years 1970-71 were first examined, followed by a review of current literature. In the few journals which were found to contain relevant materials, volumes published prior to 1970 were examined for pertinent articles.

The list of journals surveyed was divided into three groups: (1) journals which contained enough pertinent material to justify regular frequent searching; (2) journals which contained only occasional reports of relevance and which should be checked at less frequent intervals; and (3) journals which did not contain enough material to warrant routine searching. Indexes and abstracting services were also divided into two

groups depending on their usefulness. A complete list of these journals and reference sources appears in Appendix II.

In the first two weeks of July, 1973, a literature search was undertaken to check the validity of the journal recommendations made. The journals were checked for articles pertaining to the built environment and human behavior, and the results of this search are shown in Appendix III. In an additional attempt to locate sources of relevant reports, about 15 university groups and other organizations involved in human environmental design research were contacted.

C. Conclusions: It was found that this is a relatively new area in which little research data or practical applications have been recorded. Thus, most articles tend to emphasize either the behavioral or the physical aspect of design rather than both. Some areas of research, such as ergonomics, environmental psychology, and architectural psychology, have recently begun to investigate the relationships between the two. The results of these investigations tend to fall mostly into the classification of theory with a lesser number dealing with documented research. This is a field which is expanding. The more recent issues contained the most useful materials.

In most cases it was more fruitful to scan the journals themselves than to attempt to locate the desired articles through an indexing route. Indexing terms vary from index to index and because of the newness of the field usable narrow terms have not been developed to facilitate such a search. A number of very broad terms must be chosen and the desired materials selected from the listings. Much less time was required by going to the publications themselves. As the research in this area becomes more sophisticated, the indexing terms in reference tools should reflect more closely the area of interest. If indexes are frequently used, search terms for each of the most useful indexes and abstracts should be developed.

From our findings, it can be said that there exists at this time a core of about 23 journals which would keep an architect aware of the research in this field. Eleven of these were indicated as most relevant. Beyond this core are about 19 journals which might infrequently contain articles of importance. From observations on the amount of material in the last months, it would seem that in the near future relevant material will increase considerably. Thus, a mechanism for continued alertness to new journals and state-of-the-art tools should be considered in the development of an information system.

Since the area under consideration is growing there may be as much research-in-progress as there is published research. Lists of publications and other correspondence from the research groups which were contacted indicated that these groups were a valuable source of information.

II. Stage 2

A. Objective: to assess the feasibility of using the relationship sentence structure as proposed by CERL[3] as the basis for an information retrieval system for environmental and behavioral data.

B. Procedure: The previously mentioned review by Lane[4] of architectural information systems as applied to the proposed CERL system briefly discussed several ways in which a relationship sentence concept might be implemented. LRC obtained two critiques of the Lane paper by specialists in the field, Rees[5] and Baer.[6] In addition, LRC staff members met with computer specialists at the Digital Computer Laboratory (DCL), University of Illinois, to discuss the advantages and disadvantages of processing an information system based on the relationship sentence.

C. Conclusions: Both reviewers agreed that the Lane discussion quite adequately presented a state-of-the-art survey, but pointed out shortcomings of the paper as strong support

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[3]David L. Dressel and Roger L. Brauer, op. cit.

[4]Nancy Lane, op. cit.

[5]Alan M. Rees. Critique of "An Evaluation of Architectural Information Systems" by Nancy D. Lane, Case Western Reserve University, 1973, 5pp.

[6]Karl A. Baer. Critique of: Nancy D. Lane, An Evaluation of Architectural Information Systems, 1973, 7pp.

for the CERL relationship sentence concept. Rees states that, "The discussion of the proposed CERL relational sentence system is not very clear . . . does not adequately define the nature of the system . . . fails to apply the evidence presented earlier . . . to the design of the CERL system."[7] Baer concludes that the Lane report ". . . does not provide sufficient basis for an adoption of the system suggested for CERL."[8]

The DCL consultants advised giving up the idea of the relationship sentence as the basis for system development. CERL had wanted to input a complete sentence, have the user make information requests in sentence form, and match sentences for output. The computer specialists supported the LRC view that input into the system should be accessed by keywords rather than complete relationship sentences. Such an approach would enable the user to retrieve more materials pertinent to his inquiry, since single terms rather than sentences would have to be matched.

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[7]Alan M. Rees, op. cit., pp. 1-2.

[8]Karl A. Baer, op. cit., p. 7.

III. Stage 3

A. Objective: to consider the relationship sentence structure as a basis for generating an indexing vocabulary for the proposed information system.

B. Procedure: CERL had suggested that some reports might be entered into the system by the users themselves (CERL research personnel, practicing architects). A researcher might take a document he had found useful and construct a relationship sentence from its content for direct entry into the system. LRC concluded that before such a procedure was justified, an indexing study should be done to determine how well inexperienced indexers were able to understand and use the relationship sentence structure.

After testing several alternatives, a final indexing format was produced. A group of 14 undergraduate and graduate students were hired as indexers. This group included:

2 anthropology undergraduates (seniors)
2 architecture fifth-year students
2 library science graduate students
2 linguistics graduate students
1 engineering undergraduate (senior)
1 philosophy undergraduate (senior)
2 psychology undergraduates (seniors)
2 urban planning undergraduates (seniors)

The students from library science were chosen for their knowledge of indexing procedures; the students from philosophy

and linguistics for their ability to read for logical and/or semantic problems; the students in the other disciplines were chosen for their social science, architectural, or engineering backgrounds.

The documents to be indexed were 30 articles from academic or professional journals which had been selected by CERL from a larger number provided by LRC. (See Appendix IV) The criteria for selection by CERL were: (1) the inclusion of hard data as opposed to theoretical speculation; (2) exact specification of relationships between environmental and behavioral variables; and (3) potential relevance to future building projects.

Two evening indexing sessions, lasting from two to three hours each, were held. The 30 articles were divided into the general areas of psychology, architecture, and engineering. Each student was given five articles to index. Students in the same discipline (e.g., architecture, anthropology), were given some of the same articles so that indexing consistency by persons in the same discipline could be checked. Also, students in different fields were given identical articles to check for indexing consistency across disciplines. To investigate comprehension outside a student's discipline, each was given

several articles on topics related to the general information needs of the system about which they presumably had no prior training or information. When possible, each student was given two articles in his own field to index.

The packet of materials which each student received contained: (1) a list defining the relationship terms (see Appendix V); (2) an example of a completed relationship form (see Appendix V); (3) a two-page sheet for indexing identical to the sample; and (4) xerox copies of five different articles.

The indexers were asked to extract keywords from each document and to state the contents of the report in the form of a relationship sentence and complete English sentences. This procedure was to serve several purposes: (1) pinpoint main concepts contained in the article; (2) generate terms for later compilation into a demonstration thesaurus; and (3) organize information in articles to tie into the relationship structure.

Keywords were grouped by the students under four main headings adapted from the relationship structure: activity, type of facility, user(s), and design considerations. A miscellaneous "other" column was to provide space for pertinent terms which for one reason or another might not fit into the more specific categories. The relationship structure was

filled in after keyword lists were compiled. Students were also asked to form complete English sentences from the relationship terms. This was felt to be necessary since the logic of the relationship terms did not always seem apparent from reading terms out of sentence context. All students were interviewed after indexing. They were questioned about keyword selection, the relationship structure, and general reaction to the indexing procedure.

C. Conclusions: Results of the indexing study. In the first session students needed over an hour, on the average, to read and index an article. However, at the second session the same process took 30 to 40 minutes. This time can be broken down as follows: 20 minutes to read an article; 5 minutes to list keywords; 10 minutes for filling in the relationship structure. The reduction in indexing time can be attributed to several factors: (1) the students became familiar with indexing techniques, and (2) reading for relationships became less frustrating. Some students, however, never became speedy and accurate indexers. This failure seemed to be due to two factors: (1) some could not read and extract precise concepts, and (2) some were unable to understand the entire process, especially the section relating to the construction of relationship sentences.

In interviews following the indexing sessions, all students stated that they had the least problems identifying and listing keywords. However, the relationship structure presented consistent problems. The students reported that their subject backgrounds helped them index the materials. All stated that the most difficult articles were those dealing with areas unfamiliar to them. None had any previous indexing experience, but felt that with practice they could be trained to do an accurate job of indexing by keywords.

General considerations. Based on the results of the indexing study as well as LRC experience, some conclusions on the feasibility of using the relationship sentence structure to generate vocabulary for the CERL system were drawn.

1. Some articles in this field often do not lend themselves to the relationship structure. Articles of this type include: (a) studies with inconclusive results; (b) technical papers which convey information that does not relate to people *per se*, mostly in the engineering areas; and (c) papers of a theoretical nature, important to an understanding of the role of people in the built environment but not direct behavioral studies, mostly in architecture-oriented articles.

2. Either the experimental design or the results of some studies were inadequate. Some of the student indexers were of the opinion that it was intellectually dishonest to put these relationships into the sentence format.
3. Complex problems and behaviors often cannot be expressed in one- or two-word terms or even in several relationship sentences.
4. The columns of words in the CERL format for organizing relationships did not make the logic of the information immediately comprehensible. A complete English sentence seemed necessary to the students for understanding concept relationships.
5. Relationships expressed in either numbers or plus/minus signs are often meaningless out of context.
6. Terms governing relationships in the sentence structure are vague. It is not always apparent where keyword terms should be placed. Should it be physical characteristics or constraints/physical; covert/overt categorization is also difficult to determine in some formal behavioral studies. (In a study on seating arrangement, is the overt behavior eating or sitting? Is the covert behavior sitting or personal distance maintained from others at the same table?)

7. The CERL format is designed for behavioral studies of a very specific nature. Given the breadth of literature potentially relevant to human needs and architectural design, the relationship structure is not sufficiently pliable.
8. If inexperienced indexers are to be used in the long run for indexing and updating a data base, they should be trained carefully. Research tends to indicate that there is no substantial difference in consistency between experienced and inexperienced indexers, especially when an indexing aid (e.g., dictionary, thesaurus), is employed.[9]
9. Results of the indexing study indicate that a viable alternative to the relationship structure itself must be developed.

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[9]E. C. Bryant, D. W. King and P. J. Terragno. Analysis of an indexing and retrieval experiment for the organometallic file of the U.S. Patent Office. Denver: Westat Research Analysts, Inc., August 1963, 131 p.

IV. Stage 4

A. Objective: to pinpoint the needs of CERL on some important dimensions for planning and design of the proposed information system.

B. Procedure: At this point in the project it seemed necessary for LRC, based on the goals of CERL, to attempt to specify several considerations in system design. A questionnaire to determine the needs of potential system users at CERL was developed. (See Appendix VI)

Considerations:

1. Type of ultimate user.
2. Type of immediate user.
3. Characteristics of file collection:
   a. current and expected size.
   b. rate of growth.
   c. variety and complexity of subject content.
   d. format of file materials.
4. Complexity and required accuracy of searches to be conducted.
   a. current awareness of new developments.
   b. comprehensive retrospective searches on past work.
5. Number of searches expected and required response time.
6. Resources available for developing the system, conversion of backlog material to a new system, and method of information display.
7. Procedure for system maintenance.

C. Conclusions: During this phase in the development of the CERL system, to date definitive answers to these stated questions have not been obtained, and the user survey has not been conducted.

V. Stage 5

A. Objective: to develop a list of keywords in the environmental psychology field preliminary to the organization of the vocabulary.

B. Procedure: When the results of LRC work indicated that the relationship sentence structure could not serve as the basis for an effective CERL system, a decision was made with CERL to investigate other possibilities. The conceptualization of exploratory work on a classified thesaurus of terms is evident from the following excerpt from a report by LRC to CERL in May, 1973:

> As no thesaurus presently exists which combines terms from both the social sciences and architecture and allied fields (including environmental studies) a thesaurus needs to be compiled. This thesaurus would be derived from the categories formed out of the key word categories. The prototype thesaurus would be generated from terms indexed from the thirty articles used in the indexing study. Since the eventual goal of the project is a computerized data base for information searching, this classified thesaurus could be used as an aid in searching on a variant of the relationship structure. A thesaurus coded to the categories of user, activity, facility and design considerations would retain the vocabulary distinctions necessary and still allow searching on combinations of main terms. In essence, people could search on those relationships which are of interest to them, instead of searching for pre-set relationships as they exist in the relationship structure as it now stands.[10]

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[10] Olga Wise. Letter report #3; progress on the human needs/design information system for the month of May, 1973, Library Research Center, May 1973, p. 6.

An expanded discussion of the necessity for vocabulary control in any information system and some guidelines for thesaurus development in this subject area are contained in Appendix VII.

As an initial attempt to define the scope of the vocabulary in the literature relating environmental and behavioral variables, we went back to the original data from the indexing study. Ignoring distinctions asked for in the indexing forms (e.g., keyword lists, relationship sentences), the indexing reports of the 30 sample documents were viewed as a source for natural language use of environmental psychology concepts. From these forms, we extracted a list of keywords and phrases that subjects in the indexing study had used for describing the contents of the literature.

