DOCUMENT RESUME

ED 064 758 EA 004 331

AUTHOR Davis, T. A.

TITLE Evaluating Built Environments.

INSTITUTION State Univ. of New York, Albany. Office of Architecture and Facilities.

PUB DATE 11 Jul 69

NOTE 97p.

EDRS PRICE MF-$0.65 HC-$3.29

DESCRIPTORS Architectural Programing; Building Design; Correlation; Cultural Factors; *Environmental Criteria; *Environmental Influences; *Environmental Research; *Evaluation Methods; Field Studies; *Planning (Facilities); Probability Theory; Questionnaires; Values

ABSTRACT

"Environmental measures" in the forms of probability inductions are conceptualized to express the relationship between environmental conditions (temperature, illumination, etc.) and human satisfaction levels for comfort and utility. An "evaluation" method is hypothesized as a way to gather the data needed to make environmental measure probability inductions. Evaluations gather counts and measures of objects and environments needed for human activities. Human satisfaction levels are then defined through questionnaires and indepth probes of cultural meanings, and correlated to the counts and measures. Environmental measure probability inductions are made from these correlations. Preliminary to making evaluation field studies, assumptions are made about environmental parameters, quantifying user activities, the validity of user opinions, the dimensions of cultural meanings, and the manipulation of data. Five "realities" are isolated for evaluation comparisons: objects, environments, standards, records, and opinions. (Some pages in Appendix C may reproduce poorly.) (Author)

ED 064758

EVALUATING BUILT ENVIRONMENTS

T.A. DAVIS
STATE UNIVERSITY OF NEW YORK
OFFICE OF FACILITIES
194 WASHINGTON AVENUE
ALBANY, NEW YORK
7/11/69

EA 004 331

PREFACE

Several years ago it became apparent that two technological innovations would soon radically alter the planning, programing,design and construction of University facilities. The computerization of information flows was already creating huge data banks which become increasingly invalid over time unless continuously and rigorously evaluated. And the impending industrialization of the construction industry would require the development of "performance" criteria with which users of facilities could express their environmental needs.

Since the University already had a rich variety of facilities from which to gather experiential data, the central issue became the question of appropriate methodologies for the evaluation of existing environments to develop expressions linking people to their environmental needs. It soon became apparent that the method used to gather this kind of field data would also be our theory of the linkages. This necessitated the development of a complete theoretical framework for the studies, which are presented here so that others might avoid some of the agonies we've experienced, and perhaps build on our experiences.

Three persons were instrumental in keeping the studies on course. Peter Manning, at that time Director of the Pilkington Research Unit at Liverpool University, served as a consultant for the first two years, and insisted all the while that the results of building evaluations must be useful to both the occupants and to architects and engineers. Robert Sommers, Chairman of the Psychology Department at the Davis Campus of the University of California, reviewed the studies at several points, and his comments were both helpful and inspirational. Morton Gassman, Assistant Vice Chancellor of the State University of New York, who posed the initial question, and under whose aegis the studies were made, continued throughout the period to pose meaningful questions and to insist on the use of concrete terms to explain abstract concepts.

TAD
7/11/69

State University of New York
EVALUATING BUILT ENVIRONMENTS

CONTENTS

SUMMARY

"Environmental Measures" in the forms of probability inductions are conceptualized to express the relationship between environmental conditions (temperature, illumination, etc.) and human satisfaction levels for comfort and utility. An "evaluation" method is hypothesized as a way to gather the data needed to make environmental measure probability inductions. Evaluations gather counts and measures of objects and environments needed for human activities. Human satisfaction levels are then defined through questionnaires and in-depth probes of cultural meanings, and correlated to the counts and measures. Environmental measure probability inductions are made from these correlations. Preliminary to making evaluation field studies, assumptions are made about environmental parameters, quantifying user activities, the validity of user opinions, the dimensions of cultural meanings, and the manipulation of data. Five "realities" are isolated for evaluation comparisons: objects, environments, standards, records and opinions. Arguments are structured for fifteen comparisons showing the kinds of claims which can be made, how they can be used, and the warrants for making them. Two field tests are discussed which tend to support the Hypothesis.

Office of Facilities
7/11/69 TADavis:gg

State University of New York
EVALUATING BUILT ENVIRONMENTS

1.0 INTRODUCTION

This monograph conceptualizes "environmental measures" as links between humans and environments, and hypothesizes an "evaluation" method to develop them.

The development of computer technology has unleashed powerful new capabilities to process and analyze huge masses of data quickly and economically. Among these capabilities are architectural activities such as computer aided planning and design, and simulation modeling of human-environmental situations. However, there is a "missing link" at the interface between humans and their environments. A way to express this link is conceptualized as "environmental measure" probability inductions. Then an "evaluation" method is hypothesized as one way to develop the necessary data with which to begin formulating a body of theory about these measures.

We develop our argument following the pattern of thinking or inquiry of empirical proof that Dewey cannonized in How We Think as "...five logical distinct steps: i) a felt difficulty; ii) its location and definition; iii) suggestions of possible solution (i.e., hypothesis); iv) development by reasoning of the bearings on the suggestion; and v) further observation and experiment leading to its acceptance or rejection." We follow this outline because our method for studying "environmental measures" also becomes our theory of them. In other words, the "evaluation" method which we hypothesize also becomes our theory of "environmental measures".

2.0 ENVIRONMENTAL MEASURES

A "design fit" matches constructional measures to environmental measures.

2.1 Design Fit

When a building "fits" a person, it effectively and attractively shelters, warms, cools, etc., his body in a manner that is efficient in terms of cost to build, operate and maintain. One way of operationally hypothesizing the chain of events leading to the design of buildings is as follows:

- PEOPLE express their physical needs in terms of their activities as individuals and groups, plus
- ENVIRONMENTAL MEASURES which describe the environment that occupants perceive: how much space an individual needs, how warm it should be, the light he needs, etc., for his activities; plus how many of what kinds of spaces an organization needs, their arrangement, convertibility, flexibility, etc., for organizational activities.
- The architect DESIGNS a FIT, using:
- CONSTRUCTIONAL MEASURES which describe various structural and materials possibilities in terms of strengths, hardness, insulation values, etc., that will provide the owner with a
- BUILDING that can be efficiently built, maintained and operated; and (hopefully) effectively used.

2.11

The designed linkages can be diagrammed as in Figure 1:

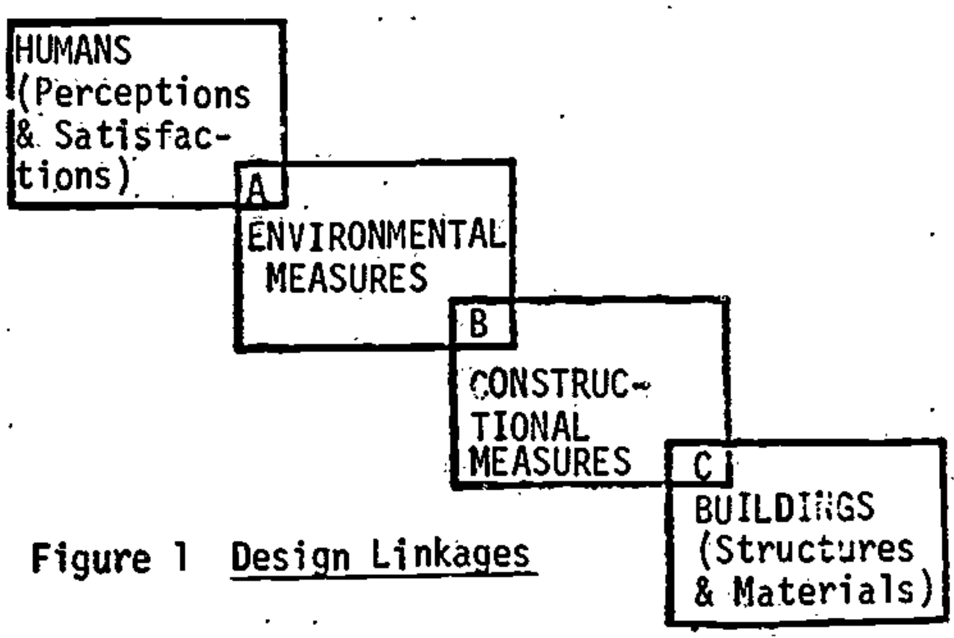


Figure 1 Design Linkages

2.2 The Symbolizing Problem

We can analyze the difficulties the designer faces in this model by looking at the linkages we have labled A, B and C.

2.21

The link between building materials and constructional measures is explicit.

There are few problems at solid linkage "C" between building materials and the constructional measures, because an explicit set of categoricals have been developed for concepts such as lengths, weights, and volumes. In addition, object-referents and physical laws have been developed and are maintained to warrant (see Section 4.3) the continuous accuracy of the categoricals. The designer can use the categoricals and warrants with confidence in their continuing applicability.

2.22

The link between constructiona measures and environmental measures is also explicit.

The solid linkage at "B" is the "design fit" between constructional measures and environmental measures. Again, there are few problems at this linkage because the environmental referent of environmental measures have had categoricals and warrants developed for them using physical terms that are consistant with constructional measure terms. The designer, for example, can with confidence logically entail, from the need to maintain a room temperature of approximately 72° in a concrete and steel structure, the amount of heat that must be provided to the room.

2.23

The link between human perceptions and environmental measures needs developing.

The dotted linkage at "A" is between the environmental referent and the human satisfaction referent, and it is here that major problems exist. No sets of categoricals and warrants have been developed with which to represent enduring human satisfaction needs for comfort and utility. Thus, the first step in evaluating built environments is the development of the human satisfaction referent for environmental measures.

2.3 Seven Kinds of Environmental Measures

Seven kinds of links between human perceptions and environmental measures could be used:

In the absence of categoricals and warrants as links between environmental referents and human satisfaction referents, researchers have used words, verbal statements, graphics, and models as links. We will briefly discuss some of these approaches as background to the approach we call the evaluation.

2.31

experimental evidence;

The traditional approach (for the past three centuries) has been to develop quantitative links in "scientific" laboratory experiments over time. Two examples of environmental measures developed through this approach and still in use are as follows:

- Air temperature ranges were established in 1923 in a laboratory correlation the responses of 130 "average" people to environmental measures which satisfied just under one-half of them. (1)
- Fresh air needs were determined in 1936 in a laboratory correlating the responses of "average" people to environmental measures in rooms for 3, 5, 15, and 47 occupants. (2)

2.32

"wine-tasters;"

A second approach to the development of quantitative links is through the use of valuing techniques with groups of qualitative experts such as "wine-tasters". Using the development of the Glare Index to show the approach, subjective comfort criteria were stated in descriptive terms wherein one unit on the scale constituted a difference that was just noticeable to the "experts". Under experimental conditions which included multiple sources, general lighting, and positional changes, the physical factors which cause glare, (such as brightness and size of the glaring source), were adjusted to accord with the stated criteria. Photometric and geometric factors were recorded, and the whole mass of data fed into a computer for correlation to the "expert's" judgments.

Index Values were then computed that could be measured with standard equipment. The final step was to make field studies of various types of interior rooms, noting the Glare Index from the table, with the "experts" judging whether the lighting did or didn't result in acceptable glare, all other factors considered. This resulted in standards of Glare Index for each kind of room examined, which architects can use in the design process without the necessary involvement of their subjectivity in the procedure. (3)

graphics;

2.33

A third approach has been to develop graphic links. Ramsey and Sleeper's Architectural Graphics Standards (4) is an example of this approach for "floor area" environmental measures. A recent attempt by Bednar (5) to use graphic representations as a link between floor area and user satisfactions for research laboratories resulted in his conclusion that, if graphics were used, perhaps "the basic premise that users can evaluate is fallacious".

physical models;

2.34

A fourth approach is the use of physical models as links. A full-scale manipulable model was used by Gassman and Green (6) to experiment with and develop both environmental and constructional measures for lecture halls. And scaled-down models of designs for new construction are often used to obtain the owners advance approval on environmental measures such as scale, form and arrangements.

physiological measures;

2.35

A fifth, and more direct way that an individual's satisfactions may be quantified in the future is through the measure of concommitant physiological changes as a person is exposed to valued objects or statements about values. Two examples will suffice to show the approach:

- The opening of the pupils of the eye have been found experimentally to vary uncontrollably as an indication of whether the observer finds an object interesting or not.
- Muscular tension has been found experimentally to vary uncontrollably as an indication of whether a person feels he has enough light or not.

It remains to measure in each case what the physiological gaussain curve is as a function of people's feelings. Using the curve as referent, it should be possible to examine an individual's placement on it by scaling his physiological state at the moment. It would then be possible to state specific human values in numerical terms relating to pupil diameter, muscular tension, etc.

2.36

word symbols;

A sixth approach is the development of word symbols as links. Cantor (7) has proposed a theoretical model for development of environmental measures which he calls "phychological appraisal tools". He adopts Osgood's semantic differential to develop curves expressing the relationship between "physical correlates" and "psychological appraisals" of them. He recommends the same kind of approach used in the development of I.Q. tests. He would thus develop a standardized test for each human activity which would show environmental measure satisfaction ranges for a given percentage of people at a given activity. Barowsky (8) uses intensive group problem-solving techniques to develop what he calls "environmental characteristics", which are then ranked according to their importance to people for whom a new facility is to be designed. He is thus attempting to develop new subjective referents to which he can later assign objective referents.