The keywords and corresponding document numbers were keypunched and two master lists were generated by a simple computer program: (1) an alphabetical listing of all words and phrases with their associated document numbers, and (2) under each document number an alphabetical list of all terms associated with that document. (See Appendix VIII) In addition, using the IBM Documentation Package, a pilot KWIC (Keyword-In-Context) index was done on the first seven documents used in the original indexing study. (See Appendix IX) Although typically a KWIC index is done on titles of articles

as a bibliographical reference tool, we indexed by keyword along with titles all other keywords and phrases in the master list. The purpose of this type of KWIC index here was to explore the usefulness in thesaurus construction of rotating keyword phrases. For example, in a natural language indexing format the phrase high-rise housing might appear, but there is always a chance that the more general term housing may not be included in a keyword listing unless some type of efficient word inversion technique is utilized.

C. Conclusion: We found that the range of vocabulary extracted from 30 documents was not large enough to serve as the basis for developing a comprehensive thesaurus. As can be seen in the keyword lists, each document supplied, to a large extent, a unique set of terms. Stated another way, as the number of documents indexed increased up to the limit of 30, the number of keywords continued to increase linearly, never reaching an asymptotic level. It is difficult to predict how many reports would have to be included before this field was covered broadly enough to allow organization of the vocabulary.

This shortcoming of the study, however, does not imply that the procedures followed--extraction of terms by indexing, mechanical manipulation of keyword lists, and use of a KWIC index to rotate terms--are not useful preliminary steps in the development of a thesaurus.

VI. Stage 6

A. Objective: to explore ways of organizing environmental and behavioral terms into a useful thesaurus for the CERL information system.

B. Procedure: In order to decide on the most appropriate structure for organizing a thesaurus, many types of subject classification methods were reviewed. A good discussion of several classification systems can be found in the book by Lancaster, Vocabulary Control for Information Retrieval[11] and in the paper by Lane.[12] One existing thesaurus that we relied on as an example was the Thesaurus of ERIC Descriptors used in the field of education.[13]

Our basic approach toward organizing environmental and behavioral terms was to construct hierarchies of words that could later be translated into a BT (broader term), NT (narrower term), RT (related term), etc., format. This vocabulary control convention is discussed more fully in

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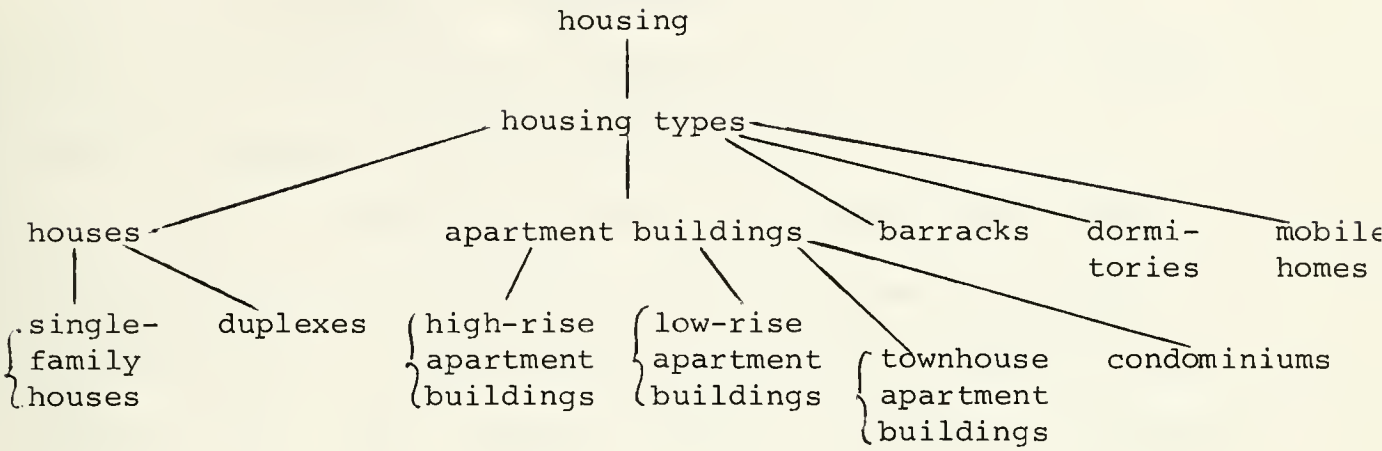
[11] F. W. Lancaster. Vocabulary control for information retrieval, Washington, D.C.: Information Resources Press, 1972, pp. 38-69.

[12] Nancy Lane, op. cit.

[13] Thesaurus of ERIC descriptors, New York: CCM Information Corporation, 1970.

Appendix VII. A simple example of this approach is shown below:



A control card would be generated for each term appearing in the hierarchy, specifying the relationship of the principal term to other terms on the same level and to the terms on the levels above and below. To take the example of the term <u>apartment buildings</u> in the hierarchy, the control card could be:

apartment buildings

BT housing
housing types

NT condominiums
high-rise apartment buildings
low-rise apartment buildings
townhouse apartment buildings

RT barracks
dormitories
houses
mobile homes

This pilot procedure was followed for a wide variety of keyword terms in the subject area.

C. Conclusion: Our basic conclusion from this stage of the project was that the development of a thesaurus based on hierarchies relating both environmental and behavioral concepts would be extremely difficult, if not impossible.

(1) The vocabulary relating to the built environment extracted from the architectural literature was relatively straightforward. There is little difficulty in defining the scope of terms such as house, concrete, or window and constructing hierarchies composed solely of environmental terms, as shown in the previous housing hierarchy example.

(2) A behavioral term such as privacy, comfort, or proxemics, however, often derives its meaning from the context in which it is used. In addition, the relationship existing between terms such as privacy and comfort are not necessarily self-evident and should be based on established research findings. For these reasons, hierarchies of psychological and behavioral terms were difficult to develop.

(3) When an attempt is made to link concepts from the built environment with behavioral concepts in a hierarchy, the difficulty is compounded. Designers of and dwellers in the built environment are aware that relationships such as

those, for example, between windows and privacy do exist. However, the compilation of a vocabulary linking these behaviors and architectural terms for indexing and searching cannot be based on intuition, but rather must be constructed from a tested and proven model of these relationships. It would be unacceptably presumptuous to go ahead and make the assumptions required for such hierarchical relationships at this point in the development of environmental psychology as a discipline.

VII. Stage 7

A. Objective: to investigate methods for the operation of the information system, primarily information access through the use of keywords.

B. Procedure: A manual system using edge-notched cards was explored for use in the initial phases of the CERL system. In the adaptation of such a system for the purposes of CERL, bibliographic information and/or an abstract of a report or journal article would be contained on the face of the card. The special cards have holes around the edges, and each keyword in the system could be assigned to a unique hole. When a given keyword is related to the subject matter, the corresponding hole is notched to the edge. After checking a master list of keywords and their corresponding hole codes, a system user inserts a sorting rod into the appropriate hole and the document cards on which that keyword is indicated and notched fall out. One card can accommodate over 100 primary keywords (ex: housing) and over 100 associated keywords (ex: housing types). If space for additional keywords is needed, as likely in the CERL system, additional decks of cards with different keyword sets and codes can be created.

As an alternative to a manual system, brief experimentation was done on the PLORTS system (Digital Computer Laboratory,

University of Illinois), a time sharing system with a text-editing routine. In addition, a publication by Roistacher[14] which suggests some criteria to be used in making comparisons between text-handling software systems was reviewed.

C. Conclusion: Since a definite decision on the structure of the CERL information system has not been made, a firm recommendation of a manual vs. a computerized system cannot be presented at this time. It is our tentative view, however, that a manual system designed to include the entire spectrum of relationships between behavioral and environmental variables would be somewhat clumsy. Since at most about 200 system keywords can be accommodated on an edge-notched card, many decks of cards could be required. On the other hand, if a computerized system were used, the type of input-output required by the proposed system should be relatively simple if an already existing text-manipulating program were employed. This is only speculative, however, and future changes may indicate a manual approach.

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[14]Richard C. Roistacher. On-line computer text processing: a tutorial, Urbana, Illinois: Center for Advanced Computation, CAC Document #82, August 15, 1973, 35pp.

RECOMMENDATIONS

Rationale for the Proposed System

As the documented history of this CERL project indicates and as the experience of the Library Research Center over the past months shows, to date it has not been possible to develop a comprehensive information system relating behavioral and design variables. We feel lack of more rapid progress can be traced to one basic problem: the development of an information retrieval system for literature and the systematization of the environmental psychology field have been pursued as a single objective. Both the previous effort to use the relationship sentence concept and our attempt to develop a thesaurus of terms that would hierarchically relate environmental design concepts suffered from such an aggregate approach.

Systematization of the field and access to relevant information could only be accomplished in a single step if all necessary research had been done to determine the effects of all important design features on an authoritative spectrum of human needs and behaviors. Obviously this is not the case, and to continue to attempt solution of the problems of information retrieval and specification of relationships between

variables concurrently would require such unwarranted assumptions as to make any end product useless.

The solution, as we see it, is to proceed in a step-wise fashion. Just as useful relationships between behavioral and environmental variables can only be derived from careful research, the development of access terms for an information retrieval system can best be accomplished from existing research literature. Only as the data base for the system we propose enlarges can the controlled vocabulary for information retrieval be developed.

The Proposed System

The basic unit of the information system should be actual research results rather than simply a bibliographic reference to lead the user to a journal article, report, or book. The primary access terms will be derived from the variables related in research results entered in the system, although other related terms will of course be included to direct the user to the information desired.

The contents of the system. For each research result entered in the system, the following is a list of suggested types of information (see Figure 1) that should be available when an access term or terms is called for.

FACTORS INVESTIGATED	RESULTS	RESEARCH METHOD	SUBJECTS	LOCATION	STATISTICAL ANALYSIS Type	Results	Significance level	CRITICAL NOTES	DOCUMENT NUMBER
Interpersonal distance as function of ethnic group	Mexicans< Anglos< Blacks <=closer	Observation of similar pairs in natural setting	Mexican, Anglo, & Blacks	Zoo (indoor & outdoor exhibits)	Analysis of variance	F=126.57	p<.001	Since only similar pairs were studied, cannot be assumed that individual spacing behavior would be maintained in mixed pairs.	12
Interpersonal distance as function of age group	Children< Adolescents< Adults <=closer	"	"	"	Analysis of variance	F= 37.53	p<.001		12
Seating distance as function of type of decision-making	Ss making individual decisions seat themselves farther apart than Ss making collective decisions. Individual dec. mean=12.27' Collective dec. mean= 6.53'	Ss were asked to seat themselves by moving chairs into position to make either an individual or a collective decision.	High school students	Large room, empty except for folding chairs stacked against wall.	t-test	t=5.86	p<.001		2

Suggested Format for Data Input to the System

Figure 1

1. Factor or factors investigated: the variable or variables represented by the input data. Usually these will be the terms by which the data is accessed. Examples: interpersonal distance, seating behavior, furniture arrangement. The system should be equipped to output all information on one factor or on any subset of factors.

2. Results: the data itself. In some cases, this will be numerical data, as for example the actual average seating distance between subjects observed in a dining hall. In other cases, a simple sentence stating a relationship between the variables studied would be output; for example, that black subjects tend to seat themselves closer together than white subjects in a dining hall. The most specific type of result available in the research report, actual data as opposed to a sentence summary of the relationship, should be preferred.

3. Research Method: a brief description of the method used to obtain the data. Examples: observation at ten-minute intervals of every third table in a dining hall, semantic differential ratings of line drawings of rooms, personal interviews.

4. Subjects: the population from which the data were gathered. Examples: army enlisted men, college sophomores, army dependent children, housewives.

5. Location: the place where the research was conducted. This information would be more critical for some types of research than for others. Examples: dining hall of an army officers' club, recreation room at a mental hospital, university classroom.

6. Type of statistical analysis: the method employed to analyze the data reported. Examples: chi-square analysis, analysis of variance, t-test.

7. Results of statistical analysis: the numerical results of the statistical method employed. Examples: $X^2=3.21$, $F=25.73$, $t=2.83$.

8. Significance level of statistical analysis: the statistical confidence level of the data obtained. Examples: $p<.005$, $p<.01$, $p<.10$. In some cases, where no test of significance or reliability is reported, a simple sentence will be supplied. For example, if the data were analyzed by a principal components factor analysis with varimax rotation, it might be stated that the factor in question was the factor that accounted for the most variance.