2.37

and probability inductions (the link we suggest).

The seventh approach is to develop verbal statements linking the environmental referent to the human satisfaction referent in the form of probability inductions. It is the approach for which the balance of this discussion sets forth a theoretical structure.

3.0 THE EVALUATION APPROACH

The evaluation is a traditional field procedure in the natural sciences,

3.1 Evaluations in the Natural Sciences

One approach to developing probability inductions as links between environments and the people who use them is the evaluation. It is the only investigation procedure that was known until about three centuries ago, and is the basic laboratory method of the applied sciences. The engineer often conducts extensive trial-and-error experiments to search for the best combination among a set of parameters. In so doing, he gathers data for comparison, and tests and re-tests his findings to be sure this solution will be efficient and effective. This feedback kind of data-collection-via-testing process we are calling an evaluative procedure when human values are included as data.

and in the social sciences.

3.2 Evaluations in the Social Sciences

The most informal and widely-used evaluation is the survey and synthesis approach by which, for example, building design and use criteria have been developed. Criteria such as square feet allowances per occupant, utilization goals for classrooms and laboratories, and acceptable reverberation times within rooms, have been developed by observing, counting and measuring actual situations. As an end result of a survey such as this, a synthesis is induced, and a criterion is stated that is used predictively to guide the use of existing buildings and to plan and design future buildings.

3.3 Using Evaluations to Develop Probability Inductions

We propose in Section 3.4 a formal evaluation methodology to develop environmental measures in the form of probability inductions. It starts with the standards now being used, and compares appropriate measures and counts of built environments to them for congruence. In addition, the occupants' activities are observed and reported, and in questionnaires and interviews the occupants are asked if, in their opinion, the built environments which the measures described are good, adequate, poor, etc. Measures and counts, and user's opinions are then correlated, and further interviews held to find out exactly what the users were referring to in responding to questionnaires. The results of such investigations, gathered over time, season, geographic areas, room orientations, generic groups of people, kinds of construction, user activities, etc., and in parallel with all other known contributing factors, would yield a data bank of information from which probability patterns of successful ranges might be induced for all combinations of specific conditions.

We hypothesize that appropriate data can be developed through evaluations to express human-activity satisfaction (comfort and utility) needs in the form of environmental measures,

3.4 The "Evaluating for Environmental Measures" Hypothesis

It is hypothesized that appropriate data can be developed through evaluations to express human-activity satisfaction (comfort, and utility) needs in the form of environmental measures, where:

"Appropriate Data" includes physical measures and counts of environments, activities of the people using them, and their opinions about the environments;

"Humans" includes people as individuals, and as groups or organizations;

"Activities" includes physical behavior, plus mental activity when appropriate;

"Satisfaction needs" means to develop, for each kind of activity, relationships showing ranges of measures for each environmental measure as a function of the percentage of people who will be satisfied.

"Environmental measures" are statements in the form of probability inductions which express probable human satisfaction needs in the built environments, in physical measure terms consistent with constructional measures; and

where "evaluations" means studying buildings as hypotheses, by gathering data in the field,

"Evaluations" as a research approach includes:

- accepting social realities as a condition, and studying objective realities as design hypotheses;
- gathering object and environment data through field observation and measures, interviews and questionnaires;

for each human activity,

searching for cultural meanings, and

stating probability induction links between humans and environments.

- gathering human activity and satisfaction data through field observations and measures, interviews and questionnaires;
- searching for cultural meanings through user interviews and reporting the data from the user's point of view;
- stating environmental measures as probability inductions of human-activity satisfaction ranges, and the probable percentage of people who will be satisfied.

Four conditions must be met: identifying fits and misfits; establishing ranges of comfort; showing how environmental measures interact; and development of new environmental measures.

3.41

A minimum of four conditions must be met in order to accept the hypothesis:

1. Identification of "fits" and "misfits" between human activity satisfaction needs (as individuals and as organizations) and built environments, which can be expressed as environmental measures;
2. Establishment of ranges of satisfaction and probable percentages of people satisfied for specific environments and for specific kinds of human activities;
3. Showing in what ways environmental measures interact with each other, and their combined affects on humans;
4. Development of new environmental measures.

In evaluations, the method determines the data; therefore the method is also the Theory

3.5 Method as Theory

One condition to be kept in mind in using the evaluation approach to develop anything is that the method itself actually becomes indistinguishable from the theory. This is in contrast to the "scientific" laboratory experiment over time, where a formal structure with rigid conditions must be followed in order to

of
environmental measures.

give credence to the findings. The structure guarantees replicability of the experiment, to prove the validity of the findings. But it is entirely separate from the theory being tested or the findings which result. The method provides the structure of all such experiments, and the theory being tested provides the content.

In using the evaluation approach, however, the method which is used actually determines what data will be collected. Thus, the method is also the theory being tested, and any change in method is a change in the theory. This means that in using the evaluation approach, both the theory of environmental measures and the method to develop them must be developed together. And this also means that a complete set of assumptions must be made explicit about both the methods used, and the things observed and measured. Some of these assumptions are set forth in Section 5.

A
composite theory
of
environmental measures
must
include humans
as individuals
and
as groups,
and
show how the
measures for each
interact.

3.6 Stating a Composite Theory

A composite theory of environmental measures must show in what ways the measures act and interact, for individuals and for organizations, for all kinds of activities, and under the influence of all kinds of natural environmental conditions. To cite two obvious examples, the climatic environmental measure could show in what ways the individual's needs for comfort and utility may change as he moves between polar positions such as, for example:

- hot, dry vs. cold, wet conditions.
- south (sun) orientation vs. a north orientation.
- large vs. small spaces.
- location next to wall vs. in center of space.
- physically active vs. sedentary activities, etc.

And space-time environmental measures for a college would show in what ways their needs change as they move between polar positions such as:

- rural-residential vs. urban-commuter conditions.
- two-year college vs. the "multiversity".
- academic vs. professional orientations.
- large groups vs. individualized instruction.
- personal vs. automated instruction, etc.

Finally, to complete our two examples, a composite theory of environmental measures would also have to show when, and in what ways climatic measures for individuals interact with space-time measures for organizations.

Evaluations are useful: to develop environmental measures (our hypothesis); to evaluate existing buildings; to validate simulation models; to validate programing and design processes; and to define what is "good" about environments.

3.7 Other Uses of the Evaluation Method

We have hypothesized the use of the evaluation method to develop new environmental measures. There are other potential uses for this method, including:

- improving planning, by evaluating existing planning environmental measures and/or procedures.
- improving programming by evaluating existing programing environmental measures and/or procedures.
- selecting appropriate planning and programing environmental measures for new user activities.
- evaluating existing facilities to locate problems that need correcting.
- comparing the success of two or more rooms (buildings, etc.) for the same activity.
- evaluating the importance of each physical aspect of an environment to the activity taking place in it.
- collecting data to improve the logic of the design process.
- defining what is "good" about environments for human occupancy.
- providing validity for computerized information systems and simulation models.

4.0 EVALUATION STATEMENTS

We have shown the need to develop the "human satisfaction" component of environmental measures, and described seven kinds of links which have been used. We have hypothesized an evaluation approach to developing probability inductions as environmental measures, and in this section will show what the inductions are, and what kinds of data are needed to make them.

Environmental measure inductions

4.1 Environmental Measure Inductions

From observations, measures and user opinion data, second-level generalizations in the form of probability inductions can be stated. At least two kinds of inductions are useful:

may show probable causality,

1. Inferences of descriptive probable causality between humans (as individuals and in organizations) and their environments; (e.g., the fact that there are several independent evidences, each of which makes it probable that an air temperature below 68°F is uncomfortable for students seated in a lecture hall, makes it probable that the lower temperature is responsible for the discomfort (9).

or ranges of satisfactions.

2. Inferences of environmental measures ranges of satisfaction (comfort and utility) for individuals and organizations (e.g., the fact that 75% of the observed students seated in a lecture hall are uncomfortable when the temperature is below 68°F makes it probable that 75% of all students would be uncomfortable. (10) This induction relates three things: a percentage of users; a level of their comfort; and a measure of an environment.

4.11
One way to show this diagramatically is in Figure 2.

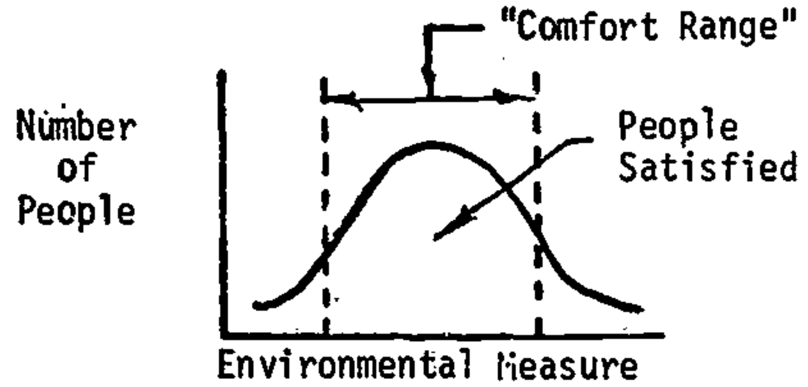


Figure 2 Environmental Measures

They can be generalized:
for an environment,
for groups of people,
for constructional measures,
or
for an activity.

4.12
Within any culture, these inductions may be generalized: 1. as the commonly re-occuring patterns of a minor input to a total situation (e.g., the built environment input to a sitting-observing situation); 2. on the basis of specific (age, etc.) groups of people performing generic classes of human activities (e.g., sitting-observing); 3. on the basis of constructional measures (e.g., a given insulation value for an exterior wall can be provided by many different materials or combinations thereof); and 4. on the basis of organizational activities, methods, etc.

Environmental measures are induced from:

4.2 First-Level Statements

These probability inductions are second-level statements which combine or aggregate first-level data. First level data are reports of opinions, or observations of measures or counts. They can take one of three (11) forms depending on the degree to which the environment is contributant to user activities:

cause-effect statements,

1. Cause-effect: This means that the environment is necessary and sufficient for the affect to be produced. Only observations can be reported in this form:

- The environment, or a characteristic of it was demonstrated by the (user or observer) to be necessary and sufficient for the user's satisfaction (comfort or utility): a) for a user's activity; b) for the achievement of planning goals; or c) to result in changes conditions after its use.

producer-product statements,

2. Producer-product: This means that the environment is necessary but not sufficient for the affect to be produced. Both observations and opinions can be reported in this form:
   - The environment, or a characteristic of it was demonstrated by an observer or reported in the user's opinion to be necessary (but not sufficient) for user satisfaction (comfort or utility): a) for a user activity; b) for the achievement of planning goals, or; c) to result in changed conditions after its use.

   Note that although opinions can be structured in this form, the content of the opinions refers only to the specific case reported, not to an invariant empirical reality, and has no validity per se for purposes of generalizing.

correlation statements (between environment conditions and user satisfactions),

3. Correlation: No causality can be shown in this kind of relationship. It simply means that a concommitant variation has been observed. Both observations and opinions can be reported in this form:

- The environment, or a characteristic of it was demonstrated by an observer, or reported by a user to correlate with user satisfactions (comfort or utility): a) for user activity; b) for the achievement or planning goals; or c) to result in changed conditions after its use.

and preferred-value statements.

4. Preferred Value Statements: This is a composite of the user's opinions, attitudes, and beliefs (again, not an invariant empirical reality), representing his preferences for each characteristic of the environment for his activities:
   - A characteristic of the environment is ranked by the user to be of more value than some and of less value than others for his activities.

Data on human satisfactions, opinions, attitudes, or beliefs must be warranted.

4.3 <u>Warranting the Data</u>

Data on observations, or measures or counts of objects and environments, are gathered according to the rules of the natural sciences. Thus, both categoricals (objective referents) and warrants (standards of lengths, volumes, weights, etc.) are supported by logic or evidence which guarantees predictability. However, data which reports on user satisfactions, opinions, attitudes or beliefs, have as yet no universal categoricals, or warrants for their use. All each finding normally has to support it is the method of collection used: the rules of the controlled experiment over time; or the rules of data analysis and statical manipulation. In using the evaluation approach, probability inductions will be developed which can be used as "physical law probability" referents. Thus, there is need to warrant any of the four kinds of statements set forth in 4.2 above.

The warrant represents the authority for the statement, and must be either the logic with which it entails from our assumptions, or a mass of experimental evidence. For example, one of the warrants we use in Section 6.2 is that "the user knows best". When inductions are based on a warrant such as this, the reporter must be prepared to also substantiate the logic or the evidence of the warant.

5.0 RESEARCH ASSUMPTIONS

In Section 3.4, we showed that the evaluation method that is used actually becomes the theory of environmental measures, and that therefore, a complete set of assumptions must be made explicit before beginning any research. This section outlines some preliminary assumptions for this purpose, about the environment, user activities, user opinions, user attitudes and beliefs, and data manipulations.

In order to
evaluate
for
environmental measures,
we assume
that
the environment
is a
minor input
if
successful
(comfortable
and utilitarian)
for
human activities.

5.1 Environmental Assumptions

The following environmental assumptions are patterned after Klapper's (12) "emerging generalizations" about mass communications, and provide a structure for the milieu "out there":

1. The effectiveness of a built environment can be stated in physical measures that can be correlated to human perceptions of satisfaction (comfort and utility).

The second assumption states that there are maximums and minimums for each environmental measure above and below which the environment will be perceived as unsatisfactory for human use:

2. There are extreme conditions (too much or too little) in which the built environment can be a direct cause for human discomfort or disfunction.

The next two assumptions state that the built environment is only one of many factors which make up a total environment, and that it interacts with the others toward a steady (predictable) state:

3. The built environment does not ordinarily serve as a necessary and sufficient cause for human comfort and utility, but instead, acts among and through a complex of mediating factors (influences) that make up the total environment.
4. These mediating factors are such that they typically render the built environment a contributory agent, but not the sole cause, in a process of reinforcing existing conditions (rather than changing them).

Thus, it acts as a necessary but not sufficient condition.

The next assumption states that when the built environment does contribute to change, either the other factors won't be acting, or there will be a "snowballing" effect:

5. When the built environment does function as an agent of perceived change, one of two conditions (is likely to) obtain. Either: a) the mediating factors to that perception will have been rendered inoperative by the agent of change; or b) the mediating factors will also be impelling toward change.

The last assumption states that the parts of the built environment are independent variables which interact with each other:

6. The role of the built environment (either as a contributory agent or direct affect on human comfort and utility) is influenced by the interaction between its independent environments (sonic, luminous, climatal, spatial, stability, time and esthetic environments).

Each independent environment of the total environment is thus described as working independently among several other independent variables acting on an individual at any one time: it may be a cause for unsatisfactory affects in extreme situations, but it normally acts only as a necessary but not sufficient contributant to human satisfactions.

It must be noted that we are not concerned in these assumptions with how the built environment may motivate a person, except to modify it to his needs. In other words, we are interested only in how it performs passively for his comfort and utility. There is a school of thought which emphasizes environmental factors as basic motivation forces. Wheeler (13) concluded that "A building must be seen as a primary shaper and conditioner of our behavior". This is an interesting idea, but it is a step beyond our present concern with environmental measures for human comfort and utility.

We also assume that existing number notations and algebraic relations may <u>not</u> fit social reality.

5.2 <u>User Activity Assumptions</u>

Environmental measures are to be developed for different kinds or levels of human activities, so assumptions must be made about grouping them. Scientists and engineers in the natural sciences have been able to partition "objective" reality into equivalent sets (groups, categories, etc.) and to develop number notations and algebraic relations that can be considered literal translations of the groupings they represent. Floor area in a building, for example, can be partitioned into "square feet", and based on the criteria that they are contained "in the same building", assigned equivalence notations. To be equivalent means that each square foot in the building is related to (e.g., is not unequal to) itself by definition (the reflexive property), that each square foot has the same relation to each of the other square feet in the building that they have to it (the symmetric property), and that any square foot has the same relationship to a second that the second has to a third and that therefore the first and third have the same relationship (the transitive property). Based on these equivalencies, the numbers assigned to the square feet of reality can be said to be a literal representation of the reality, because the reality is partitioned in such a way that the relationships between the partitions conform to the same rules as the numbering system.

5.21

However, when the same approach is used to partition and number an individual's activities (sitting, walking, etc.) or events (birthdays, etc.) or the activities and events of groups or organizations, the equivalency rules may not hold. For example, three equivalency problems that must be considered in partitioning social reality (both events and activities) are: social reality is compound in the sense that it does not contain identical elements (people); it is temporal in the sense that it changes (people learn) over time; and it has both an observable external behavior and a private meaning internal to each person involved (14). Euclidean and Boolean algebra, for example, can't easily accommodate all of these equivalency-conditions, and unless they are dealt with explicitely, and the researcher's assumptions stated to include them, the partitioning of social reality to conform to the rules of inert objects will distort social reality in ways which result in the reporting of invalid data. Thus, the only assumption we can make prior to gathering data is that the validity of social measurement data may be increased by inducing the rules of our algebraic and numbering systems from the social evaluation data that we collect. We shouldn't be surprised if this results in new symbols, because, to put it another way, it assumes that the properties of measurement systems must be developed from rather than imposed upon the structure of the realities to be quantified.

We may need to induce new rules to quantify social situations.

5.3 User Opinion Assumptions

The measuring of human values (expressed verbally as opinions) are different from those of measuring and counting objects or environments:

We assume
that
user opinions
only
tell us
how well the architect
anticipated
today's
users' opinions.

- There is no ratio scale[1], as the object being valued is compared with another object or with verbal descriptive statements.
- The object may be universally the same, but it may also be another infinitely variable human being.
- The environment includes human valuers and thus cannot be held constant or varied at will.

Therefore, instead of the subject being directly estimated, the process is one of intellectualizing a degree of satisfaction, interest, desire or aversion, or some other mental aspect of human mentality (15). In other words, a mental dimension of the valuer is being estimated, as it views and interprets reality in the context of its experience and ideals. Furthermore, since a) each valuer has unique capabilities and aggregate experiences, and b) the mental dimension can include rational and emotional aspects in various combinations, and c) the very act of valuing has the potential of changing the valuer's value structure, it is concluded that:

- The valuing act can never be exactly replicated; in other words, cause and effect relationships cannot be generalized and used to make predictions about the future behavior of individuals, except as probability generalizations about groups of which he is a member.

Whether or not something is described as good today by a particular person or group of people will not tell us how the same person or group will describe it tomorrow. In valuing facilities, some aspect of the facility is compared: a) for preference, tc the same aspect in a similar or dissimilar situation; or b) for adequacy, to the valuer's own beliefs as to what is comfort, etc.

1. i.e. There are no categoricals from which measuring instruments are calibrated.

Users can make valid expressions of preference between alternate choices.

5.31

In a) valuing preference, valid satisfaction information can be developed about existing reality, such as, for example, the relative comfort of a chair in one room as compared to a different one in another room. In this situation, where only one person is involved, and at a single point in time, the warrant that "the user knows best" is sufficient to make valid preferred-value statements which express nominal differences between several items.

And users can express adequacy opinions for in-depth study and correlation to environmental conditions.

5.32

In b) valuing adequacy, the users are asked to rate the environment on such things as temperature, humidity, etc. as a check on the objective measures for the same values; or they are asked to rate sight-lines, feelings of scale, etc., as a check on theoretical design criteria. If the architect anticipated well, the facility will be valued highly. The valuers are judging on the basis of their beliefs of what ought to be. Since these ideals may be both narrow and fixed, because they are necessarily a product of their experience and psychology, they may not include the myriad of alternate choices that are actually available in any situation. Thus, the only information that can be developed in the valuing of adequacy by users is how well the architect's design anticipated the values of those who are using the facilities. In other words, it's the valuer's ideals of what ought to be that are elicited, as their oughts are compared by them to the facilities that the architect has designed. However, we can make use of this conclusion by combining it with four further assumptions:

1. That relevant questions about human perceptions of environments can be communicated to the users;

2. That a substantial percentage of the users can and will respond with opinions (the verbal expression of their values) that represent their perception of their environment for their activities;
3. That the building design represents the architect's solution to the user's needs; and
4. That one goal of the architect is to provide a comfortable and utilitarian environment for the user-occupant.

Based on these assumptions, it follows that useful statements can be made from user interview or questionnaire responses to represent their perceived adequacy of an environment for their activities. However, no claim can be made that they refer to actual differences in the objective reality that is perceived by different people, or by the same people at two different times. The differences refer to differences in user-occupant opinions, not to objective reality, and must be correlated to all known commonalities in the total situation in order to provide referents for the words and validity for the statements of relationships.

But it's premature to develop "reliable" questionnaires as links.

5.33

In working toward these correlations, and subsequent probability inductions, we can avoid the "reliable questionnaire" approach. It wasn't included in Section 2.3, for reasons that will become evident, but another kind of human satisfaction referent that could be attempted is the "reliable questionnaire". The development of the I.Q. test is an example. "Reliability" as a scientific concept, is concerned with the repetitive accuracy of a measuring instrument (procedure). The natural sciences have developed accurate measurement techniques through nearly absolute control of the total measurement situation, including control of the object, the environment it's in, the observer's techniques, and the measuring instrument. They also have bodies of theory containing standards, with warrants for their use, and quantified symbols to represent them.

For mental "dimensions" there is no body of theory containing standards or warrants or quantified symbols to link humans to environments.

For example, going from the last item upward, length has been partitioned and symbolized as numbers which can be warranted manipulable in the same ways that length in objective reality is manipulable. A physical standard was then established from which any number of literal representations can be constructed and used as measuring instruments, subject to warrants of accuracy with corrections for environmental conditions. The end result of a large set of measurements has been shown to form a distribution which represents differences in the measurements which can be attributed to either the instrument or the observer making the measures. The object is a physical reality whose length properties can also be warranted on the basis of the physical laws in the body of theory which covers this field of knowledge. Under these conditions the instruments can be considered reliable (accurate), and the resulting symbols can be considered valid as literal representations of the object measured.

In the social sciences, in dealing with mental concepts such as intelligence, opinions, attitudes or beliefs, all we have to work with is environments, observers, and instruments. The objects to be measured are mental (vs. physical), there is no body of theory containing standards, and of course with no standards, there can be no warrants or quantified symbols for them. However, the tools and procedures of the natural scientists have been adapted for use in this situation.

The approach has been to start with the normal curve - the graphic symbolization of the dispersion of measures in the natural sciences - as the assumed dispersion of a valid measure in the social sciences, and to work to make instruments (questionnaires or tests) that will result in responses that form a normal distribution when administered to a sample of a population. When researchers get such a distribution, it is claimed that a single characteristic has been isolated and measured, and that the data is a "valid" representation of the variable. When it can also be demonstrated that the repeated use of the instrument places an individual in about the same position on the normal curve, it is claimed that the procedure is "reliable". (16)

Reliable questionnaires assume normal distributions so that questions which don't produce "normal" responses are eliminated.

The chain of reasoning that appears to justify the use of the normal curve as a symbolic referent for validity, begins with the dispersion of measures that is experienced when using a "reliable" measuring instrument in the natural sciences. It equates that dispersion to the dispersion of probability situations, such as the flipping of a coin. It assumes that both the measure and the probability dispersions form normal curves for the same reasons - the environment in which they take place has been refined of all but those variables which are acting randomly, or which have small influence, and that all the major explanatory variables have been allowed for.

It is these same random variables which are assumed to cause the measure of any population - for example, the height or weight or people - to be dispersed in the form of a normal curve within a particular culture. In these examples the variables are assumed to be both genetic and experiential, which are the same variables that are assumed to determine mental dimensions such as intelligence, opinions, attitudes, etc. This completes the chain of reasoning, and it is concluded that the counts of any measure of a single characteristic will predictably disperse in the shape of a normal curve. Thus the researcher works to refine both his stimuli and his populations in ways which show his information to be dispersed in a normal curve (at which point he has actually "made" his curve), so that he can label his information as "data" representing a "valid" set of observations.

They also assume that the tester knows the answers.

In other words, he appears to define "culturally meaningful data" as "those responses which can be shown to form a normal curve when elicited from a random sample of a population". Or to put it another way, he often appears to be locked in to the development of reliable instruments as a goal, rather than to the development of culturally meaningful data.

Since we are looking for answers, questionnaires can only provide "signal" data for further in-depth study.

The approach has resulted in the development of some highly sophisticated test instruments. For example, some intelligence tests form normal distributions when administered to a representative sample of K-6 populations. In this situation, both the stimuli (questions) and the populations (students) can be specifically designated. And the increases in scores which students experience each year are about equal for each year of chronological age which is divided into the score. The equal intervals mean the scores can be called "valid", and the fact that repeated administrations continue to place the subject on the same spot on the normal curve means that the instrument and procedure can be called "reliable". When the test has been administered to thousands of subjects, and the scores plotted, the entire process takes on the aura of a standard, and the tests are called "standardized". But note that in this approach it must be assumed that the student doesn't possess all the information that is requested, and that the tester does. Thus the tester can construct a scale from 0 to 100%. But also note that as a result, the intelligence which is defined grows out of the testing instrument, not out of any psychological or sociological theory about intelligence. Cicourel calls this "measurement by fiat" because there is no theory to support it.

When the same approach is used on questionnaires, such as those which may be designed to obtain opinions in evaluation studies, we are seeking information about how users experience their environments. And if we are asking the users, we've got to remember that we don't have the "right" answers, (there are none) and that we are assuming that the users can provide us with some. This assumption is the reverse of the test-design situation, and there's no possibility of constructing a scale of intervals, or even of more or less, because we aren't testing anyone. What we're trying to do is to correlate user responses (to our questions about their environments) to actual environmental conditions. And under all but the most extreme conditions, the users' answers can be expected to form a binomial distribution. (7)

In-depth studies attempt to ascertain cultural meanings: what symbols mean, cultural attitudes and beliefs, and individual physiological differences.

5.4 Cultural Meanings Assumptions

In other words, in studying normal conditions, the users opinions about an environment or an activity can be expected to vary between extremes, and to cluster predominantly about a center position. And it is these variances that are so interesting to the evaluator. Because, instead of the spread being an "error" of a "measure" it actually can represent differences in one or more of at least three possibilities: 1) environments, objects,or other people "out there"; 2) individuals perceptual or psychological equipment; and/or 3) the attitudes and beliefs of the users which help to determine the meanings they assign to descriptions of objects, events, and activities and to their responses to our questions. All three are present in the response curves, and it's the shape of the curves, the extremes (ranges) of the responses, and what the subjects believe they were actually using as referents that may enable us to construct theoretical models of people and of their environments that will reveal in what ways and why they interact.