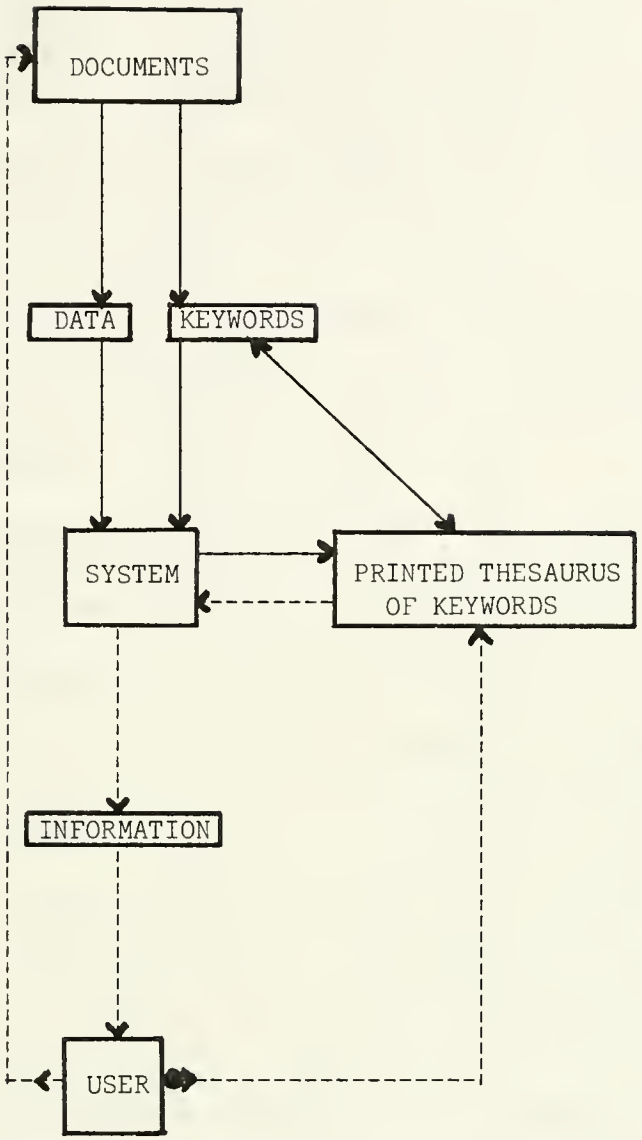
9. Notes restricting interpretation of the data: critical comments to limit the applicability of the research findings. Examples would be problems with the experimental design, an

alternative explanation of the relationship described, questions of the applicability of the findings to a military setting.

10. Bibliographic reference information: either a complete citation of the article, report, or book from which the data were obtained and an indication of the physical location of the actual document or simply a document access number which could lead the user to more complete bibliographic information if desired. Example: Doe, John. A study of the effects of preferences in interpersonal distance on seating behavior. Journal of Proxemics, 2:1, September 1973, 110-115, CERL Library or Document #119.

The development of the system. An information retrieval system equipped to output the type of specific information described above will require a great amount of effort and expertise to develop. The necessary steps for system development are described below. (See Figure 2 for an outline of the proposed system.)

1. Literature search. The first step will be to locate and obtain copies of all documents from which data might potentially be input to the system. This will require careful



_____ Data base construction

------- Information use

A Basic Outline of the Proposed Information System

Figure 2

and lengthy searches of indexes to literature, relevant journals, and books. In addition, contacts with other groups actively engaged in research in environmental psychology should be maintained to keep abreast of forthcoming publications. As stated, previous work done by LRC will be of help here, since a list of journals most likely to be of use has been compiled (see Appendix II), and initial contacts with a number of research groups have been made.

For efficient literature searching it will be necessary for CERL to attempt to define the content areas of greatest interest. It may be possible at the outset to eliminate certain types of research. For example, if a study of wall color preferences is found which compares the color preferences of subjects high and low on a given personality trait, such as hypochondria, and contains no general results, the data could perhaps be excluded from further processing at this stage by a trained searcher. As a general rule, only data which can eventually be translated into design recommendations should be included.

2. Data evaluation. One reason we recommend that the proposed information system be developed at the level of data rather than the level of the document is that a research report often contains several types of results or even results of

several different experiments. By entering discrete data into the system, separate evaluation of each conclusion reported is possible. Without elaboration here, the obvious should be pointed out. Any data input to the system must be derived from good research--adequate experimental design, appropriate statistical analysis, and proper interpretation of the results. Such criteria become particularly important in view of the objectives of CERL to apply these research results in actual recommendations to architects. As suggested previously, not only criteria for the quality of the data but also criteria to define the content of the information will be necessary in order that output of greatest usefulness to CERL be available as soon as possible.

3. Thesaurus construction and maintenance. A central element in the information system must be the terms by which data are indexed, a thesaurus of terms in which words or phrases are standardized. Since our attempts to structure concepts in the environmental psychology literature a priori failed, we recommend that the thesaurus develop as the system itself develops. As data is entered into the system, terms will be entered into the thesaurus.

The diagram of the proposed system (Figure 2) illustrates that the thesaurus is the central link between the user and the information. To develop a useful thesaurus, several steps are recommended:

a. An authoritative list of broad terms that covers the field should be developed. There are terms which are so general that they may not actually appear in all of the specific research reports to which they are relevant. Examples might be proxemics, ergonomics, psychology, behavior. This list of generic terms would not be entered into the system at the outset but only when suggested by data from a specific research report. Because of their ubiquitous nature, however, these terms would become a part of the system quite rapidly.

The list of broad terms would serve as a good reference for the indexer, who would make the decision to index information by a broad term in addition to the specific terms generated by the data. This method would give the system the capability of outputting all data in the system under a very general category, ex: proxemics. While extensive content analysis could uncover frequently used broad terms, it seems quite possible that a fairly definitive list could be developed by

brainstorming with the help of broad categories used in information retrieval systems in this area.

b. Specific terms should be assigned to data using the categories of Figure 1 (factors investigated, results, methods, etc.) as a guide. The vocabulary should be standardized on all dimensions in order that a researcher interested in, for example, all data on dining halls (a location) would be able to retrieve such information. The indexer will use the thesaurus as it develops to assign consistently terms to new entries into the system and to decide when references from one term to another should be made in the thesaurus.

c. At some point in thesaurus development, the potential users of the system, CERL personnel as well as practicing architects, should be surveyed to find out which terms they consider primary and which terms secondary. They could be given a list of terms in their area of expertise and asked to rate how likely they would be to look up information under each of the terms. More information is needed on the research interests of the potential users, and the questionnaire developed by LRC to be given to users should be administered. (See Appendix VI)

Implementation and Use of the System

At this point we are assuming that the CERL system will utilize some type of interactive computer terminal with access to a text-handling capability. Figure 1 again shows a general sample of the format such input might take, as well as the way the information might look when output to the user. Of course, pretests of available text-handling systems should be made by CERL before final commitment to one system is made.

In addition to pretesting the mechanical aspects of the system, we recommend that a well-defined content area within the field of environmental psychology be selected for an intensive pilot study. The topic should be one on which a great deal of information is available and which would be of most immediate help to Army building projects that are getting underway.

Since the primary objectives of the CERL system is to provide design guidelines to architects and builders, perhaps such guidelines could evolve coincident with system development. Ideally, recommendations should be made after a great body of overlapping data is in the system to provide an opportunity for replication and validation. However, given

time constraints, perhaps each bit of data input to the system should be checked at the outset for design implications and such implications stated as part of the output. This would insure that data irrelevant for the purposes of the system would not be input, and, more importantly, would speed up the compilation of usable design recommendations. In this manner, the CERL information system could prove itself useful at the nearest opportunity.

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APPENDIX I

CERL

Initial Report on Systemizing Information to Identify and Relate Behavioral and Physical Design Parameters

by
David L. Dressel
Roger L. Brauer

PRELIMINARY REPORT D-4

INITIAL REPORT ON SYSTEMIZING INFORMATION TO IDENTIFY AND RELATE BEHAVIORAL AND PHYSICAL DESIGN PARAMETERS

(Identification and Classification of Human Needs in the Military Facility)

by

David L. Dressel
Roger L. Brauer

March 1973

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ABSTRACT

This preliminary report summarizes progress to date on development of an information system to service the identification and classification of human needs in the military facility. The system will be used to develop information for design decisions. At present, behavioral and design theories have been reviewed, and have played an important part in formulating the pilot information system. The system is responsive to the requirements of both the researcher and the designer, with data categorized and translated through the "relationship sentence." Amenable to computer input, storage and data retrieval, the relationship sentence is a statement of relation between constraints, user activities, and physical characteristics. The structure of the relationship sentence is thought to be complete enough for easy gathering of data from existing studies, yet sufficiently flexible to allow categorization of behavioral data in varying degrees of explicitness. The output from the system is intended to be compatible with developing computer-aided design programs, if not an integral part of such programs.

Discussed in this report is the structure and function of the information system, its relation to information science and computer-aided architecture, and work required for its further development.

CONTENTS

INITIAL REPORT ON SYSTEMIZING INFORMATION TO IDENTIFY AND RELATE BEHAVIORAL AND PHYSICAL DESIGN PARAMETERS

1 INTRODUCTION

Purpose. This report summarizes the progress to date on the development of a system to identify and classify human needs. The system, which will be used in the development of design information for military facilities, is intended to help define the relationships between the needs of Army personnel and the design of physical spaces and environmental features for their facilities. Although this system is primarily in support of the Corps of Engineers building design process, it may have value to designers outside the Corps.

Background. In the past, the designer's main concern in creating a functional environment consisted of environmental control systems, spatial allocation, and an awareness of aesthetics. Any human-needs oriented design criteria which helped shape the environment were usually introduced as a product of the designer's experience. Recently, however, such criteria have come to the forefront of environmental design, resulting in a tremendous - and growing volume of disorganized, un-ordered data. If this data and the benefits resulting from its use are to be utilized, an information system is needed to organize, order (in the sense of identifying relationships between data bits), and disseminate the data.

At the outset of this investigation it was agreed that there were two basic criteria to which the information system would have to respond:

1. It would have to serve as a design tool by storing and ordering user-based criteria from which design decisions or criteria could be formulated.

2. It would have to serve as a research tool, indicating to the researcher where "gaps" exist in accumulated data.

Initially, a solution to this problem seemed to be a tri-variate matrix, accounting for the three major dimensions: "needs," (e.g. as in Murray[1]) "activities" and "physical characteristics." It was, however, necessary to abandon this plan because the "needs" dimension was unrealistic, and the matrix format proved awkward when inter-relating and translating data for design use.

An extensive literature investigation on the topic of human needs indicated that (1) theorists differ widely on classifications and definitions of needs, and (2) needs, per se, cannot be measured, but merely inferred from, or used to label, measurable human behaviors.[2] The concept of human needs is, therefore, of little use for either the organizational framework or classification scheme of the information system. If behaviors (overt and covert) are dealt with directly, the information system can be made more operational, and compatible with established and rigorous behavioral research. At the same time, the data is more explicit if actual behaviors are referred to, rather than some inferred "human need." This position does not wholly endorse the behaviorists' world view (e.g., in Skinner[3]), nor does it reject behavioral constructs. It is proposed that the information system be designed to store and communicate data from systematic research. It must be recognized, however, that data derived from behavioral research is either implicitly or explicitly linked with some type of theoretical base. Even the most rigorous behavioral research is dependent on theoretical constructs akin to needs; thus it is appropriate that the information system reflect an awareness of this fact.

2 THE STRUCTURE OF THE PILOT INFORMATION SYSTEM

Development of the current classification scheme has been tempered by inputs from several in-house

[1] H. A. Murray, *Explorations in Personality* (Oxford University Press, 1938).

[2] C. Alexander and B. Poyner, *The Atoms of Environmental Structure* (University of California, Berkeley, 1966).

[3] B. F. Skinner, *Science and Human Behavior* (Free Press, 1953).

(CERL) sources. These inputs insured that the following format was compatible with current work in work unit 002, "Measurement Techniques to Determine Architectural Satisfaction of Human Needs in Military Facilities," with the progress in 89106007, "Computer-Aided Architectural Design," and with the planned work unit 003, "Development of Architectural Standards to Satisfy Human Needs in Military Facilities." The classification scheme will be used in a pilot study that will test:

1. Its adequacy for the storage of results of in-house research efforts and other work reported in the literature.

2. Its compatibility with the criteria formulation goals projected for work unit 003, while providing information for use by others in making design decisions.

3. Its compatibility with "Computer-Aided Architectural Design," as well as other computerized design tool systems.

The basic dimensions of categorization are currently as follows (see Figure 1):

User Group – a "profile" of individuals for whom the relationship has been shown applicable (e.g., Army, volunteers, grades E-2 through E-5).

Constraints – additional factors influencing the activities, facility, or environment. Such factors include *management requirements* (check-in is required upon entering dining halls), *social influences* (music choice has major racial differences), *physical environment* (Ft. Leonard Wood is rather isolated), *economics* (spending free time away from barracks will cost the soldier more money than spending it in the barracks).

Facility – general type of facility (e.g. dining).

Area – the functional area within the facility; a "key station" or spatial area (e.g., "sign-desk" or "latrine").