Thus it is premature at this time to attempt to develop "reliable" instruments and procedures via anonymous questionnaires, sample populations and statistical manipulation. Instead, the evaluator must work to increase the validity of his data by searching for cultural meanings in order to make explicit the common-sense assumptions he finds operative. He can then accept the users in all their diversity and changeability, and work to develop expressions that show in what ways they are different and changeable, and in what ways their environments can be made to fit these differences and changeabilities. He must begin with questionnaires and interviews of purposive samples of users, and go beyond the answers to search for their "cultural meanings" - i.e. their object referents plus those physiological conditions, and the attitudes and beliefs which also contributed to their responses.

Several ways to search for cultural meanings are suggested, including ethnoscience methods. The aim is to report data from the users' point of view instead of the researcher's.

5.41

Some techniques for this kind of data search are available, and Cantor's and Barowsky's approaches are mentioned in Section 2.3. Interviews also contributed meaningful data to the studies previously cited by Bednar and to our prototype study in Appendix C. Other kinds of techniques that might be adopted include psychological approaches such as "T" groups, sensitivity training sessions, or the recently developed method of description known as ethnoscience, "The goal of this approach is to discover how members of a particular society categorize, code or otherwise define their experience". (18) In using this data in combination with other data, the researcher can begin to explain behavior in terms of its meaningfulness to the social actor, and to develop a body of theory containing warrants and arguments that grow out of social empirical data. In so doing, he will avoid biasing his data, as all social scientists must in making parametric studies, by assuming: 1. that the people being studied share his cultural meanings; or 2. that social meanings can be explained in terms of factors external to the actor, discarding as irrelivant those cases that don't appear to conform with the researcher's theory (19). These twin biases can be avoided in evaluations by using questionnaire data as "signal" probes, and going beyond to search for deeper meanings, particularly those meanings that don't conform with the preponderance of evidence.

It's assumed that correlation statistical techniques can be used for validity tests.

5.5 Data Manipulation Assumptions

Studies of social meanings often involve the use of analytic techniques such as factor or regression analysis (20) to reveal patterns of association between man and his environment. Based on our discussion above, these correlations of socio-economic, etc., data are only a part of the story, and can only be fully understood by going on the show from "cultural meanings" studies what each factor "means" to, and in what ways it affects, the person(s) being studied. In working toward increasingly valid data, we assume that face validity tests can be used with other data to seek user-referents for the words we use; interview - face validity correlations can be used to define the shape and size of the curve which represents the users responses; and percentage analysis correlations can be used to compare actual environmental measures to the curve of the responses. With enough of this kind of data in hand, we can work to refine our generalizations and assumptions (our body of theory) about the interactions of humans with their environments. And it is then that we can begin to construct "reliable" instruments which entail from our theory, and which can be used to test the human-environmental hypotheses which appear to be worth pursuing.

6.0 EVALUATION COMPARISONS

We have developed the concept of environmental measures as probability inductions, hypothesized an evaluation method with which to gather data, and made basic assumptions for field studies. This section isolates five realities which bear on environmental measures sufficiently to be profitably compared, and is included exclusively to show the structure of the comparisons and the kinds of warranted arguments which must be used to begin developing a body of theory about environmental measures. Particular attention will have to be given to developing the logic of experimental evidence with which to establish the warrants, because they are the authority for the links between the environmental referent and the human satisfaction referent in any measure.

The world is divided into five realities which can be compared:
- -objects
- -environments
- -standards
- -records, and
- -opinions.

6.1 Five Realities

As a convenience in evaluating for environmental measures, we divide the world into five realities which can be compared, and operationally describe them as follows:

- Objects such as rooms and buildings and the equipment and items of which they are composed, and the people using them.
- Environments in which objects and people are immersed, including the spatial, luminous, sonic, climatal, stability, time and esthetic environments for individuals; and the size, assortment, location, privacy, flexibility and convertibility of space environments for organizations.
- Standards such as temperature, light levels, etc., and time and use standards which serve over time as guides and goals for the operation of a college or the conduct of people.
- Records of experiences which show the progress being made toward achieving the standards, such as time and use records.
- Opinions of people about the objects and environments, and the standards and records which sym-

bolize them. They are expressed at a single po˙nt in time, in interviews or on questionnaires.

This gives us fifteen combinations for field study, each of which may have dozens of comparison possibilities. In the section which follows, only those possibilities are structured which appear to be most promising for the development of environmental measures for the activities of individuals or of groups of people.

6.2 Evaluation Arguments

The structure of the argument that might be used to warrant the evaluation statements is given for each comparison. The verb "describes" in each comparison refers to statements shown in Section 3.2 which show cause-effect, necessary but not sufficient, correlative, or ranking relationships.

For each comparison,
- -who
- -compares what, and
- -the descriptive statement

are outlined.

6.201

A. Comparing Objects to Similar Objects

1-3 An Evaluator compares:
- two or more similar: 1) objects in the built environment, except people; 2) objects containing standards; or 3) objects containing records.
- used for the same activity, and
- describes their comparative appearances, performance, etc.
- e.g., 1) An evaluator compares a green chalkboard to a black chalkboard and describes similarities and/or differences in appearance, performance, etc.

For each argument,
- -the kind of claim,
- -the scales,
- -the measurer, and
- -the warrant

are shown.

Structure of Argument for A-1 to A-3:

Producer-Product claim: If physical differences can be perceived between two objects serving the same activity, then these differences are necessary (but not sufficient) to effect the performance of the activity.

Scales: Either of the objects being compared.

Measurer: Evaluator.

Warrants: If an observer can perceive a difference, it can be studied.

Use of Statement: Description.

We compare objects to objects,

Discussion - The observer looks at, smells, feels, listens to, etc., two objects serving the same function and notes how the one differs with the other. This is the common structure of argument on which all purely comparative or descriptive statements are based. The approach is most useful where some particular room is widely known for its success in fulfilling a design function. Other rooms can then be usefully compared with it simply because so many people know about it and use it as a point of reference.

user behaviors to user behavior,

4-5 An evaluator compares:
- the overt behavior of the user(s)
- of two different objects
- (or, 5, the behavior of a group of users of the same object)
- used for the same activity, and
- describes differences in physical behavior.
- e.g., An evaluator compares the physical activities of: 4) one lecturer using two different lecterns, and notes similarities and differences.

Structure of Argument for A-4 and A-5:
Producer-Product Claim: If, after single demonstrations of each, a lecturer is able to select lectern controls correctly more often at one lectern than at another lectern, then the differences in the design are necessary (but not sufficient) to cause the behavioral differences.
Scales: Physical measures and counts.
Measurer: Evaluator.
Warrant: The design of an object is a factor in its use.
Use of Statement: Prediction.

physiology
to
physiology,

6.7 An evaluator compares:
- the physiological conditions of a user
- of two different objects
- (or 7, the physiological conditions of a group of users of the same object)
- used for the same activity, and
- describes the variations.
- e.g., 6) An evaluator compares the respiration rate(s) of the user of two different kinds of television cameras, and notes similarities and differences.

Discussion - This is not structured because it would interfere with the on-going activities of the users.

environments
to
environments

6.202

B. Comparing Environments to Similar Environments

1. An evaluator compares:
   - two or more similar environments
   - used for the same activity, and
   - describes similarities and differences in performance, comfort, utility, etc.
   - e.g., An evaluator compares the luminous environment in one room with that in another and describes similarities and differences.

Structure of Argument (same as comparison A-1)

opinions
to
opinions
(for
preferences)

6.203

C. Comparing Opinions to Opinions (Same Users)

1-4 An evaluator compares:
- the opinions of two or more users.
- about the physical characteristics of: 1) objects in the environment, except people; 2) environments; 3) objects containing standards; or 4) objects containing records
- used for the same activity, and
- describes preferences.
- e.g. 1) An evaluator compares the opinion of one teacher to that of other teachers about the same chalkboard and describes the preferences on their opinions as to the adequacy of the chalkboard for their activities.

5-8 An evaluator compares:
- the opinions of two or more users
- about the physical characteristics of two or more objects: 5) objects in the environment, except people; 6) environments; 7) objects containing standards; or 8) objects containing records
- used for the same activity, and
- describes preferences.
- e.g., 5) An evaluator compares the opinions of one teacher to that of another teacher about a green vs. a black chalkboard, and describes the preferences they have for one or the other for use in their activities.

9-10 An evaluator compares:
- the opinions of two or more users
- about the same object: the informational content of 7) standards; or 8) records
- used for the same activity, and
- describes preferences.
- e.g., 9) An evaluator compares the opinion of one teacher to that of another teacher about a time usage standard for language labs, and describes the preferences of their opinions as to the adequacy of the standard for their activities.

11-12 An evaluator compares:
- the opinions of two or more users
- about several objects: the informational content of 9) standards; or 10) records
- used for the same activity, and
- describes preferences.
- e.g., 10) An evaluator compares the opinion of one teacher to that of another teacher about a time usage standard for student station vs. one for classrooms, and describes the preferences they have for one or the other for use in their activities.

Structure of Argument for C-1 to C-12
Correlation Claim: If differences of opinions are reported between users of an object(s), as to its comfort and/or utility for their activities, then these differences will correlate with differences in the objects.
Scale: Verbal statements of comfort or utility.
Valuer: Users.
Warrants: The user knows best: his opinions affect his activities; the form and content of an object is a factor in its use; differences in opinions can be studied.

Procedure - The user(s) are interviewed or asked to complete questionnaires such as the examples included in Appendix C, Initial Evaluations of New Buildings: A Prototype Study. The opinions are then compared as indicated.

opinion to opinion (for preference)

13. An evaluator compares:
- the opinions of user(s)
- about the importance of each object, aspect, goals or consequences of a room,
- used for the same activity, and
- describes the relative importance of each to user activities.
- e.g., An evaluator has a lecturer rank the importance of each A-V equipment he uses, and reports the ranking and how they may be similar to or differ from the rankings of other lecturers.

Structure of Argument for C-13
Correlation Claim: If a teacher can rank the importance of the environmental aspects of a room, then the ranking will correlate with the actual contribution of the aspects to his activities.

Scale: Verbal Statements.
Valuers: Users.
Warrant: The user knows best: his opinions affect his activities; differences in opinions can be studied.
Use of Statement: Description.

Discussion - The separate aspects are each noted on a separate "Q-Sort" card and sorted by each user into most-to-least value. This shows a way to rank separate aspects, (physical characteristics, equipment, goals, and consequences) of a room into statements of instrumental preference. This information is useful in programing, in design, and in research to examine alternate design solutions.

standards to standards,

6.204

D. Comparing Standards to Standards (for same Objects, Environments or Users)

1-3. An evaluator compares:
- two or more standards
- for the same: 1) object; 2) environment; or 3) user
- at a single moment in time, and
- describes conflict or reinforcement.
- e.g., 1) An evaluator compares a standard for area usage to a standard for time usage of a classroom, and describes in what ways they conflict or reinforce.

4-6. An evaluator compares:
- standards
- for: 4) objects to users; 5) objects to environments or; 6) users to environments,
- at a single moment in time and
- describes how they conflict or reinforce.
- e.g., 4) An evaluator compares a standard for time usage of classrooms to a standard for student contact hours in classrooms, and describes in what ways they conflict or reinforce.

Structure of Argument for D-1 to D-6
Producer-Product Claim: If standards are used to guide the design or use of objects for human goals, then they must contain congruent elements which are necessary (but not sufficient) to attain the goal.
Scale: Measures and Counts.
Measurer: Expert.
Warrants: If differences can be found, they can be studied.
Use of Statement: Descriptions of necessary but not sufficient standards relating objects, and environments for human activities.

6.205

records to records,

E. Comparing Records to Records (for same Objects, Environments or Users)

1-3 An evaluator compares:
- two or more records
- for the same: 1) object; 2) environment; or 3) user,
- at a single moment in time, and
- describes conflict or reinforcement.
- e.g., An evaluator compares a record of time usage to a record of area usage of a classroom, and describes in what ways the information shows conflict or reinforcement.

4-6. An evaluator compares:
- records
- of: 4) objects to users: 5) objects to environments; or 6) users to environments,
- at a single moment in time, and
- describes conflict or reinforcement.
- e.g., An evaluator compares a record of time usage of a classroom to a record of student contact hours in classroom, and describes in what ways the information shows conflict or reinforcement.

Structure of Argument for E-1 to E-6
Producer-Product Claim: If the utilization of student chairs in one lecture hall exceeds their utilization in some other hall, then the form or content of the room is a necessary (but not sufficient) condition of the utilizations.
Scales: Counts (average percentage per hour and per week of student station use).
Warrant: Utilization of student stations is a measure of efficiency: the form and content of an object are determinable to its use.
Use of Statement: Description.

7-9. An evaluator compares:
- two or more use records
- for the same: 7) object; 8) environment; or 9) user,
- before and after, and
- describes changed conditions.
- e.g., 7) An evaluator compares records of class enrollment distributions before and after a lecture hall center is used on a campus, and describes in what ways the form or content of the center effects the class enrollment.