Activity – observable behavior, or identifiable behavior and attitudes which can be described as "overt" or "covert."

Relations – two major relationships are accounted for: the relationship between overt and covert activities, and the relationship between "activity" and "physical characteristics." These relationships may be represented by a correlation coefficient or, if this data is not known, merely by a plus or minus sign to indicate a direct or inverse relationship.

Physical Characteristics – environmental elements which the designer can manipulate (e.g. foot-candles of light).

3 THE FUNCTION OF THE PILOT INFORMATION SYSTEM

Once data bits are recognized, coded, and stored in the computer, a translation program can be utilized to yield a print-out as illustrated in Figure 1. If the dimensions of categorization are listed in the order depicted, the print-out will come in the form of "relationship sentences." Each relationship sentence reflects the tendency of a particular user group to elicit some specific behavior, given a specific environmental characteristic, or set of characteristics. By means of the correlation coefficients (or relation direction indicators), many relationship sentences can be grouped to suggest some particular physical setting, i.e., a combination of many physical characteristics. If correlation coefficients are known, they may be employed to list the sentences hierarchically by the degree of correlation between a physical characteristic and a particular response. As the examples in Figure 1 illustrate, not all dimensions of categorization need be filled by each data bit for the entry to communicate. This built-in freedom allows for ready classification and input of data.

To stimulate research, one could, for example, access the system with the knowns of "light" and "dining"; if little data were printed out concerning the relationships between light and dining, the gap in data would indicate that particular area might be in need of research. (or location + entry of more data in systems).

It is anticipated that the relationship sentence, with its clearly defined structure, should enable library researchers to quickly record the results of relevant behavioral studies. In this regard, it will probably be helpful to have some type of source code preceding each sentence to enable system users to refer to the original document.

4 REVIEW OF INFORMATION SCIENCE FOR ARCHITECTURE

CERL has initiated a contract with a consultant in the field of information science to review the "state of

User Group	Constraints			Facility	Area	Activity			Relation*	Physical Characteristics	
	Physical	Soc./Man'l	Financial			Overt	Relation*	Covert		Adjective	Noun
An example from the SAMVA survey:											
Army enlisted men				Barracks	Exterior			Rating of beautiful	--	Room population	Density
[(Army enlisted men) for the barracks exterior, the rating of beautiful decreases as the room population density increases.]											
An example from the Travis AFB studies:											
Air Force enlisted men	Sign-in required		Food is free	Dining	Interior	Time at sign-in	−.24	Rating of pleasant			
[(AF enlisted men; sign-in required; free food) for dining facility interiors, as the time at the sign-in increases, the rating of pleasant decreases (r=.24).]											
Air Force enlisted men	Quick return to job required			Dining	Interior	Time eating w/others	+	Rating of relaxed			
[(AF enlisted men; quick return to job required) for dining facility interiors, as the time eating with others increases, the rating of relaxed increases.]											

* In "Relation" columns, plus sign indicates direct relationship; minus sign indicates inverse relationship.

Figure 1. Structure of relationship sentences.

the art" in information system design, and to determine its applicability to the developmental system described above. This consultant will review types of information systems and detail their advantages and disadvantages. Each type of system will be discussed with regard to its applicability for inclusion of social and behavioral information about users, and the relationships between that information and physical characteristics of buildings.

The contract study will also evaluate the current CERL developmental system, discuss the feasibility of its use, and attempt to identify its potential problems.

5 RELATIONSHIP TO COMPUTER-AIDED ARCHITECTURE

The developmental information system is expected to complement recently developed computer spatial allocation/arrangement programs. Computer-aided design programs developed by Perry, Dean and Stewart[4] and by Johnson and Weinzapfel[5] provide tools for establishing the relationships between spaces or areas within a space. The information system proposed by CERL is structured to allow the input of information (based on behavioral data) to modify or establish the parameters of such spatial arrangement programs.

6 EVALUATION AND DEVELOPMENT

Alternative system proposals are expected to be an outgrowth of the current "state of the art" investigation. The input, storage, and output/translation capabilities of these systems must be evaluated with regard to their usefulness to the researcher and designer. By the end of FY 73 (June 30, 1973), a definite plan for an operational information system will have been developed that can be implemented on a larger scale in FY 74. To reach this point by the end of the current fiscal year, the following steps will be taken:

1. The review of standard information system types which may have architectural applications will be completed.

2. The above review will be validated by selected experts.

3. Applicability of an issue-based information system will be investigated.

4. Compatability checks with spatial-relationship computer aids will be continued.

5. Information systems will be chosen for pilot testing; data inputs will be performed, and categories of classification will be developed.

6. A method for managing the collection, input, and output of information will be developed, as well as computer programming for input, output, and internal searching.

7. More sophisticated determinations of relationships in stored data will be explored.

7 CRITICAL REVIEW

It is recognized that the proposed information system must be capable of giving greater definition to design problems, or be keyed to already well-defined and recurrent physical, social and psychological design problems. That is, the system must eventually be able to help provide designers with criteria and architectural standards. For this reason, the accessing and communication functions of the information system must be carefully considered in future work.

In communicating a hierarchy of relationships based on strength of correlation coefficients, the question may arise of whether a physiological relationship of +.62 is necessarily less important in the environment than a relationship of +.81 between a gross motor response and a physical characteristic group. When tradeoffs are considered in design, which relationship is actually more important? This problem is currently being addressed; one possible solution would be to have parallel hierarchies listed by discipline.

In actual situations, the effect of any one physical

[4] *Enlisted Bachelor Housing: Computer Aided Design Project*, by Perry, Dean and Stewart, Architects & Planners (Department of the Army, 1972).

[5] T. E. Johnson, G. Weinzapfel, et al., *Image: An Interactive Graphics-Based Computer System for Multi-Constrained Spatial Synthesis* (MIT, 1970).

characteristic on facility users is not only difficult to determine, it does not sufficiently explain the effect of the perceived environment. While such an effect is discernible in a highly controlled experimental setting, in non-experimental situations several factors (e.g., red carpet and green walls) usually interact to produce some effect (e.g., "ugly"). The information system must therefore be able to communicate the effects of combinations of variables. Several ways of accomplishing this are currently under study.

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This preliminary report summarizes progress to date on development of an information system to service the identification and classification of human needs in the military facility. The system will be used to develop information for design decisions. At present, behavioral and design theories have been reviewed, and have played an important part in formulating the pilot information system. The system is responsive to the requirements of both the researcher and the designer, with data categorized and translated through the "relationship sentence." Amenable to computer input, storage and data retrieval, the relationship sentence is a statement of relation between constraints, user activities, and physical characteristics. The structure of the relationship sentence is thought to be complete enough for easy gathering of data from existing studies, yet sufficiently flexible to allow categorization of behavioral data in varying degrees of explicitness. The output from the system is intended to be compatible with developing computer-aided design programs, if not an integral part of such programs.

Discussed in this report is the structure and function of the information system, its relation to information science and computer-aided architecture, and work required for its further development.

DISTRIBUTION

Copies obtainable from:
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Information Service,
Springfield, VA 22151

Construction Engineering Research Laboratory (CERL)
Champaign, Illinois 61820

INITIAL REPORT ON SYSTEMIZING INFORMATION TO IDENTIFY AND RELATE BEHAVIORAL AND PHYSICAL DESIGN PARAMETERS

Preliminary Report U-4, March 1973, 10 pp, by D. L. Dressel and R. L. Brauer

KEY WORDS

information system
design data
relationship sentence

This preliminary report summarizes progress to date on development of an information system to service the identification and classification of human needs in the military facility. The system will be used to develop information for design decisions. At present, behavioral and design theories have been reviewed, and have played an important part in formulating the pilot information system. The system is responsive to the requirements of both the researcher and the designer, with data categorized and translated through the "relationship sentence." Amenable to computer input, storage and data retrieval, the relationship sentence is a statement of relation between constraints, user activities, and physical characteristics. The structure of the relationship sentence is thought to be complete enough for easy gathering of data from existing studies, yet sufficiently flexible to allow categorization of behavioral data in varying degrees of explicitness. The output from the system is intended to be compatible with developing computer-aided design programs, if not an integral part of such programs.

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APPENDIX II

RELEVANT JOURNALS AND REFERENCE SOURCES

Journals

I. Include: These sources tend to contain enough substantial material (ranging from several articles per issue to several articles per year) to warrant regular scanning. (Note: The most relevant are indicated by an asterisk.)

ASHRAE Journal
American Sociological Review
Man Environment Systems
Applied Ergonomics
The Architect
Architectural Association Quarterly
*Architectural Research and Teaching
The Architect's Journal
*Built Environment
*DMG Bulletin
*DMG-DES Journal
*Design and Environment
EDRA Proceedings
*Ekistics
*Environment and Behavior
*Human Ecology
Human Factors
Illuminating Engineering Society, Journal
Light and Lighting
*Lighting Design and Application
Lighting Research and Technology
*Man Environment Systems
Progressive Architecture
*Sociometry

II. May be Useful: This list is largely made up of social science and architectural journals. They either contained an occasional article on the subject matter or, contained articles which were close to the needed subject matter. For this reason it was felt that they should be watched further and checked again at a later date. As the field expands, these may well include references to the types of materials sought.

AIA Journal
Applied Acoustics
Architectural Design
Architectural Record
Behavior Today
Council of Facility Planners, Journal
Environment/Planning and Design
Ergonomics
Journal of Social Issues

II. (cont.)

Journal of Social Problems
Journal of Social Psychology
Journal of Personality and Social Psychology
Landscape Architecture
Library Bulletin. Dept. of the Environment. Great Britain.
Organizational Behavior and Human Performance
Social Problems
Sociology and Social Research
Sound, Journal devoted to the study of audiology
Transaction
Zodiac

III. Do not include: These are publications which may contain some useful information every six months or once a year. They would usually be indexed in the suggested indexing and abstracting services and thus not lost completely to the proposed data bank.

We exclude these generally for the following reasons: 1)Solely behavior oriented and not dealing with the specific problems or subjects of concern here (e.g., using rats or pigeons, etc., as subjects); 2)Solely engineering in concentration (i.e., describing how to design or build a particular structure or system without discussion of its effects); 3)Highly abstract discussion of design problems (i.e., discussing color and its effects abstractly without relating the discussion to a given physical area, group of subjects, or specific situation--intuitive design).

American Anthropology
American Psychologist
Architekter
Arkktehti
Behavior Science
British Journal of Social and Clinical Psychology
British Journal of Sociology
Domus
Ecology Law Quarterly
Environmental Affairs
Futurist
Habitat (Canada)
Human Relations
IEEE Journals

III. (cont.)

Industrial Design
Interior Design
Interiors
International Journal of Environmental Studies
Journal of Applied Psychology
Journal of Applied Social Psychology
Journal of Comparative and Physiological Psychology
Journal of Experimental Social Psychology
Journal of General Psychology
Journal of Psychology
Journal of the Experimental Analysis of Behavior
Man
Metron
Perception and Psychophysics
Physiology - Behavior

Indexing and Abstracting Services. The titles listed below have some use. Bearing in mind the great amount of inevitable overlapping, the first group should cover a great deal of the field. A list of search terms should be developed for each individual index.

I. Most Useful:

British Technology Index
Building Science Abstracts
Council of Planning Librarian's Exchange Bibliographies
Current Contents in Engineering and Technology
Engineering Index
National Clearinghouse for Criminal Justice
Planning and Architecture. U. of Illinois Campus.
(Keep aware of their acquisitions)
RIBA Library Bulletins

II. Other Sources Covering Broad Area:

Applied Science and Technology Index
Architectural Index
Art Index
Avery Index (Good for retrospective searching)
Cumulative Index Medicus
Dictionary Catalog of HUD
Dissertation Abstracts
H.M.S.O. Catalogs
Housing and Planning References/HUD

II. (cont.)

Monthly Catalog of Government Publications
Psychological Abstracts
Readers Guide to Periodical Literature
Sociological Abstracts
Thermal Abstracts
USGRDR Indexes

APPENDIX III

SUPPLEMENTARY LITERATURE SEARCH

Another search of the literature was made to check the validity of the journal list presented in Appendix II. The call numbers are for the University of Illinois library holdings of the journals. An asterisk indicates those journals which are also available at the CERL Library. Journals located at the University of Illinois have limited circulation, but may be taken to the office of photoduplication in the basement of the main library for xeroxing by them. The office charges 10¢ per page, however, the quality of reproduction is much better than that available from the 5¢ per page Xerox machines located in campus libraries.

697.05 *ASHRAE Journal. Jan. - May, 1973.
AS
Engin. Feb. 1973. A new application of building analysis procedures. pp. 46-51.

305 American Sociological Review.
AME
Educ.

006.05 Applied Ergonomics. March, 1973.
AP
City Noise in landscaped offices, pp. 19-22.
Planning

720.5
AR3
Arch.

The Architect. Jan. - April, 1973.

Jan. 1973. Computer-aided architectural design, pp. 57-59. Other issues include product analyses on such building elements as partitions, doors, etc.

720.6
ARQ
Arch.

Architectural Association Quarterly. 1972 issues.

Excellent book reviews, no articles.

720.5
ARRT
Arch.

Architectural Research and Teaching. vol. 2, 1971-72. (1973 issues not yet in library).

Nov. 1971. Some observations regarding man-environment studies. pp. 4-15.
Nov. 1971. Color systems and color scaling. pp. 16-22.
Architecture and engineering in environmental education, pp. 111-118.

720.5
ARB
Arch.

The Architect's Journal. April, 1973.

no material.

711.405
BUI
Arch.

Built Environment. Jan. - May, 1973.

Scattered short items which might be useful, for example, March, 1973 - an article on "Brick" which examines patterns, choice of materials, etc.

745.405
DESM
CPLA

DMG Bulletin. Feb. 1973 - May, 1973.

No articles, but good lead-in into other items; notes research projects, meetings, etc.

745.405
DES
CPLA

DMG-DRS Journal (formerly DMG newsletter). 1973.

Jan. - Mar, 1973, vol. 7, #1. Use of statistical methods to measure people's subjective responses to urban spaces. pp. 1-10.
April - June, 1973, vol. 7, #2. Perception, environmental preferences and the designer. Includes excellent bibliography. pp. 173-181.

771.405
DE
CPLA

*Design and Environment. vol. 3, 1-4, 1972.

No articles, but good source of information on research ongoing at other organizations.

729.2
En88
Arch.

EDRA Proceedings.

Copy available at CERL; copies on U. of Illinois campus checked out.

331.8305
EK
CPLA

*Ekistics, Jan. - April, 1973.

Some issues missing (Feb. and March) but no material in remaining issues. Ekistics is changing to a format of devoting each issue to a single topic, so the journal bears watching in any case.

309.2605
EN
CPLA

*Environment and Behaviour. Vol. 5, #1, March, 1973.

"The Spatial Character of Friendship Formation," pp. 43-65, (excellent bibliography)
"Human Ethology - Personal Space Revisited," pp. 67-71.
"Physical, Social and Personal Determinants of the Perception of Crowding," pp.87-115.

301.305
HU
Biol.

Human Ecology. Mar. and Sept., 1972 (Most recent issues; vol. 1, #1 and #2, new jnl.)
Vol. 1, #2, Sept. 1972. "Privacy and Environment," pp.93-110. Plus excellent bibliography.

612.05
HUM
Engin.

Human Factors. Feb. and April, 1973.

April, 1973. Results of an ergonomic investigation of large-space offices. pp.111-124.

621.3205
IL
Engin.

Illuminating Engineering Society, Journal. Oct. 1973 - April, 1973.

No articles.

628.05
ILE
Engin.

Light and Lighting. Jan. - March, 1973.

No material.

621.3205
LD
Engin.

Lighting Design and Application. Jan. - June, 1973.

Feb. 1973. pp. 39-43. Summary of current continental research in lighting; includes descriptions of Canter's work. Short bibliography.

March. 1973. Lighting design and air distribution. pp. 46-48. "... interaction between illumination levels and lighting efficiencies for various air-handling systems."

March. 1973. pp. 54-60. Technical topics section. Includes such topics as "Visual Comfort Probabilities."

May. 1973. pp. 19-22. Nonuniform lighting in office spaces.

June. 1973. Includes abstracts of papers presented at the yearly meetings of the Illuminating Engineers Society. Full texts will be published beginning in the October 1973 issue of the Journal of the IES. Topics abstracted include:

Office landscape and open-plan lighting.
The movement of people toward lights.
Display lighting preferences.
Interim study of procedures for investigating the effects of light on impression and behavior.

621.3205
LIG
Engin.

Lighting Research and Technology.

V. 5, #1, 1973. Individual and group differences in discomfort glare responses. pp. 41-49.
V. 5, #2. Spaciousness in interiors. pp. 103-111.
Includes scan abstracts at back of each issue.

301.305
MANE
City Planning

*Man Environment Systems. Jan. - May, 1973.

Jan. 1973. Research note on "Representative research in social psychology." p. 41.
Research note: "Size of informal groups in public areas." pp. 51-52.
Research note: "Environmental illumination and human behavior: relationship between spectrum of light source and human performance in a university setting." pp. 53-55.

March. 1973. Research note: "Interpersonal spacing in two-person cross-cultural interactions." pp. 115-117.

May. 1973. Article: The relationship between micro- and macrocrowding phenomena: some implications for environmental research and design. pp. 139-149.
Research note: Contextual fittingness of everyday encounters, pp. 185-186. (Full report in EDRA 4).

720.5
PE
CPLA

Progressive Architecture. May & June, 1973.

Nothing.

301.05
SO
Educ.

Sociometry. March, 1973.

No material.

Some journals included in the second list were scanned for material. The assumption that they would contain only occasional relevant articles, if any at all, was correct.

720.5
AMJA
Arch.

AIA Journal. Jan. - June, 1973.

Mainly a good source for current book reviews in area under consideration.

301.05
Jo
Educ.

Journal of Social Psychology. Feb. - June, 1973.

Nothing.

137.05
JOU
Educ.

Journal of Personality and Social Psychology. Feb. - June, 1973. Added to the list.

June, 1973. Boundaries around group interaction. Effect of group size and member status on boundary permeability. pp. 327-332.

305
JAS
Educ.

Sociology and Social Research. Jan. 1973.

Nothing.

Several indexes and abstracts were checked. Usually the material in the indexes and abstracts leads back to articles in the main lists, but the material is six months to a year old. Still useful for double checking that no material has been overlooked.

690.5
BUID
Eng.

Building Science Abstracts. Jan. and Feb. 1973.

Good source, again reviews of research, mostly British.

697.05
TH
Eng.

Thermal Abstracts.

No material.

APPENDIX IV

ARTICLES USED IN INDEXING STUDY

1. Reactions to Open Plan Offices. Built Environment (October 1972), 465-467.

2. Spatial Arrangements in Freely Formed Groups. Sociometry, 34 (no. 2, 1972), 270-279.

3. Interpersonal Speaking Distance as a Function of Age, Sex and Relationship. Sociometry, 35 (no. 4, 1972), 491-498.

4. The Effect of Spatial and Interpersonal Variables on the Invasion of Group Controlled Territories. Sociometry, 35 (no. 3, 1972), 477-489.

5. Seating Arrangement and Conversation. Sociometry, 34 (no. 2, 1971), 281-289.

6. Living off the Ground. Architect's Journal, 150 (August 20, 1969), 459-470. (in Ekistics)

7. Changes in Employee Attitudes and Work Practices in an Office Landscape. EDRA II, 14-1-1 to 14-1-9.

8. Testing a Housing Design Reference: A Pilot Study. Architectural Research Quarterly (1970-71).

9. The Ecology of Privacy. The Library Quarterly (July, 1966), 234-249 .

10. Desk Heights. Applied Ergonomics, 2 (no. 3, 1971), 138-140.

11. The Effect of the Meaning of Buildings on Behaviour. Applied Ergonomics, 1 (no. 3, 1970), 144-150.

12. Interpersonal Space in Natural Settings. Sociometry, 33 (no. 4, 1970), 444-456.

13. Individual Differences in Annoyance by Noise. Sound, 6 (1972), 56-61.

14. Ergonomics in the Home. Applied Ergonomics, 1 (No. 4, 1970), 223-227.

15. Ecological Aspects of Group Behavior in Social Isolation. Journal of Applied Social Psychology, 1 (no. 1), 76-100.

16. Analytic Sampling for Design Information: A Survey of Housing Experience. EDRA I, 183-197.

17. Behavioural Design Criteria in Student Housing. EDRA I, 243-258.

18. Delineating Personal Distance and Territoriality. Environment and Behaviour (December, 1971), 375-381.

19. A Study of Proxemic Behavior: Toward a Predictave Model. Environment and Behavior (December, 1971), 418-437.

20. Music--An Aid to Productivity. Applied Ergonomics, 3 (no. 4), 202-205.

21. Social Ritual and Architectural Space. ART, 1 (April, 1971).

22. Natural Landscape Preference: A Predictave Model. Journal of Leisure Research, 1 (Winter 1969). (in Ekistics)

23. Thermal Comfort: A Behavioural Approach. Architectural Psychology Conference, Strathclyde (1969), 30-35.

24. Pupillary Response to Architectural Stimuli. Architectural Psychology Conference, Strathclyde (1969), 35-39.

25. Visibility and Privacy. Architectural Psychology Conference, Strathclyde (1969), 39-43.

26. The Assessment of Room-friendliness. Architectural Psychology Conference, Strathclyde (1969), 48-55.

27. How Loud is Loud? Noise, Acoustics and Health. Architectural and Engineering News (February, 1970), 20-22.

28. Perceptual Effects of Reticulated Detailing. Architectural Science Review (June, 1970), 65-74.

29. Noise and Vibration. Architectural and Engineering News (February, 1970), 33-35.

30. Individual Loudness Susceptibility. Sound, 6 (1972).

APPENDIX V

MATERIALS USED IN INDEXING STUDY

User Group--a "profile" of individuals for whom the relationship has been shown applicable (e.g., Army, volunteers, grades E-2 through E-5).

Constraints--additional factors influencing the activities, facility, or environment. Such factors include management requirements (check-in is required upon entering dining halls), social influences (music choice has major racial differences), physical environment (Ft. Leonard Wood is rather isolated), economics (spending free time away from barracks will cost the soldier more money than spending it in the barracks).

Facility--general type of facility (e.g., dining).

Area--the functional area within the facility; a "key station" or spatial area (e.g., "sign-desk" or "latrine").

Activity--observable behavior, or identifiable behavior and attitudes which can be described as "overt" or "covert."

Relations--two major relationships are accounted for: the relationship between overt and covert activities, and the relationship between "activity" and "physical characteristics." These relationships may be represented by a correlation coefficient or, if this data is not known, merely by a plus or minus sign to indicate a direct or inverse relationship.

Physical Characteristics--environmental elements which the designer can manipulate (e.g., foot-candles of light).

INDEXING PROCEDURE

1. Read article through. Do not fill anything in.

2. Fill in "key word" columns. Try to use nouns or short phrases. List words corresponding to main concepts.

3. Construct relationship sentences. Refer to "key words" for concepts. Some concepts will not go through relationship columns, but fill in what you can.

4. Write out complete sentences resulting from relationship columns.

Article number ___"Seating Arrangement and Conversation," Sociometry, 34 (no. 2, 1971), 281-289.

Key words:

Type of facility:

Room, small

User(s):

Men (124)
Women (120)

Type of activity:

Listening to music--seated
Conversation--seated

Design consideration(s):

Chair position (location)

a. Furniture (arrangement)
   1. Circular
   2. Rectangle
   3. Two squares
   4. Pairs

b. Distances between

c. $\angle^{\circ}$ and to another

Other:

Subject

a. Affiliative tendency
b. Sensitivity to rejection

Descriptors:

1. Proxemics
2. Immediacy [average $\sim$ 5.12ft.
3. Seating preferences

RELATIONSHIP FORM

User Group	Constraints			Facility	Area
	Physical	Social	Financial		
Four person groups		No prior knowledge of relationship		Music listening room	Interior

Activity

Overt	Relation	Covert
Sitting and interacting with others	<	Mental set regarding acceptance or rejection

Physical Characteristics

Adjective	Noun
immediacy	social acceptance

Full sentence resulting from relationship words:

1. Interaction within four person groups listening to music dependent upon individual
2. Mental set regarding strangers and immediacy (closeness to others)
3.
4.
5.

INDEXING PROCEDURE

1. Read article through. Do not fill anything in.

2. Fill in "key word" columns. Try to use nouns or short phrases. List words corresponding to main concepts.

3. Construct relationship sentences. Refer to "key words" for concepts. Some concepts will not go through relationship columns, but fill in what you can.

4. Write out complete sentences resulting from relationship columns.

Article number __ Visibility and Privacy. Architectural Psychology Conference, Strathclyde (1969), 39-43.

Key words:

Type of facility:

Living units--bungalow
--kitchen-dining room
--ground floor bedroom

User(s):

Housewives

Type of activity:

Visibility and
privacy behavior

Design consideration(s):
Window design
--outward & inward vision
--room function
--outside view conditions
--occupant's personality

Other:

RELATIONSHIP FORM

User Group	Constraints			Facility	Area
	Physical	Social	Financial		
1) Housewives		Visibility & privacy requirements of occupant		Bedroom Kitchen-dining room	Ground floor & pedestrian walk Landscape--view
2) "		"		-------	-------
3) Extroverts & Introverts		"			

Activity			Relation	Physical Characteristics	
Overt	Relation	Covert		Adjective	Noun
1) Privacy & visibility standards			+		Privacy
2) "			-		"
3) Privacy & personality			-	Visual	"

Full sentence resulting from relationship words:

1. Housewives demonstrated greater privacy standards for bedroom with pedestrian-walk view than for kitchen-dining room with landscape view.
2. Extroverts have a greater need for visual privacy than do introverts.
3.
4.
5.