Structure of Argument for E-7 to E-9

Producer-Product Claim: If data on class enrollment distribution is compared before and after a new lecture hall center is put in use, then the form or content of the center is a necessary (but not sufficient) condition of the distribution differences.

Scale: Counts.

Measurer: An expert.

Warrant: Manipulation of a single variable (the center) while holding all other conditions constant will show the significance of the variable.

Use of Statement: Description.

10. An evaluator compares:
- two or more achievement records
- for the same users of an object or environment
- before and after, and
- describes differences.
- e.g. An evaluator compares the recorded mental achievement scores of users before and after the use of an object.

Structure of Argument for E-10

Producer-Product Claim: If learning is greater in a lecture hall than in other rooms for identical lectures, then the form or content of the hall is a necessary (but not sufficient) condition for the differences in learning.

Scale: Scores on mental tests.

Measurer: Expert(s)

Non-educational warrants: The room environment has an effect on the amount of learning that takes place in it; manipulation of a single variable (the room) while holding all other conditions constant will show the significance of the variable.
Use of Statement: Description.

Discussion - The expert administers identical, fully-instrumented lectures to matched groups in different kinds of rooms, tests them before and after the lectures, and compares the results noting T-score variations in the mean. There is no way to show cause and effect in comparison tests of this kind, nor can "all other conditions" be held constant. The lecture halls are designed to support the lecturer with A-V media which in turn is assumed to lead to better learning. But ironically, to evaluate this directly is the least promising approach because another variable (the lecturer) is introduced for whom there are no standard scores. However, these kinds of mental achievement tests are firmly established in educational methodology experiments and are useful in evaluating a lecture hall simply to demonstrate through concomitant achievements that as much learning can take place in one environments as in another. Lesser and Schueler (21) in a recent review of the research literature on the use of new media in teacher education, concluded that this type of testing has "...harvested a rich crop of non-significant findings".

6.206

objects to environments,

F. Comparing Objects to Environments

1. An evaluator compares:
   - an object to the environment it creates
   - at one point in time
   - for a single activity, and
   - describes characteristics of the environment created by the object.
   - e.g., An evaluator compares a 40 watt electric bulb to the light it creates and describes in what ways luminosity appears to be a function of the bulb.

Discussion - This comparison is not structured because the "evaluation"would have to be either a user or an (appropriate kind of) engineer for the findings to be useful.

Structure of Argument for G-1

Correlation Claim: If differences of opinion are reported by users of an object as to its comfort and utility for their activity, then the opinion differences will correlate with differences in the referents for their opinions.

Scales: Verbal statements about the adequacy of view; physical measures and counts.

Warrants: The expert user knows best; if an observer perceives a difference, it can be studied.

Use of Statements: Description.

6.207

G. Comparing Objects to Opinions

1. An evaluator compares:
   - an object
   - to the opinion(s) of the user(s), and
   - describes in what ways the object is a referent for the opinion.
   - e.g. An evaluator compares a chalkboard to a Teacher's opinion about it, and describes those characteristics of the chalkboard that are a referent for the opinion.

objects
to
standards,

6.208

H. Comparing Objects to Standards

1. An evaluator compares:
   - physical characteristics or operation of objects or separate aspects of objects
   - to specifications for its: 1) form or content; or 2) performance, and
   - describes conformance of the object to the specifications.
   - e.g., An evaluator compares a chair to design drawings for its manufacture and describes similarities and/or variations.

Structure of Argument for H-1

Producer-Product Claim: If the lights work according to specifications, then they are a necessary (but not sufficient) condition to the operation of the room.

Scales: Design specifications (manufacturer and/or architect); physical counts and measures.

Measurer: Expert or user.

Warrant: Experimental evidence: design specifications are objectives: The object must be literal translation of design objective.

Use: Prediction of operation.

Discussion - The resulting statements are positive or negative re-statements of the standard or goal for the aspect observed. As a negative statement, it indicates a problem that can be investigated. And because the aspects were chosen for their pertinence to the instrumentality of the room being evaluated, it may also indicate a disfunction. As a positive statement, it indicates a contributing (but not sufficient) condition for the success of the room.

2. An evaluator compares:
   - the physical behavior of a user(s)
   - at an activity involving an object with human performance standards stated
   - comparing the standards to their behavior, and
   - describing congruences.
   - e.g., An evaluator observes, measures, counts, etc., the physical behavior of a student and compares it to behavior standards.

Structure of Argument for H-2

Producer-Product Claim: If, after a single demonstration, the majority of lecturers are able to select audio-visual controls correctly in three out of four selections, then the lectern design is a necessary (but not sufficient) condition for selection of controls.
Scale: Physical measures and counts.
Measurer: Evaluator.
Warrant: Since the ideal is fictional, no warrants are proposed.
Use: Description and prediction.

Discussion - so few standards are available for physical behavior in classrooms and lecture halls that standards such as the fictional one above may have to be hypothesized. However, for rooms designed for studying or discussions or testing, on in laboratories or other physical performance rooms, standards of behavior could be stated in performance terms and this comparison could then become a part of the evaluation. The approach shows the most promise for use in experimental situations such as the one by Sommers (22) on the effects of classroom environment on student learning. Various physical aspects of rooms can be changed under controlled conditions, and the overt physical behavior of the occupants observed to search for the kinds of environments that seem to foster a performance (behavior) stated as an objective. Sommers recommends the development of "...frankly experimental building facilities," for this purpose.

3. An evaluator compares:
   - the physiological states of user(s)
   - at an activity involving an object which has human psychological performance specifications stated,
   - comparing the user states to the standards, and describing congruences.

Discussion - This comparison is not structured because: 1) it would interfere with the on-going activities of the user; and 2) few standards are available for comparison.

objects to records,

6.209

I. Comparing Objects to Records

1-2. An evaluator compares:
   - one: 1) object; or 2) user
   - to experience records of performance, or use, and
   - describes the accuracy of the records.
   - e.g., An evaluator compares the number of student chairs in a classroom to the inventory record of chairs, and describes the accuracy of the record.

Discussion - This is an internal audit to verify the validity of the recorded information.

environments to opinions,

6.210

J. Comparing Environments to Opinions

1. An evaluator compares:
   - an environment
   - to the opinion(s) of the user(s) and
   - describes in what ways the environment is a referent for the opinion.

Discussion - This is structured as in G above.

environments to standards,

6.211

K. Comparing Environments to Standards

1. An evaluator compares:
   - physical characteristics or operations of environments
   - to environmental measure standards, and
   - describes conformance of the environment to the standard.
   - e.g., An evaluator measures the temperature of the air and compares it to design standards, noting variations.

Structure of Argument for K-1

Producer-Product Claim: If the air meets the standards of the ASHRAE for temperature, then it is a necessary (but not sufficient) contributant to the occupants comfort.
Scales: Physical measures and counts.
Measurer: An expert.
Warrant: Experimental evidence.
Use of the resulting statement: Prediction.

Discussion - This is a traditional approach to evaluation because many standards are available. It is also used to evaluate against architectural objectives such as sight-lines. For an example of this approach, see Appendix D, Area per Activity in Classrooms. When environmental measures are taken as authoritative, it is assumed that the standard is correct, and a reference to it is sufficient notice of this assumption. But care must be taken that "comfort" is not miscounstrued to mean any more than lack of discomfort to human perceptions. There is a wide range of possibilities (tolerances) for comfort, and the significance level of the standard used should always be explicitly stated. As an alternate approach, a population percentage can be stated as allowable, and all standards chosen to meet this range.

environments to records,

6.212

L. Comparing Environments to Records

As in comparison I, this is an internal audit procedure to determine the validity of the record and is not structured here.

opinions to standards,

6.213

M. Comparing Opinions to Standards

This comparison would be structured as in "G" above.

opinions to records,

6.214

N. Comparing Opinions to Records

This comparison would be structured as in "G" above.

standards to records,

6.215

O. Comparing Standards to Records

1,2. An evaluator compares:

- a standard
- to a record
- for object(s): 1) physical facility; or 2) environments and
- describes achievement toward the standard.
- e.g., An evaluator compares a record of time use to a standard for time use for classrooms, and describes the progress made in achieving the standard.

Structure of Argument for O-1 to O-2

Producer-Product Claim: If the facility experience data for a target year compares favorably with planning data (plans made in 1964 for class enrollment distributions in 1970, for example), then the facility is a necessary (but not sufficient) condition to meeting the goal.
Scale: Counts.
Measurer: An expert.
Warrant: Manipulation of a single variable (the room) while holding all other conditions constant will show the significance of the variable.
Use of Statement: Description and projections.

(for both
efficiency
area
and
time usage
standards,
and

Discussion - Time utilization factors and area per occupant standards are often cited in the planning or use of instructional rooms. And in using them, recognition is seldom given to the possibility that a larger variety of sizes of rooms might have the potential of raising the standards. In other words, the utilization factors are used to evaluate the scheduling procedures, given the facility, rather than to evaluate the planning of the facilities, given the educational program that needs to be housed.

In addition to time and use objectives that can be compared, a facility program contains explicitely stated objectives, from which implied objectives or assumptions can be derived and compared to actual accomplishments. For example, lecture halls have been programmed by the State University as (120 seat or more) rooms to support the lecturer with audio-visual aids, and one (unstated) assumption that can be evaluated is that the use of these rooms will have salutory educational effects or outcomes.

3,4. An evaluator compares:
- two or more standards
- to a record
- for object(s); 3) facility; or 4) environment, and
- describes adequacy of the record for the standards.
- (This is simply an internal audit procedure like comparison I)

5,6. An evaluator compares:
- a standard
- to two or more records
- for object(s): 5) facility, or 6) environment, and
- describes the adequacy of the records for the standard.
- (This is simply an internal audit procedure like comparison I)

for
effectiveness
activity
achievement
standards).

7. An evaluator compares:
   - a standard
   - to a record
   - for users, and
   - describes achievement toward the standard.
   - e.g., An evaluator compares the recorded mental achievement scores of the users of an object, to standardized scores, and make statements of efficient performance of humans while using the object.

Structure of Argument for 0-3 to 0-7

Producer-Product Claim: If the test scores of students after viewing an instrumented lecture are equal to or higher than universal standard scores, then the room is a necessary (but not sufficient) condition of the test scores.

Scale: Standard scores.

Measurer: The program, administered by a teacher.

Non-educational warrants: The room environment has an effect on the amount of learning that takes place in it; manipulation of a single variable (the room) while holding all other conditions constant will show the significance of the variable.

Discussion - The teacher runs a fully programmed and instrumented instructional sequence, scoring the students before and after and comparing the results to standard validation scores for the sequence, noting variations. There are no standardized tests listed in Buros Sixth Mental Measurements Yearbook which contain an environment-learning factor. The use of any other standardized test, because student matching information is never provided, would only show how the students tested varied from the norm. Thus, the only possibility for the use of this kind of test is to develop one that does have an environment-learning factor. But perhaps none have been developed because the environment is a minor factor compared to others in a learning environment, as we have assumed. Thus, the success of a room for learning purposes at this time can be no more than a conclusion inferred from the results of other evaluation tests.

7.0 TESTS OF THE HYPOTHESIS

Two field studies are examined as support for the hypothesis: the first gathered user opinions on questionnaires and in interviews, at both the individual and the group levels.

7.1 User Opinions of Design Fit

This test of the hypothesis is structured to comparison "C", Section 6.201. The user response options took into account: the environmental assumption that the built environment is not acting alone on the user under satisfactory conditions; and the methodological assumptions that the user only responds with perceptions that are compared to his ideals rather than to an absolute good. Thus responses may refer to meanings internal to the responder, but may also reflect their relative satisfaction with other factors such as the teacher, the subject matter, and so on.

1. Opinions about the built environment were gathered in two ways:
   - directly about objects (floors, walls, lights, etc.); and
   - indirectly as user's perceptions of the objects (sight, hearing, skin sensing, etc.)

2. Open response opportunities were included on the same line with each rating, and at the bottom of each page, with a request for comments. These responses are reported as "not functional because" to keep them in the opinion (vs. cause-effect) mode.

3. Responses were obtained at three levels -
   - at the student and teacher level for rooms, at the academic administrative level for major spaces (library, museum, etc.) and the building, and
   - at the campus administration level (maintenance and operation) for the building.

   These three levels are responsive to the ultimate goal of matching student and faculty needs for comfort and utility with the college's needs for efficient use of its buildings.

7.11

Examples of the evaluation questionnaires are included as pages C-19 to C-23. The response options used were excellent, good, fair, poor and bad. This quality scale was used extensively by Prosser and Allnatt (17) to subjectively rate the impairment of television pictures, and was found to form a binomial distribution. This is a measure, for them, of the excellent precautions they have taken to exclude all other variables from the ratings in order to rate a single variable, the television tube quality. This procedure is the opposite of the evaluation, which seeks to include all variables in the opinion ratings, and ultimately a comparison with their findings should be interesting. The scale also:

1. Allows a numerical scale weighting for response distribution computations.

2. Facilitates the comparison of several different responses for the same environmental aspect.

3. Reveals the intensity of feeling in the responses; e.g., normal vs. U-shaped curves.

4. Allows for tests of internal consistency between specific items and the general rating of a group of items. However, instead of this being a reliability test to eliminate specific items which don't correlate strongly with the general rating, it will provide an indication of the specific dimensions of the environment which contribute most strongly (or not) to the general rating of the group.

But no counts and measures were gathered for correlation studies.

These questionnaires are probes to obtain signals which indicate a fit or misfit situation. Data distribution descriptions, apparent intensity of responses, and the significance of individual items to a group can be reported, but no meanings can be ascribed to the data until the environment being studied is actually observed and measured, and a portion of the respondents interviewed. If a person rates a room "bad", it may be because he hates the subject, or the teacher, or getting up for an early class, or so on. And since these meanings are a part of social reality, they must be known and reported as such. For this reason, all questionnaires ask for the respondent's name, so that a purposive sample of the group with the majority response, and those respondents who disagree with the majority response, could be contacted in an attempt to find out why they so responded (to search for the referent of their responses, plus the norms, values or ideologies which prompted them). Thus the questionnaires were distributed through the normal administrative structure of the college to obtain an expression of the total reality of the respondents.

7.12

The same assumptions were followed in making the interviews as in structuring and administering the questionnaires. The aim was to obtain insights into the relationships between humans and their environments. Thus, those interviewed were selected because of the likelihood that their responses would be more informational. Their responses of misfit are reported in the "not functional because" mode.

7.13

The pre-test which was conducted is included as Appendix C. Questionnaires were distributed, interviews held, the responses tabulated, and user individual and aggregate opinion statements of fit-misfit, plus "not functional because" statements reported.[1] Second-level inferences of environmental adequacy were made, and value judgements offered for further study of the misfits.

7.14

Thus only the "signal" data is available.

It can be concluded that fits and misfits between the users and their built environments were identified. But these are only the "signals" of the subjective opinions of the users. Field measures must follow to ascertain and dimension the referents of the opinions.

1. Note that the questionnaires were substantially revised after the pre-test. The response options used in the pre-test were "good-OK-poor", so the resulting statements differ from our theoretical discussion. See pages C-16 to 20 for examples of the original pre-test questionnaire forms.

The second study gathered count and measure data but no user opinions.

7.2 Observations of Design Fit D

The study, included as Appendix "B", is an unobtrusive observation of "remnants" (furniture, etc., left at it was at the end of the term) and "archives" (inventory and class sectioning records and architectural drawings). The tests of the hypothesis are structured to comparison "F", Section 6.206; "H", Section 6.208; and "I", Section 6.209. Rooms were observed, measurements and pictures taken, and floor areas computed for the human activities that appeared to have taken place on the last day of the term. These data were compared between rooms with similar functions, and the name of the room (displayed on door-tags), the chairs it contained, and its measured area were compared to campus class sectioning and inventory records. All observations and implications are reported on pages D4-15.

However, the data tends to fulfill all four conditions as tests of the hypothesis.

7.21

The four conditions which are stated as tests of the hypothesis in Section 3.4 are are individually discussed below.

Condition 1: Identification of "fits" and "misfits" between human satisfaction needs and built environments, which can be expressed as environmental measures:

- observation 3 discusses misfits between the concept or net area and the floor area it actually represents in classrooms.
- observation 4 discusses misfits between the architectural design needed by users and the design they have.
- observation 5 discusses misfits between institutional needs for efficient use of floor area, and the use being made of it.
- observation 6 discusses misfits between net floor area and usable floor area.
- observation 7 discusses misfits between activities of users and the kinds of rooms they have.
- observation 8 discusses misfits between institutional needs for efficient use of student stations, and the use being made of them.
- observation 9 discusses misfits between institutional needs for accurate symbols of objective reality, and the symbols it has.

Condition 2: Establishment of ranges of satisfaction and probable percentages of people satisfied for specific environments and kinds of activities:

- the only environmental measure examined in this study was floor area needs per human activity. Observation 5 suggests that 12 sq. ft. per student is adequate in classrooms of 40 students.

Condition 3: Showing in what ways each environmental measures interact with each other:

- the way floor area interacts with comfort criteria for seating is discussed in observation 5, and the fact that it interacts with walls (sound-sight criteria) is discussed in observation 6.

Condition 4: Development of new environmental measures:

- observations 3, 4, and 6, taken together, suggest that the traditional criterion of net area can be refined to a concept of usable area which is more representative of the actual use of floor areas for human activities.

7.22

Thus the next step is to gather both counts and measures and user opinions in the same environments.

This evaluation only compared objects to standards, environments and records. Any study of remnants or archives is implicitely limited by the lack of descriptive and interpretive information which could be contributed by users in the situation being investigated. In spite of this limitation, it can be concluded that the Area per Activity study did contribute information relevant to (but not proof of) all four tests of the hypothesis.

APPENDICES

APPENDIX A

REFERENCES

REFERENCES

1. Houghten, F.C. and Yaglou, C.D.; ASHVE Report 673; ASHVE Transactions, Vol. 29, 1923, page 361; as referenced in ASHVE Guide and Data Book, 1965, page 112.

2. Yaglou, C.D., Riley, E.C. and Coggins, D.I.; ASHVE Report 1031; ASHVE Transactions, Vol. 42, 1936, page 133; as referenced in ASHRAE Guide and Data Book, 1965, page 101.

3. Hopkinson, R.G., "The Evaluation of the built environment". Inaugral lecture as Haden-Pilkington Professor of Environmental Design and Engineering at University College, London, H.K. Lewis, 1966.

4. Ramsey, C.G., and Sleeper, H.R.; Architectural Graphic Standards; John Wiley and Sons, Inc., New York.

5. Bednar, M.J. and Haviland, D.S., "User evaluation of the Spatial Environmental Measure in University Teaching and Research Laboratories: A Methodology Study", Center for Architectural Research, Rensselaer Polytechnic Institute; November, 1969; page 2-69.

6. Haug, H., et al, New Spaces for Learning: Designing College Facilities to Utilize Instructional Arts and Media (Revised Edition), Troy, New York, Rensselaer Polytechnic Institute, 1966.

7. Cantor, David; "The Subjective Assessment of the Environment", University of Strathclyde Building Performance Research Unit, 1969.

8. Barowsky, George; "Improving Performance of Teacher Education Facilities", BOSTI, State University of New York at Buffalo, 1970.

9. Day, J.P., Inductive Probability; Humanities Press, Inc. New York, 1961. See page 279 for the field conditions.

10. Ibid, page 324.

11. Ackoff, R.L., Sciencific Method; Optimizing Applied Research Decisions, John Wiley & Sons, Inc., New York, 1962, pages 16-19.

12. Klapper, J.T., "What we know about the Effects of Mass Communications: The Brink of Hope", in Communication and Culture, edited by A.G. Smith; Holt, Rinehart and Winston, New York, page 538.

13. Wheeler, L., "Behavioral Research for Architectural Planning and Design", Ewing Miller Associates, Terre Haute, Indiana, 1976, page 5.

14. Cicourel, Aaron V., Method and Measurement in Sociology, The Free Press, New York, 1964, page 25.

15. Lepley, Ray; Value: A Cooperative Inquiry, Columbic Press, New York, 1949, article by Gerger, page 107.

16. Simon, J.L., "What does the Normal Curve Mean?" in the Journal of Educational Research, Vol. 61, No. 10, July-August, 1968, page 435.

17. Weaver, L.E., "The Quality Rating of Color Television Pictures," in the Journal of the SMPTE; June, 1968, page 610.

18. For an example of this approach, see Spradley, James P., "The Moral Career of a Bum". in Transaction, May, 1970, page 17.

19. Scott, M., "New Rules for Suicide;" in Psychiatry and Social Science Review, 1968, page 21.

20. Moroney, M.J., Facts from Figures; Penguin Books, Baltimore, Maryland.

21. Lesser, G.S., and Schueler, H., "New Media Research in Education," AV Communications Review, Fall, 1966, page 324.

22. Sommers, Robert, Effects of Classroom Environment on Student Learning, University of California, Davis, California, 1965, page 43.

State University of New York
EVALUATION OF BUILDINGS: A PILOT STUDY

SUMMARY

This evaluation pilot study is designed to demonstrate ways users can express their opinions about new buildings, and report the problems they are encountering. An appropriate field comparison is selected from evaluation theory. Specific environments and physical characteristics of an Art Building are selected for evaluation by students and staff. Questionnaires are designed and administered, and opinions, problems and conclusions reported. Value judgements are suggested, and observations on the methodology made.

Office of Facilities Programing and Research
5/1/69 TADavis

OBJECTIVES

The purpose of this study is to structure a procedure with which users of buildings can: 1) express their degree of satisfaction with characteristics of the building, in the form of valuing statements; and 2) report facility problems that they have experienced, in the form of statements of cause and effect. In addition, this study is structured within a specific theory of evaluation[1] in order to 3) serve as a pilot study for comparing user opinions within that theory.

PROCEDURE

1. A building was selected for study: criteria weren't available to select a building that was functionally typical of all campus buildings, so an Art Building was chosen that was convenient to the researchers.

2. The kinds of users were selected from whom evaluations would be gathered: no individual user experiences a building in all of its dimensions, so all known users were sorted into 5 groups: administrators, teachers, staff (librarians, secretaries, clerks, etc.), students, and maintenance and operation personnel.

3. The human activities that the building was to be evaluated for were selected: The building and rooms were evaluated: 1) as instrumental to the principle activities for which they are utilized by each user (i.e. for students attending lectures, instructors lecturing, etc.); and 2) for human comfort.

4. "Environments" and physical characteristics to be evaluated were selected: since the user compares each physical characteristic to his own personal standards, and we were only after "first impression" evaluations of a new building, physical characteristics were chosen which would obviously affect seeing, hearing and air sensing in the room itself.

5. Questionnaires were designed for gathering evaluation information: five questionnaires were structured (see Appendix for examples):

   A. M & O Personnel evaluation of Buildings
   B. Administration evaluation of Buildings
   C. Student evaluation of Instructional Rooms
   D. Teacher evaluation of Instructional Rooms
   E. Occupant evaluation of Non-Instructional Rooms

   Each questionnaire contains six sections:

   1. Title (who is evaluating what) of questionnaire.
   2. Identification: what's being evaluated by whom, and when.
   3. Instructions.

[1]Davis, T.A., Evaluation of Facilities: Theoretical Considerations, State University of New York, 1/22/68.

4. Structured responses (EXCELLENT-BAD) to CHARACTERISTICS being EVALUATED.
5. Open responses (What is the PROBLEM?) to groups of characteristics.
6. Open responses, (OTHER COMMENTS) respondent's initiative suggested.

The structured responses are meant to measure 1) the users' satisfaction with the functioning of each characteristic relative to his own standards and ideals for it. The open resoonses give the users the opportunity to 2) report facility problems that they have experienced.

6. Questionnaires were administered: The blank "M & O Personnel evaluation of Buildings" questionnaire was given to the Plant Superintendent, who said he would respond with the help of his utilities chief, buildings and grounds supervisor, building services supervisor and campus safety coordinator. The questionnaires were given to the chairman of the Art Department, who gave all but the one he completed to other teachers and to students for completion. Interviews were held with the Plant Superintendent and the Department Chairman, the latter while touring the building.

7. Data was tabulated and statements made: the four kinds of statements are as follows:

OPINIONS

Each thing being evaluated is compared by the responder to his own personal standards or ideals for it. The question he asks himself is: How well does it fulfill its function for his activity? The answer is the user's personal opinion, and can be stated as follows:

> The (characteristic observed) of the object, room or building was reported by (users) to be (or operate) in conformance (or not) with his personal standards (or ideals) for it.

In our opinion statements, we substitute a simpler phrase: "To be (GOOD, O.K., or POOR) in his opinion" for the "to be in conformance with his personal standards for it." For the sake of accuracy we occasionally add a "because" phrase to an opinion statement, when a "poor" opinion is followed by a comment in the What is the Problem? column.

PROBLEMS

The free response sections produce an opportunity for the user to comment on why something isn't functional for his use. These statements take the following form:

> The (characteristic observed) of the object, room or building was reported by the (user) NOT FUNCTIONAL in his opinion BECAUSE (his reason given).

When the responder makes a "GOOD or O.K. except" type of answer, we make it into a problem statement about the second characteristic. For example, if a room is reported good except that the walls should be tackboard, we report the statement about the walls separately as "not functional because."

CONCLUSIONS

We also make aggregate statements about each physical characteristic. These are subjective conclusions made from the reported opinion and problem statements. They are the statements that are reported by the evaluator.

VALUE JUDGEMENTS

On the basis of the reported opinions, problems and conclusions, an administrator could make value judgements about the facility. Examples are given on Page 13.

RESULTS

At the interview with the Plant Superintendent, the writer offered to contact each of his personnel who were concerned with the Art Building to obtain their evaluations separately. This procedure wasn't followed because he said that a composite return coordinated by himself would be a more accurate, consistent, and valid response. Notes were taken to record the facility problems that he mentioned during the interview. Without exception, these problems were all mentioned in his questionnaire response.

At the interview with the Department Chairman, the writer offered to contact his teachers individually to obtain teacher and student evaluations. This procedure was not followed because he said he much preferred to do it himself. Notes were taken to record the facility problems that he mentioned while giving the writer a tour of the building. Of the three principle problems mentioned, only one (insufficient ceiling height in sculpture and painting studios) showed up on his questionnaire. The other two not functional statements are reported in the "conclusions."