INDEXING PROCEDURE

1. Read article through. Do not fill anything in.

2. Fill in "key word" columns. Try to use nouns or short phrases. List words corresponding to main concepts.

3. Construct relationship sentences. Refer to "key words" for concepts. Some concepts will not go through relationship columns, but fill in what you can.

4. Write out complete sentences resulting from relationship columns.

Article number ____ Changes in Employee Attitudes and Work Practices in an Office Landscape. EDRA II, pp. 14-1-1 to 14-1-9.

Key words:
Office Landscape

Type of facility:
Corporate Offices

User(s):
Staff of Offices
(Clerical ——→ President)

Type of activity:
Various Types of Office work
--Clerical
--Filing
--Management
etc.

Design consideration(s):
Economy of space
Aesthetics
Acoustics
Illumination
Increased Productivity
Increased Communication
Better Maintenance
Social Interaction
Other:

RELATIONSHIP FORM

User Group	Old Constraints			Facility	Area
	Old Physical	Old Social	Financial →	Functional	
Office Workers				Corporate Headquarters	Large Office Areas
	Rectalinear Office Grid	Barriers of Communication			
New →	Integrated Modules	Increased Social Interaction			

Activity

Overt	Relation	Covert
↳	Better Office Communication and Interaction	
→	No Increase in Productivity/Motivation	

Physical Characteristics

Adjective	Noun
Open	Plan
Landscaped	Office
Private	

Full sentence resulting from relationship words:

1. The open plan office increased communication among co-workers, but had little to do with better office functioning and productivity.
2. Increased aesthetics is not proportional to increased motivation.
3.
4.
5.

INDEXING PROCEDURE

1. Read article through. Do not fill anything in.

2. Fill in "key word" columns. Try to use nouns or short phrases. List words corresponding to main concepts.

3. Construct relationship sentences. Refer to "key words" for concepts. Some concepts will not go through relationship columns, but fill in what you can.

4. Write out complete sentences resulting from relationship columns.

Article number ___ "Testing a Housing Design Reference: A Pilot Study," Architectural Research Quarterly (1970-71).

Key words:

Type of facility:

Study-bedroom, full size
Scale models

User(s):

Subjects (observers)

Type of activity:

Rating room pleasantness
Rating room gloom

Design consideration(s):

Illumination
Source luminance
Fitting type
Luminous flux

Other:

RELATIONSHIP FORM

User Group	Constraints			Facility	Area
	Physical	Social	Financial		
Subjects				Study-bedroom, Full size Scale model	Interior

Activity

Overt	Relation	Covert		Physical Characteristics	
				Adjective	Noun
rating pleasantness	+	feeling pleasantness	+		illumination
rating gloom		feeling gloom			

Full sentence resulting from relationship words:

1. Subjects rate pleasantness and gloom in full size and scale model rooms similarly.
2. Subjects' rating of pleasantness increases as illumination increases up to a point.
3. Subjects' rating of gloom increases as illumination decreases.
4.
5.

APPENDIX VI

QUESTIONNAIRE FOR POTENTIAL SYSTEM USERS

1. Profession _____

2. What was your most recent project? _____

_____

3. Please place a check mark by any of the following methods which you use to keep aware of current developments in your field.

	Often	Occasionally	Never
Personal file of pertinent articles			
Communication with co-professionals			
Abstracting and indexing services			
Magazines and journals in your field			
Textbooks			
Reports on similar projects			
Ask librarian			

4. Please check appropriate boxes. Add any titles you feel are of particular use to you in your work and that you follow fairly regularly.

	Routed to me	Have my own subscription	Borrow from others	Read regularly	Read frequently	Read occasionally	Helpful in my work	Not useful to me in my work	Know of journal, but never see it. Could be useful to me.
ASHRAE Journal									
Applied Ergonomics									
American Sociological Review									
The Architect									
AIA Journal									
Progressive Architecture									
Built Environment									
Design and Environment									
EDRA Proceedings									
Ekistics									
Environment and Behavior									
Human Ecology									
Human Factors									
Sociometry									
Man Environment Systems									
Applied Acoustics									
Landscape Architecture									

5. How often do you make use of the following?

	Fre-quently	Once in a While	Rarely	Never
Building Science Abstracts				
Engineering Index				
Environment Index				
Applied Science and Technology Index				
Architectural Index				
Psychological Abstracts				
Sociological Abstracts				
USGRDR Indexes				
Reader's Guide				
British Technology Index				
Monthly Catalog of Government Publications				

6. Concepts you consider in design work. Please check appropriate boxes:

	Feel this has bearing on my type of work	Interesting, but not very applicable to my work	Not significant	Have seen much relevant material on on this concept	Some material available	Seems to be little relevant material available	Interested in this concept	More research studies in this area would be helpful
A. Human response to:								
color in buildings								
noise in buildings								
light in buildings								
heating & ventilating								
music in buildings								
room size								
crowding in buildings								
privacy								
interior design of bldg.								
dormitories								
dining areas								
landscape design								
open & closed space								
B. Influence of design:								
work productivity								
communication								
spatial arrangement								
comfort								
site								
C. General concepts:								
territoriality								
building satisfaction								
proxemics								
ergonomics								
human needs								
Add terms you find necessary								

7. Rate your interest in the following (on a scale of one to five with five indicating highest interest and one indicating lowest interest) as you feel they might apply to your design work.

1. ___ Delineating personal distance and territoriality
2. ___ Reactions to open plan offices
3. ___ Testing a housing design reference: a pilot study
4. ___ Living off the ground
5. ___ Seating arrangement and conversation
6. ___ Spatial arrangements in freely formed groups
7. ___ The ecology of privacy
8. ___ Interpersonal spacing in natural settings
9. ___ The effect of the meaning of buildings on behavior
10. ___ Ecological aspects of group behavior in isolation
11. ___ Behavioral design criteria in student housing
12. ___ Desk heights

APPENDIX VII

VOCABULARY CONTROL

Vocabulary control is the heart of an information system. An indexing language must exist to bring the vocabulary of the indexer and searcher into coincidence, thereby preventing indexers and searchers from using dissimilar terms to express identical subject matter. To the indexing vocabulary is naturally linked the subject matter under consideration, its special characteristics and organization, thus the manner in which it should be stored and retrieved.

The subject heading in a library card catalog is an example of a controlled vocabulary most familiar to information seekers. The subject heading represents the first step of the four basic phases of information retrieval:

1. word retrieval: words that will adequately describe the information sought are identified.
2. reference retrieval: identification of references that are pertinent to the inquiry is made.
3. document retrieval: the actual document is located.
4. data retrieval: sought information is extracted from the documents.

To a degree, a reversal of the process just described would characterize the task of the indexer of information for a data base.

The compilation of a word list for an indexing vocabulary can take the form of a thesaurus. This type of word list is

especially useful for a data base compiled for computer storage and access, since the links between terms can be machine-coded, and since a thesaurus is not a static word list, but rather one that expands and changes as the information to which it is linked is added and taken from the data base.

The thesaurus under discussion here can be related to the familiar Roget's Thesaurus in basic concept, in that it links words in related areas. The terms in the suggested thesaurus, however, go beyond synonyms and antonyms, since the entire range of relationships between terms on a given topic can be displayed. The terms used are extracted from documents in the area of information under consideration and arranged alphabetically in hierarchical format.

A document on a specific topic will thus always be linked to a uniform set of terms, even if the subject matter is expressed in the literature or by the searcher with a variant term. A thesaurus is instrumental in preventing inconsistent use of subject words.

Guidelines for Thesaurus Development

Before any information system can be developed, basic decisions must be made regarding the parameters of the

information to be included in the system and the format of the vocabulary used to store and retrieve the information which comprises the data base.

Contingent with the development of a thesaurus is the necessity for guidelines for thesaurus formation. The following guidelines should be considered as the thesaurus for data base control expands:

1. After a basic structure for the thesaurus has been decided on, the thesaurus should include words taken from actual documents to insure a direct link between the vocabulary and the body of information that it represents.

2. The primary objective of the information system under consideration is the linking of behavioral and architectural terms. Attempts to develop a vocabulary that accomplishes this goal will necessitate not only adequate vocabulary sources, but also consultation with subject specialists. It is imperative that the structure of the thesaurus avoid unacceptable a priori assumptions and coordination of terms.

3. The users of the potential system have not as yet been precisely identified. A common complaint of the users of other information systems is their inability to retrieve relevant terms when conducting a literature search. This is often due to false coordination of terms and the documents to which they are keyed. For this reason, the thesaurus should not

only be tested by indexers for validity and coincidence of terms, but also by searchers. Then the vocabulary will develop in a way that will avoid disappointing retrieval results.

Thesaurus Display

As we explored displaying the thesaurus, several different methods were attempted (lattices, facets, etc.). The method given below is recommended with reservations. Given the problems of the vocabulary under consideration, this sytem of display is helpful, yet we are aware that it is subject to individual preferences and interpretation. As the thesaurus display develops, it would be wise to undertake statistical word counts, checking for frequencies of word coincidence in given documents. Such a count will aid the compiler in having a data backup for display decisions.

The method by which the vocabulary is listed for access to information is essential to the manner in which the thesaurus is organized and used. The format recommended below has been chosen because (1) the format allows for many facets of a single word or idea to be brought together with ease, (2) indexers and searchers comprehend the structure without complicated pre-instruction for its use, and (3) the

structure can be expanded or contracted in a logical fashion.

TERM:	CHAIRS
BT:	furniture design furniture arrangement furniture types
NT:	chair distance easy chairs fixed seats seating distance
RT:	seating seats
UF:	

Each term in the hierarchy above will appear elsewhere in the vocabulary in a different arrangement, linked to different terms. Here the perspective is from the main word CHAIRS. The concepts linked to the word CHAIRS relate to one another via the literature.

By the abbreviation BT (broader term) the searcher or indexer learns that there exists a broader hierarchy FURNITURE DESIGN that will give him information if he looks at that hierarchy on other related topics such as ergonomics.
NT (narrower term) indicates that there are subconcepts which relate to the main term. RT (related term) shows that there are related concepts different from and often more general than BT and NT that appear in connection with the term CHAIRS.

RT is a useful concept in that it allows for terms to appear in the hierarchy which might otherwise be excluded because the term does not at first glance seem to fit logically into the structure. UF (use for) can allow the vocabulary to appear in the alphabetical list but not within a hierarchy. It also allows for the consistent use of terms by indexers and users, i.e., a term such as mobile home could appear in the system. The searcher or indexer could begin their search with the term trailer . They look in the list and find TRAILER, use MOBILE HOME, and MOBILE HOME UF (use for) TRAILER. Thus the same word MOBILE HOME is always used to express a given concept, but there is always access to that word via the variant term TRAILER using the UF indicator. The UF indicator involves arbitrary decisions which provide for indexing consistency.

This example demonstrates that the choices for hierarchy formation will depend on the linkage of terms found in the documents themselves and the placement of a word within a hierarchy which will at times be arbitrary, i.e., is seating a RT or BT? For this reason any hierarchical display of words must be constantly reviewed, criticized, and tested.

Vocabulary Systematization

Below follows a list of considerations which must be kept in view when adding a word to the thesaurus:

1. elimination of redundancies.
2. combination of synonyms. This step involves some arbitrary decisions as the example of MOBILE HOMES vs. TRAILERS has shown.
3. introduction of higher generic terms (FURNITURE DESIGN).
4. breaking down of generic terms into specific terms (CHAIRS).
5. determination of use of singular and plural forms of nouns. Without consistent use of singular and plural forms, terms can be listed within the vocabulary during alphabetization (CHAIRS instead of CHAIR).
6. determination of accepted permutations and uses of multi-word terms. Natural language order and thesaurus order may not coincide. Preference is usually given to natural language order: FURNITURE DESIGN not DESIGN, FURNITURE.

This is not meant to be a complete list, but rather an indication of some factors which should be considered in thesaurus compilation. As the vocabulary develops, a manual for thesaurus construction, a thesaurus term control form, and a definite selection procedure should be developed. Without a careful consideration of language and content problems, the thesaurus will develop in a haphazard and useless fashion and not accomplish the use for which it is intended.