On the Plant Superintendent's return there are 140 structural response spaces and 82 free response spaces. Seventeen spaces weren't applicable (9 - no air conditioning, 8 - no science group II equipment). Good-value statements can be made about the 97 physical characteristics reported "good" or "o.k." The negative, or "poor-value" of the same statement can be used to describe his evaluation of the seventeen physical characteristics which were reported "poor."

The Superintendent exercised his initiative to make free problem responses 18 times-- 9 times in the "What is the Problem?" column and 9 times via footnotes to poor responses (which were typed on the back of the questionnaires, because of limited space in which to respond on the front.) Removing duplications, 14 poor-value-because statements can be made: 7 can be classed as maintenance (expensive, non-standard out of adjustment hardware, leaking roof, unpainted walls, unsealed concrete, burned flooring); 3 can be classed as safety (excess fire exits, insufficient electric service and fire extinguisher boxes); and 4 can be classified as comfort problems (insufficient ventilation, air conditioning, poor acoustics, cold exterior walls.)

On the Department Chairman's return, all 25 structured responses were completed. Four responses fall on the POOR side of O.K. and 21 fall on the GOOD side. The following 25 evaluations can be stated from his report:

21 good - value
1 poor - value (about window lighting)
3 poor - value - because

Table 1: QUESTIONNAIRE RESPONSES

Physical Characteristic	Building M & O	Acad.	Art Gallery	Instr. Rooms Teachers	Students	Offices	Library
Ventilation	2-3-5	O.K.	O.K.	0-2-2	4-4-4	0-3-0	Poor
Heating	3-6-0	O.K.	Poor	0-2-2	5-3-5	1-1-4	Poor
Cooling			(not installed)				
Artificial Ltg.	9-0-0	O.K.	O.K.	1-2-1	7-5-1	1-5-1	O.K.
Floor Covering	7-1-1	O.K.	O.K.	1-1-1	7-5-1	0-5-0	-----
Entrances	Good	Poor	O.K.	1-1-1	4-8-0	0-5-0	Good
Acoustics	(Poor)	Poor	O.K.	0-2-2	3-6-1	1-1-3	*
Noise Isolation Between Rooms		O.K.	O.K.	1-3-0	6-5-1	2-3-0	Good
Window Lighting		O.K.	O.K.	0-2-0	2-5-2	0-5-0	*
Room/Bldg. Shape		O.K.	O.K.	0-3-0	4-7-1	0-5-1	O.K.
Circulation Areas		O.K.	Good	0-1-1	4-5-2	----	-----
Window Location				0-2-0	3-7-1	0-5-1	O.K.
Color Scheme				0-3-0	1-3-6	0-5-0	Poor
Supply Storage				0-1-2	3-4-3	0-3-2	Poor
Garment Storage				(2)	1-5-6	0-0-6	Poor

* Means that a value wasn't marked but that a comment was made.

OPINION, PROBLEM AND CONCLUSION STATEMENTS

The following report starts with the characteristics that are mentioned on the most questionnaires and follows through to the characteristics that are listed only once. In this way we sometimes develop composite statements before becoming limited to the opinions of a single group. The opinion statements for multiple kinds of returns are tabulated by characteristic and by return in Table 1, (see "Results," above).

Where we encounter multiple returns for the same characteristic, the subjectivity of the researcher determines which values to report and the content of the conclusion. Table I is an objective tabulation, but the complete evaluative statements sift out some of the contradictions and ambiguities in order to report an "average." It might be argued that since all that's being reported is personal opinions, they should be reported only as in Table 1. On the other hand, it can be seen that report opinions that represent a consensus does have a social group significance which can be treated statistically if large enough samples are taken. The variants can also then be studied for their significance. The following statements include opinions, problems and conclusions grouped by each characteristic being evaluated.

VENTILATION OPINIONS

GOOD in halls, elevator
O.K. in service rooms, art gallery, faculty and staff offices
POOR in service tunnels, library
POOR in stairways because there is none
POOR in instructional spaces because it only turns over 3x/hr.

In conclusion, the ventilation was reported GOOD or O.K. in the users opinion in low population density rooms, and POOR where there is none, in the service tunnel, and in high population density rooms.

HEATING

The heating system was in the process of being balanced to individual room demand at the time of the study, so any evaluation statements would be premature. One not-functional statement can be reported:

Some heating supply grilles were reported NOT FUNCTIONAL in the Art Gallery, in the Curator's opinion, BECAUSE they are located at the base of walls where art work is to be hung.

LIGHTING

GOOD or O.K. in the entire building
POOR in three faculty studio offices because it bothers eyes, is too pink, or leaves dark spots

Some artificial lighting fixtures were reported NOT FUNCTIONAL in the user's opinion BECAUSE: a) they are non-standard, and difficult to maintain; b) they are difficult to access in the Art Gallery; and c) they need dimmer switches in the classrooms.

In conclusion the artificial lighting was reported GOOD or O.K. in the user's opinion, except in three faculty studios (rooms 116, 219, 220)

FLOOR COVERING

GOOD in stairways, assigned rooms, and service rooms
O.K. in elevator, art gallery (but would prefer wood)
POOR in halls because of cigarette burns.

The vinyl asbestos tile flooring in the halls was reported NOT FUNCTIONAL in the Plant Superintendent's opinion BECAUSE cigarette butts burn and thereby deteriorate it.

In conclusion the floor coverings were reported GOOD or O.K. in the user's opinion except in the halls.

ENTRANCES

GOOD or O.K. in all rooms but 226
POOR in exterior walls because one entrance makes a corridor of the Art Gallery
POOR in the Art Gallery because there are too many (5 instead of 1)
POOR in Room 226 because too narrow and hard to open

The panic door hardware was reported NOT FUNCTIONAL by the Plant Superintendent because it doesn't stay in adjustment and has floor mounted checks.

The fire exits were reported NOT FUNCTIONAL by the Plant Superintendent BECAUSE there are too many above the code, making security difficult.

The special art handling provisions were reported NOT FUNCTIONAL by the Art Gallery Curator BECAUSE there are none.

In conclusion the building and room entrances were reported GOOD or O.K. in the user's opinion except in the Art Gallery and Room 226.

ACOUSTICS

O.K. in Art Gallery

The ceilings were reported NOT FUNCTIONAL by several users BECAUSE they are of barrel-vault design and don't carry sound uniformly throughout the room.

In conclusion the acoustics of the rooms (except art gallery) were reported POOR in the opinion of the faculty and building administrators and GOOD or O.K. in the opinion of the students.

NOISE ISOLATION BETWEEN ROOMS

O.K. or GOOD everywhere

The open space at windows between floors was reported NOT FUNCTIONAL by the Art Curator BECAUSE sound carries through it.

In conclusion, the noise isolation between rooms was reported O.K. or GOOD in the opinion of the users.

NOISE ISOLATION FROM OUTDOORS (Not tabulated in Table 1)

Because of the extensive noisy construction work being carried on immediately adjacent to the building, any value report at this time would be premature. Many of the returns mentioned this temporary and excessive noise source.

NOISE ISOLATION FROM CORRIDORS (Not tabulated in Table 1)

In AGGREGATE, noise isolation of rooms from corridors was reported GOOD or O.K. in the opinion of all the users.

WINDOW LIGHTING

In conclusion window lighting was reported GOOD or O.K. except for 3 comments that sunlight doesn't reach indoors.

BUILDING/ROOM SHAPE

In conclusion the building and room shape were reported GOOD or O.K. in the opinion of the users.

CIRCULATION AREAS

The corridor exhibit facilities on the third floor of the Art Building were reported by the academic building administrator NOT FUNCTIONAL in his opinion BECAUSE the corridor is too narrow, the wall is too hard (plaster) and the lighting is too hot.

In conclusion the circulation areas were all reported GOOD or O.K. in the opinion of the users except for three comments on there being too much furniture in instructional rooms.

WINDOW LOCATION

In conclusion, the windows were reported to be located GOOD or O.K. in the opinion of the users.

COLOR SCHEME

POOR in the library.

In conclusion, the interior color scheme (except library) was reported O.K. in the opinion of the faculty and O.K. or POOR in the opinion of the students.

AUDIO VISUAL EQUIPMENT (Not tabulated in Table 1)

The rooms for which reports were made did not contain AV equipment.

SUPPLY STORAGE

POOR in library because none provided.

In conclusion, personal student supplies storage facilities in instructional rooms was reported in a manner that suggest individual room problems exist: i.e. perhaps ceramic students store more supplies than painting students, etc.

Ceilings (Not tabulated in Table 1)

POOR in halls because they aren't designed for easy access to utilities. (z bar instead of lay-in)
POOR in sculpture and painting studios because not high enough.
POOR in art gallery because architecturally "too active"

In conclusion, the ceilings were reported POOR in the opinion of the users.

OFFICE DESKS AND CHAIRS (Not tabulated in Table 1)

In conclusion, the office desk storage, and work surface height and size were reported GOOD or O.K. in the opinion of the users.

In conclusion, the office chairs and bookshelves were reported GOOD or O.K. in the opinion of the users.

GARMENT STORAGE

POOR in library because none provided
POOR in offices because none provided
POOR in instructional rooms because located incorrectly

In conclusion the garment storage facilities were reported POOR in the opinion of the users.

OTHER CHARACTERISTICS OF BUILDING

In conclusion, the other characteristics of the Art Building that were reported GOOD or O.K. in the opinion of the academic administrator were other classroom and office equipment, student chairs, departmental storage rooms, student lounges, rest rooms, conference room, relationships of rooms, size of classrooms and location of the building.

One further observation was made:

The outside walls of the Art Building were reported NOT FUNCTIONAL in the opinion of the plant superintendent because they contain no sandwich insulation in the ribs which are exposed to room interior; "terrific heat loss results in drafty conditions near outside walls and high heating costs."

OTHER CHARACTERISTICS OF ART GALLERY

In conclusion, the other characteristics of the Art Gallery that were reported GOOD or O.K. (without exception) in the opinion of the curator were rest rooms, relationship of rooms, shape of rooms and location of gallery.

OTHER CHARACTERISTICS OF INSTRUCTIONAL ROOMS

The painting studio skylights in the Art Building were reported by the academic building administrator NOT FUNCTIONAL in his opinion BECAUSE the daylight only reaches about 25% of the total room floor area, and about 50% of that area is circulation space.

In conclusion, the facilities for darkening windows in instructional rooms were reported POOR in the opinion of the faculty because there aren't any.

VALUE JUDGEMENTS

From the opinions and problems reported by the users, and the conclusions reported by the evaluator, the following value judgements might be made by an administrator:

1. The thermal environment is unsatisfactory for all functions. The HVAC system was not completely operational at the time of the survey and was generally reported unsatisfactory: it should be re-evaluated again this spring.

   a) The role that the uninsulated exterior walls and loose-fitting windows play in uncomfortable conditions should be specifically investigated.

2. The luminous environment is satisfactory for all functions.

3. The sonic environment is poor in the classrooms and offices for two reasons:

   a) High intensity construction noises
   b) Poor room acoustics reported by the faculty. However, this should receive further study because the students valued room acoustics GOOD or O.K.

4. The spatial environment is satisfactory for all functions.

5. The ceilings, hallway floors, and garment storage facilities are universally not functional and should be studied for correction.

6. The studios and exhibit areas and building safety facilities have design problems that should be studied for programming statements that would foster more satisfactory solutions in future designs.

CONCLUSIONS ON THE EVALUATION METHODOLOGY

The third study objective was to have this study serve as a pilot study for a theory of evaluations. The following comments respond to that objective.

1. Information useful for programming and design, and for possible renovations was gathered from users in reference to the building, to specific kinds of rooms, and to some specific physical characteristics.

2. The procedure can be improved to provide more useful information:

   a) By interviewing students and faculty, particularly while touring the building or room which is to be evaluated.
   b) By adding one more kind of form, entitled: Administrator evaluation of Special Purpose Rooms.
   c) By filling in the identification lines for campus, building and room before the forms are distributed to the campus for completion.
   d) By increasing the common content of all forms for more generalization.
   e) By using fewer, but the broadest, and more inclusive term possible for each characteristic.

3. There's no easy way to assure a careful or thoughtful questionnaire completion, but the qualifications of the person making the return can be considered when the results are reported.

4. If an evaluation is to be centered on the instrumental use of an object for a human end, this kind of opinion poll immediately exposes for further study physical characteristics that are both good and bad in the opinions of the users for their activities.

APPENDIX B

REVISED METHODOLOGY AND QUESTIONNAIRES

APPENDIX B: REVISED METHODOLOGY AND QUESTIONNAIRES

The questionnaires which follow have been redesigned from the experience gained in using those in Appendix A. They are intended only for use in evaluating a new academic facility after initial occupancy. Further redesign will undoubtedly be needed as further experience is gained in their use. The questionnaires are meant to give the users the opportunity to report: a) problems they have perceived, and b) "valuing" opinions about separate physical characteristics of facilities. With these goals in mind, they have been designed using the broadest and most general terms possible, and using each term on as many questionnaires as possible. All returns (except the M & O Evaluation of Building) can be tabulated in the following manner, entering the number of returns with GOOD or O.K. or POOR values in the appropriate column as was done in Table 1.

Item	Instructional Rooms		S.P. Rms.	Offices	Bldg.
	Student	Teacher	Adm.	Teacher & Staff	Adm.
	G'D-OK-P'R	G'D-OK-P'R	G'D-OK-P'R	G'D-OK-P'R	G'D-OK-P'R
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

Values above the solid horizontal line can be horizontally generalized; below the line, all values are unique for each kind of questionnarie.