APPENDIX VIII

LISTS OF KEYWORDS ALPHABETICALLY AND BY DOCUMENT NUMBER

RECTILINEAR PLANES	
SQUARES OF HOUSES	
ACOUSTIC PRIVACY	1
CELLULAR OFFICE	1
CELLULAR PLAN	1
CLERICAL OFFICES	1
CLERICAL WORK	1
CLERICAL WORKERS	1
COMMUNICATION	1
COST OF SPACE	1
EFFICIENCY	1
INFORMAL CONTACT	1
INFORMAL PROCEDURES	1
INTERDEPARTMENTAL FRIENDSHIPS	1
INTERIOR	1
LANDSCAPING	1
MANY PEOPLE	1
OFFICE	1
OFFICE INTERIOR	1
OFFICE SITE	1
OFFICE STRUCTURE	1
OFFICE WORK	1
OFFICE WORKERS	1
OPEN OFFICE	1
OPEN PLAN	1
OPEN-PLAN CLERICAL OFFICES	1
PREFERENCE FOR LARGE ROOMS	1
PREFERENCE FOR SMALL ROOMS	1
ROOM POPULATION	1
ROOM SITE	1
ROOM SIZE	1
SATISFACTION	1
SINGLE CLERICAL OFFICES	1
SINGLE OFFICES	1
SOUND BARRIER	1
SUPERVISORS	1
VISUAL BARRIER	1
VISUAL PRIVACY	1
WORKER SATISFACTION	1
ACTIVITY NORM	2
ARRANGEMENT OF FURNITURE	2
COLLECTIVE DECISIONS	2
CONFERRING	2
CONVERSATION	2
CONVERSING	2
DECISION-MAKING	2
EMPTY ROOM	2
EXPERIMENTERS	2
FURNITURE ARRANGEMENT	2
HIGH SCHOOL SENIORS	2
INDIVIDUAL DECISIONS	2
INDIVIDUAL LOCATION CHOICE	2
INTERIOR	2
LARGE EMPTY ROOM	2
LARGE GROUPS	2
LARGE ROOM	2
PLACING CHAIRS	2
READING	2

ROOM PURPOSE	2
ROOM SIZE	2
SEATING ARRANGEMENT	2
SPATIAL ARRANGEMENT	2
SPATIAL ECOLOGY	2
STUDENTS	2
STUDYING	2
VERSATILITY OF ARRANGEMENT	2
ACQUAINTANCES	3
AGE	3
BEING AT EASE	3
BRITISH SUBJECTS	3
CULTURAL BIAS	3
CULTURAL DIFFERENCES	3
DISRUPTION	3
DISTANCE	3
DYADS	3
ETHNIC GROUPS	3
EXPERIMENTERS	3
EXTERIOR	3
FEMALE	3
FEMALE SUBJECT	3
FRIENDS	3
INTERACTING	3
INTERPERSONAL DISTANCE	3
LONDON, ENGLAND	3
MALE	3
MALE SUBJECT	3
MARKETS	3
NATURAL OUTDOOR SETTINGS	3
NON-VERBAL CUES	3
OTHER PERSON	3
PARKS	3
PEOPLE	3
RELATIONSHIP	3
RELATIVES	3
ROLE CONSTRAINTS	3
SEX	3
SPEAKING	3
STANDING	3
STANDING POSITION	3
STRANGERS	3
STREETS	3
SUBJECTS (HUMAN)	3
AGGRESSIVE REACTION	4
ANXIETY REACTIONS	4
APPROPRIATION OF OBJECTS	4
APPROPRIATION OF TERRITORY	4
AREA	4
AVOIDANCE	4
AVOIDANCE BY INTRUDERS	4
BEHAVIOR	4
CORRIDOR	4
DEFENSE	4
DEFENSE REACTIONS	4
DISTANCE	4
DISTANCE BETWEEN SUBJECTS	4
FLIGHT REACTION	4
GROUP (OF PEOPLE)	4
GROUP OF INDIVIDUALS	4
GROUP SPACE	4

APPENDIX IX

PILOT KWIC INDEX

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FEMALE SUBJECT FRIENDS	INTERACTING INTERPERSONAL DISTANCE L	HESH72	3
NDIVIDUALS GROUP SPACE	INTERACTION INTRUSION HUMAN TERRITOR	CHEY72	4
CT INFORMAL PROCEDURES	INTERDEPARTMENTAL FRIENDSHIPS INTERI	CANT72	1
S EMPLOYEES FUNCTIONAL	INTERIOR FILING AS TYPE OF OFFICE WO	BRO070	7
EXPERIMENTAL SUBJECTS	INTERIOR FOUR PERSON GROUPS FURNITUR	MEHR71	5
PARTMENTAL FRIENDSHIPS	INTERIOR LANDSCAPING MANY PEOPLE OFF	CANT72	1
VIDUAL LOCATION CHOICE	INTERIOR LARGE EMPTY ROOM LARGE GROU	BATC72	2
Y PEOPLE OFFICE OFFICE	INTERIOR OFFICE SITE OFFICE STRUCTUR	CANT72	1
SONS HIGH RISE HOUSING	INTERNAL CORRIDOR SLAB BLOCKS LIVING	REYN69	6
NGEMENT IN TWO SQUARES	INTERPERSONAL DISTANCE INTERREACTING	MEHR71	5
CT FRIENDS INTERACTING	INTERPERSONAL DISTANCE LONDON ENGLAN	HESH72	3
ANGERS STREETS SUBJECT	INTERPERSONAL SPEAKING DISTANCE AS A	HESH72	3
EFFECT OF SPATIAL AND	INTERPERSONAL VARIABLES ON THE INVAS	CHEY72	4
INTERPERSONAL DISTANCE	INTERREACTING WITH OTHERS LOUNGE LIS	MEHR71	5
AVOIDANCE AVOIDANCE BY	INTRUDER BEHAVIOR CORRIDOR DEFENSE R	CHEY72	4
ROUP SPACE INTERACTION	INTRUSION HUMAN TERRITORIAL BEHAVIOR	CHEY72	4
IOR INTERACTING GROUPS	INVASION MAN-WOMAN MIXED SEX PAIRS O	CHEY72	4
SONAL VARIABLES ON THE	INVASION OF GROUP CONTROLLED TERRITO	CHEY72	4
PRACTICES IN AN OFFICE	LANDSCAPE ABSENTEEISM ACOUSTICS ATTR	BRO070	7
L FRIENDSHIPS INTERIOR	LANDSCAPING MANY PEOPLE OFFICE OFFIC	CANT72	1
CATION CHOICE INTERIOR	LARGE EMPTY ROOM LARGE GROUPS LARGE	BATC72	2
ERIOR LARGE EMPTY ROOM	LARGE GROUPS LARGE ROOM PLACING CHAI	BATC72	2
MPTY ROOM LARGE GROUPS	LARGE ROOM PLACING CHAIRS READING RO	BATC72	2
OFFICES PREFERENCE FOR	LARGE ROOMS PREFERENCE FOR SMALL ROO	CANT72	1
CTION DWELLINGS GROUND	LEVEL ENVIRONMENTAL DENSITY ENVIRONM	REYN69	6
ING WITH OTHERS LOUNGE	LISTENING ROOM LISTENING TO MUSIC MA	MEHR71	5
LOUNGE LISTENING ROOM	LISTENING TO MUSIC MALE MEN MENTAL S	MEHR71	5
OUPLES HOUSES HUSBANDS	LIVING HIGH BUILDINGS FOR SINGLE PER	REYN69	6
L CORRIDOR SLAB BLOCKS	LIVING OFF GROUND LOCATION LONDON DW	REYN69	6
ND LOCATION LONDON DWE	LIVING OFF THE GROUND APPEARANCE OF	REYN69	6
L DECISIONS INDIVIDUAL	LOCATION CHOICE INTERIOR LARGE EMPTY	BATC72	2
OCKS LIVING OFF GROUND	LOCATION LONDON DWE LIVING OFF THE G	REYN69	6
ERREACTING WITH OTHERS	LOUNGE LISTENING ROOM LISTENING TO M	MEHR71	5
ISTANCE LONDON ENGLAND	MALE MALE SUBJECT MARKETS NATURAL OU	HESH72	3

OOM LISTENING TO MUSIC	MALE MEN MENTAL SET MUSIC SEATING A	MEHR71	5
CE LONDON ENGLAND MALE	MALE SUBJECT MARKETS NATURAL OUTDOOR	HESH72	3
REACTIONS HALL HUMANS	MAN-MAN DISTANCE BETWEEN SUBJECT FLI	CHEY72	4
ACTING GROUPS INVASION	MAN-WOMAN MIXED SEX PAIRS OCCUPANTS	CHEY72	4
S INTERIOR LANDSCAPING	MANY PEOPLE OFFICE OFFICE INTERIOR O	CANT72	1
LAND MALE MALE SUBJECT	MARKETS NATURAL OUTDOOR SETTINGS NON	HESH72	3
ORK GENERAL ATMOSPHERE	MEN GEOMETRIC DESIGN GROUP COHESIVEN	BROO70	7
ISTENING TO MUSIC MALE	MEN MENTAL SET MUSIC SEATING ARRANG	MEHR71	5
NING TO MUSIC MALE MEN	MENTAL SET MUSIC SEATING ARRANGEMEN	MEHR71	5
UPS INVASION MAN-WOMAN	MIXED SEX PAIRS OCCUPANTS PEDESTRIAN	CHEY72	4
TION OFFICE INTEGRATED	MODULES CHANGES IN EMPLOYEE ATTITUD	BROO70	7
IC MALE MEN MENTAL SET	MUSIC SEATING ARRANGEMENT AND CONVE	MEHR71	5
NING ROOM LISTENING TO	MUSIC MALE MEN MENTAL SET MUSIC SEA	MEHR71	5
E MALE SUBJECT MARKETS	NATURAL OUTDOOR SETTINGS NON VERBAL	HESH72	3
TURAL OUTDOOR SETTINGS	NON VERBAL CUES OTHER PERSON PARKS P	HESH72	3
FORMED GROUPS ACTIVITY	NORM ARRANGEMENT OF FURNITURE COLLEC	BATC72	2
CTION APPROPRIATION OF	OBJECTS AREA APPROPRIATION OF TERRIT	CHEY72	4
-WOMAN MIXED SEX PAIRS	OCCUPANTS PEDESTRIANS PEOP THE EFFEC	CHEY72	4
OOR SLAB BLOCKS LIVING	OFF GROUND LOCATION LONDON DWE LIVIN	REYN69	6
TION LONDON DWE LIVING	OFF THE GROUND APPEARANCE OF BUILDIN	REYN69	6
USTIC PRIVACY CELLULAR	OFFICE CELLULAR PLAN CLERICAL WORK C	CANT72	1
COMMUNICATION BUSINESS	OFFICE CLERICAL PERSONNEL CLERICAL W	BROO70	7
UNICATION CONVENTIONAL	OFFICE COOPERATION DISTRACTIONS CORP	BROO70	7
ESIVENESS ILLUMINATION	OFFICE INTEGRATED MODULES CHANGES I	BROO70	7
ING MANY PEOPLE OFFICE	OFFICE INTERIOR OFFICE SITE OFFICE S	CANT72	1
D WORK PRACTICES IN AN	OFFICE LANDSCAPE ABSENTEEISM ACOUSTI	BROO70	7
ANDSCAPING MANY PEOPLE	OFFICE OFFICE INTERIOR OFFICE SITE O	CANT72	1
WORKERS OPEN PLAN OPEN	OFFICE OPEN PLAN CLERICAL OFFICES PR	CANT72	1
OFFICE OFFICE INTERIOR	OFFICE SITE OFFICE STRUCTURE OFFICE	CANT72	1
E INTERIOR OFFICE SITE	OFFICE STRUCTURE OFFICE WORK OFFICE	CANT72	1
RIOR FILING AS TYPE OF	OFFICE WORK GENERAL ATMOSPHERE MEN G	BROO70	7
SITE OFFICE STRUCTURE	OFFICE WORK OFFICE WORKERS OPEN PLAN	CANT72	1
STRUCTURE OFFICE WORK	OFFICE WORKERS OPEN PLAN OPEN OFFICE	CANT72	1
REACTIONS TO OPEN PLAN	OFFICES ACOUSTIC PRIVACY CELLULAR OF	CANT72	1
CLERICAL WORK CLERICAL	OFFICES CLERICAL WORKERS COMMUNICATI	CANT72	1
ICE OPEN PLAN CLERICAL	OFFICES PREFERENCE FOR LARGE ROOMS P	CANT72	1
FICE WORKERS OPEN PLAN	OPEN OFFICE OPEN PLAN CLERICAL OFFIC	CANT72	1
OPEN PLAN OPEN OFFICE	OPEN PLAN CLERICAL OFFICES PREFERENC	CANT72	1
TION SING REACTIONS TO	OPEN PLAN OFFICES ACOUSTIC PRIVACY C	CANT72	1
CE WORK OFFICE WORKERS	OPEN PLAN OPEN OFFICE OPEN PLAN CLER	CANT72	1
ION FIXED SEATS DIRECT	ORIENTATION DISTANCES BETWEEN CHAIRS	MEHR71	5
S FEMALE ACCEPTANCE BY	OTHERS AFFILIATIVE TENDENCY CHAIR PO	MEHR71	5
NCE INTERREACTING WITH	OTHERS LOUNGE LISTENING ROOM LISTENI	MEHR71	5
UBJECT MARKETS NATURAL	OUTDOOR SETTINGS NON VERBAL CUES OTH	HESH72	3
ON MAN-WOMAN MIXED SEX	PAIRS OCCUPANTS PEDESTRIANS PEOP THE	CHEY72	4
RBAL CUES OTHER PERSON	PARKS PEOPLE RELATIONSHIP RELATIVES	HESH72	3
ED SEX PAIRS OCCUPANTS	PEDESTRIANS PEOP THE EFFECT OF SPATI	CHEY72	4
OCCUPANTS PEDESTRIANS	PEOP THE EFFECT OF SPATIAL AND INTER	CHEY72	4
IGHT REACTION GROUP OF	PEOPLE GROUP OF INDIVIDUALS GROUP SP	CHEY72	4
ERIOR LANDSCAPING MANY	PEOPLE OFFICE OFFICE INTERIOR OFFICE	CANT72	1
UES OTHER PERSON PARKS	PEOPLE RELATIONSHIP RELATIVES ROLE C	HESH72	3
SUBJECTS INTERIOR FOUR	PERSON GROUPS FURNITURE ARRANGEMENT	MEHR71	5
NON VERBAL CUES OTHER	PERSON PARKS PEOPLE RELATIONSHIP REL	HESH72	3
SINESS OFFICE CLERICAL	PERSONNEL CLERICAL WORK COMMUNICATIO	BROO70	7
H BUILDINGS FOR SINGLE	PERSONS HIGH RISE HOUSING INTERNAL C	REYN69	6
ARGE GROUPS LARGE ROOM	PLACING CHAIRS READING ROOM PURPOSE	BATC72	2
PLAN OPEN OFFICE OPEN	PLAN CLERICAL OFFICES PREFERENCE FOR	CANT72	1
LLULAR OFFICE CELLULAR	PLAN CLERICAL WORK CLERICAL OFFICES	CANT72	1

SING REACTIONS TO OPEN	PLAN OFFICES ACOUSTIC PRIVACY CELLUL	CANT72	1
RK OFFICE WORKERS OPEN	PLAN OPEN OFFICE OPEN PLAN CLERICAL	CANT72	1
E FOR SMALL ROOMS ROOM	POPULATION ROOM SITE ROOM SIZE SATIS	CANT72	1
KING STANDING STANDING	POSITION STRANGERS STREETS SUBJECT I	HESH72	3
LIATIVE TENDENCY CHAIR	POSITIONS ANGLES BETWEEN CHAIRS CHOO	MEHR71	5
YEE ATTITUDES AND WORK	PRACTICES IN AN OFFICE LANDSCAPE ABS	BRO70	7
PLAN CLERICAL OFFICES	PREFERENCE FOR LARGE ROOMS PREFERENC	CANT72	1
ERENCE FOR LARGE ROOMS	PREFERENCE FOR SMALL ROOMS ROOM POPU	CANT72	1
PLAN OFFICES ACOUSTIC	PRIVACY CELLULAR OFFICE CELLULAR PLA	CANT72	1
ORMAL CONTACT INFORMAL	PROCEDURES INTERDEPARTMENTAL FRIENDS	CANT72	1
NG CHAIRS READING ROOM	PURPOSE ROOM SIZE SEATING ARRANGEMEN	BATC72	2
Y REACTIONS AGGRESSIVE	REACTION APPROPRIATION OF OBJECTS AR	CHEY72	4
BETWEEN SUBJECT FLIGHT	REACTION GROUP OF PEOPLE GROUP OF IN	CHEY72	4
ED TERRITORIES ANXIETY	REACTIONS AGGRESSIVE REACTION APPROP	CHEY72	4
AVIOR CORRIDOR DEFENSE	REACTIONS HALL HUMANS MAN-MAN DISTAN	CHEY72	4
SIZE SATISFACTION SING	REACTIONS TO OPEN PLAN OFFICES ACOUS	CANT72	1
GE ROOM PLACING CHAIRS	READING ROOM PURPOSE ROOM SIZE SEATI	BATC72	2
NCTION OF AGE, SEX AND	RELATIONSHIP ACQUAINTANCES AGE BEING	HESH72	3
ER PERSON PARKS PEOPLE	RELATIONSHIP RELATIVES ROLE CONSTRAI	HESH72	3
KS PEOPLE RELATIONSHIP	RELATIVES ROLE CONSTRAINTS SEX SPEAK	HESH72	3
OR SINGLE PERSONS HIGH	RISE HOUSING INTERNAL CORRIDOR SLAB	REYN69	6
RELATIONSHIP RELATIVES	ROLE CONSTRAINTS SEX SPEAKING STANDI	HESH72	3
DECISION-MAKING EMPTY	ROOM EXPERIMENTERS FURNITURE ARRANGE	BATC72	2
E INTERIOR LARGE EMPTY	ROOM LARGE GROUPS LARGE ROOM PLACING	BATC72	2
THERS LOUNGE LISTENING	ROOM LISTENING TO MUSIC MALE MEN MEN	MEHR71	5
OOM LARGE GROUPS LARGE	ROOM PLACING CHAIRS READING ROOM PUR	BATC72	2
ERENCE FOR SMALL ROOMS	ROOM POPULATION ROOM SITE ROOM SIZE	CANT72	1
PLACING CHAIRS READING	ROOM PURPOSE ROOM SIZE SEATING ARRAN	BATC72	2
ROOMS ROOM POPULATION	ROOM SITE ROOM SIZE SATISFACTION SIN	CANT72	1
M POPULATION ROOM SITE	ROOM SIZE SATISFACTION SING REACTION	CANT72	1
S READING ROOM PURPOSE	ROOM SIZE SEATING ARRANGEMENT SPATIA	BATC72	2
S PREFERENCE FOR LARGE	ROOMS PREFERENCE FOR SMALL ROOMS ROO	CANT72	1
S PREFERENCE FOR SMALL	ROOMS ROOM POPULATION ROOM SITE ROOM	CANT72	1
HOUSEHOLD FEELINGS OF	SATISFACTION HOUSEHOLDS HIGH BUILDIN	REYN69	6
ON ROOM SITE ROOM SIZE	SATISFACTION SING REACTIONS TO OPEN	CANT72	1
ITURE ARRANGEMENT HIGH	SCHOOL SENIORS INDIVIDUAL DECISIONS	BATC72	2
MEN MENTAL SET MUSIC	SEATING ARRANGEMENT AND CONVERSATION	MEHR71	5
ROOM PURPOSE ROOM SIZE	SEATING ARRANGEMENT SPATIAL ARRANGEM	BATC72	2
ETWEEN CHAIRS CHOOSING	SEATS COLLEGE STUDENTS CIRCULAR FURN	MEHR71	5
ENT CONVERSATION FIXED	SEATS DIRECT ORIENTATION DISTANCES B	MEHR71	5
IACY DISTANCES BETWEEN	SEATS EXPERIMENTAL SUBJECTS INTERIOR	MEHR71	5
RRANGEMENT HIGH SCHOOL	SENIORS INDIVIDUAL DECISIONS INDIVID	BATC72	2
MUSIC MALE MEN MENTAL	SET MUSIC SEATING ARRANGEMENT AND C	MEHR71	5
ARKETS NATURAL OUTDOOR	SETTINGS NON VERBAL CUES OTHER PERSO	HESH72	3
AS A FUNCTION OF AGE,	SEX AND RELATIONSHIP ACQUAINTANCES A	HESH72	3
VASION MAN-WOMAN MIXED	SEX PAIRS OCCUPANTS PEDESTRIANS PEOP	CHEY72	4
TIVES ROLE CONSTRAINTS	SEX SPEAKING STANDING STANDING POSIT	HESH72	3
ROOM SIZE SATISFACTION	SING REACTIONS TO OPEN PLAN OFFICES	CANT72	1
ING HIGH BUILDINGS FOR	SINGLE PERSONS HIGH RISE HOUSING INT	REYN69	6
OFFICE INTERIOR OFFICE	SITE OFFICE STRUCTURE OFFICE WORK OF	CANT72	1
S ROOM POPULATION ROOM	SITE ROOM SIZE SATISFACTION SING REA	CANT72	1
ULATION ROOM SITE ROOM	SIZE SATISFACTION SING REACTIONS TO	CANT72	1
DING ROOM PURPOSE ROOM	SIZE SEATING ARRANGEMENT SPATIAL ARR	BATC72	2
SING INTERNAL CORRIDOR	SLAB BLOCKS LIVING OFF GROUND LOCATI	REYN69	6
E ROOMS PREFERENCE FOR	SMALL ROOMS ROOM POPULATION ROOM SIT	CANT72	1
ECONOMICAL ECONOMY OF	SPACE EFFICIENCY EMPLOYEE STATUS EMP	BRO70	7
COMMUNICATION COST OF	SPACE EFFICIENCY INFORMAL CONTACT IN	CANT72	1
P OF INDIVIDUALS GROUP	SPACE INTERACTION INTRUSION HUMAN TE	CHEY72	4

ANS PEOP THE EFFECT OF	SPATIAL AND INTERPERSONAL VARIABLES	CHEY72	4
ZE SEATING ARRANGEMENT	SPATIAL ARRANGEMENT SPATIAL ECOLOGY	BATC72	2
TILITY OF ARRANGEMENT	SPATIAL ARRANGEMENTS IN FREELY FORME	BATC72	2
NT SPATIAL ARRANGEMENT	SPATIAL ECOLOGY STUDENTS STUDYING VE	BATC72	2
SUBJECT INTERPERSONAL	SPEAKING DISTANCE AS A FUNCTION OF A	HESH72	3
S ROLE CONSTRAINTS SEX	SPEAKING STANDING STANDING POSITION	HESH72	3
URE ARRANGEMENT IN TWO	SQUARES INTERPERSONAL DISTANCE INTER	MEHR71	5
SEX SPEAKING STANDING	STANDING POSITION STRANGERS STREETS	HESH72	3
NSTRAINTS SEX SPEAKING	STANDING STANDING POSITION STRANGERS	HESH72	3
CE EFFICIENCY EMPLOYEE	STATUS EMPLOYEES FUNCTIONAL INTERIOR	BRO070	7
DING STANDING POSITION	STRANGERS STREETS SUBJECT INTERPERSO	HESH72	3
ING POSITION STRANGERS	STREETS SUBJECT INTERPERSONAL SPEAKI	HESH72	3
IOR OFFICE SITE OFFICE	STRUCTURE OFFICE WORK OFFICE WORKERS	CANT72	1
CHOOSING SEATS COLLEGE	STUDENTS CIRCULAR FURNITURE ARRANGEM	MEHR71	5
GEMENT SPATIAL ECOLOGY	STUDENTS STUDYING VERSATILITY OF ARR	BATC72	2
ATIAL ECOLOGY STUDENTS	STUDYING VERSATILITY OF ARRANGEMENT	BATC72	2
N-MAN DISTANCE BETWEEN	SUBJECT FLIGHT REACTION GROUP OF PEO	CHEY72	4
EXTERIOR FEMALE FEMALE	SUBJECT FRIENDS INTERACTING INTERPER	HESH72	3
TION STRANGERS STREETS	SUBJECT INTERPERSONAL SPEAKING DISTA	HESH72	3
NDON ENGLAND MALE MALE	SUBJECT MARKETS NATURAL OUTDOOR SETT	HESH72	3
BEING AT EASE BRITISH	SUBJECTS CULTURAL BIAS CULTURAL DIFF	HESH72	3
EEN SEATS EXPERIMENTAL	SUBJECTS INTERIOR FOUR PERSON GROUPS	MEHR71	5
BY OTHERS AFFILIATIVE	TENDENCY CHAIR POSITIONS ANGLES BETW	MEHR71	5
ACTION INTRUSION HUMAN	TERRITORIAL BEHAVIOR INTERACTING GRO	CHEY72	4
ON OF GROUP CONTROLLED	TERRITORIES ANXIETY REACTIONS AGGRES	CHEY72	4
AREA APPROPRIATION OF	TERRITORY AVOIDANCE AVOIDANCE BY INT	CHEY72	4
RNITURE ARRANGEMENT IN	TWO SQUARES INTERPERSONAL DISTANCE I	MEHR71	5
TIAL AND INTERPERSONAL	VARIABLES ON THE INVASION OF GROUP C	CHEY72	4
L OUTDOOR SETTINGS NON	VERBAL CUES OTHER PERSON PARKS PEOPL	HESH72	3
LOGY STUDENTS STUDYING	VERSATILITY OF ARRANGEMENT SPATIAL	BATC72	2
RICAL OFFICES CLERICAL	WORKERS COMMUNICATION COST OF SPACE	CANT72	1
URE OFFICE WORK OFFICE	WORKERS OPEN PLAN OPEN OFFICE OPEN P	CANT72	1