The initial evaluation should occur: a) for the users, in the first few weeks of occupancy; and b) for the building, in the first six months of occupancy, preferably after three or four months have elapsed to allow HVAC, etc. adjustments to have been made. When it isn't possible to meet both of these criteria at the same time, it is recommended that since only a few of the physical aspects included in the questionnaires are adjustable, first consideration should be given to catching the user's fresh impressions of the building, and the evaluation should take place no later than the beginning of the third week of initial use of the building. The following steps are recommended:

1. Entitle all questionnaires with respondent's, campus and building names, and date of evaluation.
   a. One Administrator Evaluation of Building for each person directly responsible for the functional occupancy of the building or a major group of rooms in it; department heads may be an example of this.
   b. One M & O Personnel Evaluation of Building for each person directly responsible for the planning or implementation of the maintenance and/or operation of the building; the plant superintendent and chief custodian may be examples of this.
   c. One Teacher & Staff Evaluation of Offices for each person assigned to the continuous use of an office.
   d. One Teacher Evaluation of Instructional Rooms per room for each teacher who uses it at least one contact hour per week.
   e. Enough Student Evaluation of Instructional Rooms per room to represent a 20% sample of those students using it each contact period per week.
   f. One Administrator Evaluation of Other Rooms for each room not otherwise included, to be evaluated by the functional or operational administrator, whichever is more appropriate. Examples of rooms in this category may be lobbies, storage rooms, building service rooms, exhibit areas, assemblage rooms, etc.
2. Deliver questionnaires, interviewing each functional or operational administrator concerned with the building ,and noting "not functional because" (page 6) comments they make while touring the building.
3. Tally the "good-ok-poor" value responses as shown in Table 1 (page 8).
4. Make summary value statements from Table 1 about each physical aspect evaluated for each room and for the building (pages 10 - 15)

5. Make "not functional because" statements from the "What's the Problem?" column about physical aspects of each room and of the building. (pages 10 - 15)
6. Prepare value judgment statements about environmental conditions or about rooms or specific physical aspects that indicate what conditions ought to be further evaluated (page 16)

C-79.16

EVALUATION (A) OF BUILDINGS BY M & O PERSONNEL

CUNY Office of Facilities Programing
and Research

Campus ____________________
Building ____________________
Person's Name ____________________
Title ____________________
Date ____________________

This is your opportunity to help us do a better job of planning instructional facilities. Please give us your best opinion on the physical aspects of rooms and mechanical equipment by writing in each space GOOD, OK, or POOR. We are really looking for problems, so when you write POOR, please try to tell us what the problem is in the section below, or on the back of the page.

	Circulation Areas				Assigned Rooms				Service Rooms			
	Halls	Stair-ways	Ele-vator	Other	Class-rooms	Labs	Off-ices	Other	Mech	Store	Rest	Other
Interior Surfaces												
Walls												
Floor												
Ceiling												
Hardware												
Other												
Mechanical Equip.												
Heating												
Cooling												
Ventilating												
Plumbing												
Lighting												
Electrical												
Science Gr.II												
Other												
Safety Facilities												
Fire Alarms												
Fire Exting.												
Fire Exits												
Handicapped												
Other												

Exterior Surfaces

Walls ____________________
Windows ____________________
Roof ____________________
Hardware ____________________
Other ____________________

WHAT'S THE PROBLEM: Please use room number when possible, and cross-index your comments by number to the appropriate box above.

FILMED FROM BEST AVAILABLE COPY

EVALUATION (D)
OF BUILDINGS BY ADMINISTRATORS

SUNY Office of Facilities Programing & Research

Building ______
Room No. ______
Room Type ______
Name ______
Date ______

C-20
C-17

This is your opportunity to help us do a better job of planning facilities. Please give us your best opinion of the following list of items in this room by making an appropriate check (✓) on the rating lines. And if you rate something on the poor side, try to tell us what you think the problem is.

		The CHARACTERISTIC being EVALUATED	EXCELLENT	GOOD	FAIR	POOR	BAD	WHAT IS THE PROBLEM?
	SOUND	Overall sound quality of room						
		Ability to hear/be heard						
3.		Noise isolation from outdoors						
4.		Noise isolation between rooms						
		Other sound considerations (specify)						
6.	CLIMATE	Overall climate quality of room						
7.		Freshness of air						
		Temperature of air						
9.		Draft-free-ness of air						
10.		Comfort of exterior walls/windows						
		Other climate considerations (specify)						
	LIGHTING	Overall lighting quality of room						
13.		Light from windows						
		Room lighting						
		Color of walls, floors, etc.						
16.		Glare-free-ness of surfaces						
		Other lighting considerations (specify)						
	SPACE	Overall "space" quality of room						
19.		Length, width, & height of room						
		Length, width, & height of space you occupy						
		Amount & arrangement of furniture						
22.		Work surface height & size						
		Other "space" considerations (specify)						
	BUILDING	Overall quality of building						
25.		Doors						
26.		Windows						
		Floor coverings						
28.		Light control for audio-visual viewing						
		Other building considerations (specify)						
	EQUIPMENT	Overall quality of equipment						
31.		Furniture						
32.		Facilities to store garments						
		Facilities to store supplies						
		Other equipment (specify)						
35.	ROOMS	Overall quality of rooms						
		Student lounges						
		Conference rooms						
38.		Entrances and lobbies						
		Rest rooms						
		Building storage						
41.		Departmental storage						
		Custodial rooms						
		Shapes and sizes of rooms						
		Relationships room to room						

OTHER COMMENTS: Perhaps we have missed something in the above list that you'd like to comment on. Please do so on the back of this questionnaire. We want to know in what ways this building "turns you on" - or off!

EVALUATION (C) OF ROOMS BY STUDENTS

SUNY Office of Facilities Programing & Research

Campus ____________
Building ____________
Room No. ____________
Room Type ____________
Name ____________
Date ____________

C-21 18

This is your opportunity to help us do a better job of planning facilities. Please give us your best opinion of the following list of items in this room by making an appropriate check (✓) on the rating lines. And if you rate something on the poor side, try to tell us what you think the problem is.

	The CHARACTERISTIC being EVALUATED	EXCELLENT	GOOD	FAIR	POOR	BAD	WHAT IS THE PROBLEM?
1. SOUND	Overall sound quality of room						
2.	Ability to hear/be heard						
3.	Noise isolation from outdoors						
4.	Noise isolation between rooms						
5.	Other sound considerations (specify)						
6. CLIMATE	Overall climate quality of room						
7.	Freshness of air						
8.	Temperature of air						
9.	Draft-free-ness of air						
10.	Comfort of exterior walls/windows						
11.	Other climate considerations (specify)						
12. LIGHTING	Overall lighting quality of room						
13.	Light from windows						
14.	Room lighting						
15.	Color of walls, floors, etc.						
16.	Glare-free-ness of surfaces						
17.	Other lighting considerations (specify)						
18. SPACE	Overall "space" quality of room						
19.	Length, width, & height of room						
20.	Length, width, & height of space you occupy						
21.	Amount & arrangement of furniture						
22.	Work surface height & size						
23.	Other "space" considerations (specify)						
24. BUILDING	Overall quality of building						
25.	Doors						
26.	Windows						
27.	Floor coverings						
28.	Light control for audio-visual viewing						
29.	Other building considerations (specify)						
30. EQUIPMENT	Overall quality of equipment						
31.	Furniture						
32.	Facilities to store garments						
33.	Facilities to store supplies						
34.	Other equipment (specify)						

OTHER COMMENTS: Perhaps we have missed something in the above list that you'd like to comment on. Please do so below or on the back of this questionnaire. We want to know in what ways this building "turns you on" - or off!

EVALUATION (D) OF ROOMS BY TEACHERS

SUNY Office of Facilities Programing & Research

Campus ______
Building ______
Room No. ______
Room Type ______
Name ______
Date ______

19
C - 22

This is your opportunity to help us do a better job of planning facilities. Please give us your best opinion of the following list of items in this room by making an appropriate check (✓) on the rating lines. And if you rate something on the poor side, try to tell us what you think the problem is.

		The CHARACTERISTIC being EVALUATED	EXCELLENT	GOOD	FAIR	POOR	BAD	WHAT IS THE PROBLEM?
1.	SOUND	Overall sound quality of room						
2.		Ability to hear/be heard						
3.		Noise isolation from outdoors						
4.		Noise isolation between rooms						
5.		Other sound considerations (specify)						______
6.	CLIMATE	Overall climate quality of room						
7.		Freshness of air						
8.		Temperature of air						
9.		Draft-free-ness of air						
10.		Comfort of exterior walls/windows						
11.		Other climate considerations (specify)						______
12.	LIGHTING	Overall lighting quality of room						
13.		Light from windows						
14.		Room lighting						
15.		Color of walls, floors, etc.						
16.		Glare-free-ness of surfaces						
17.		Other lighting considerations (specify)						______
18.	SPACE	Overall "space" quality of room						
19.		Length, width, & height of room						
20.		Length, width, & height of space you occupy						
21.		Amount & arrangement of furniture						
22.		Work surface height & size						
23.		Other "space" considerations (specify)						______
24.	BUILDING	Overall quality of building						
25.		Doors						
26.		Windows						
27.		Floor coverings						
28.		Light control for audio-visual viewing						
29.		Other building considerations (specify)						______
30.	EQUIPMENT	Overall quality of equipment						
31.		Furniture						
32.		Facilities to store garments						
33.		Facilities to store supplies						
34.		Other equipment (specify)						______

OTHER COMMENTS: Perhaps we have missed something in the above list that you'd like to comment on. Please do so below or on the back of this questionnaire. We want to know in what ways this building "turns you on" - or off!

EVALUATION (E) OF NON-INSTRUCTIONAL ROOMS BY OCCUPANTS

SUNY Office of Facilities Programing & Research

Campus ____________
Building ____________
Room No. ____________
Room Type ____________
Name ____________
Date ____________

C-2B

This is your opportunity to help us do a better job of planning facilities. Please give us your best opinion of the following list of items in this room by making an appropriate check (✓) on the rating lines. And if you rate something on the poor side, try to tell us what you think the problem is.

	The CHARACTERISTIC being EVALUATED	EXCELLENT	GOOD	FAIR	POOR	BAD	WHAT IS THE PROBLEM?
1. SOUND	Overall sound quality of room						
2.	Ability to hear/be heard						
3.	Noise isolation from outdoors						
4.	Noise isolation between rooms						
5.	Other sound considerations (specify)						
6. CLIMATE	Overall climate quality of room						
7.	Freshness of air						
8.	Temperature of air						
9.	Draft-free-ness of air						
10.	Comfort of exterior walls/windows						
11.	Other climate considerations (specify)						
12. LIGHTING	Overall lighting quality of room						
13.	Light from windows						
14.	Room lighting						
15.	Color of walls, floors, etc.						
16.	Glare-free-ness of surfaces						
17.	Other lighting considerations (specify)						
18. SPACE	Overall "space" quality of room						
19.	Length, width, & height of room						
20.	Length, width, & height of space you occupy						
21.	Amount & arrangement of furniture						
22.	Work surface height & size						
23.	Other "space" considerations (specify)						
24. BUILDING	Overall quality of building						
25.	Doors						
26.	Windows						
27.	Floor coverings						
28.	Light control for audio-visual viewing						
29.	Other building considerations (specify)						
30. EQUIPMENT	Overall quality of equipment						
31.	Furniture						
32.	Facilities to store garments						
33.	Facilities to store supplies						
34.	Other equipment (specify)						

OTHER COMMENTS: Perhaps we have missed something in the above list that you'd like to comment. Please do so below or on the back of this questionnaire. We want to know in ways this building "turns you on" - or off!

APPENDIX D

AREA PER ACTIVITY IN CLASSROOMS

State University of New York
AREA PER ACTIVITY IN CLASSROOMS

CONTENTS

SUMMARY

A prototype study is conducted which reveals that the empirical study of rooms as they are being used (as contrasted to surveys, or to normative approached) contributes useful information for the planning, programming, and design of classrooms. The use being made of the floor areas of thirty-seven classrooms is analyzed for each activity occurring in them. Observations are made with two implications on the definition of terms, and two implications on the timing of area per activity studies. Observations on the use of floor area indicate: the need for a new planning unit of "usable" floor area; the need to examine area and access implications of furniture before it is purchased; the need to re-plan rooms with inefficient architectural designs; the need for "universal" kinds of spaces; the need to substitute empirical for normative approaches to projecting floor area requirements; the need to substitute two efficiency measures for the "space utilization" concept; and the need to store both "is" and "ought" data for analytic purposes.

Office of Facilities Programing and Research
9/15/68 TADavis:gg

State University of New York
AREA PER ACTIVITY IN CLASSROOMS

INTRODUCTION

The factor which we call "area per activity" is expressed as square feet of floor area per activity, where the activity may be a seated student, an instructor lecturing, or any other of the many activities that occur in classrooms. The factor is a link between human needs for comfort and utility, and the floor area (and space) which is needed to accommodate them. The factors are often called "space standards" when the activities have been lumped together for a particular kind of space for human use.

It is common for space standards to be the result of survey and averaging. For example, a recent California report[1] cites: "The space per station component commonly used in planning...has traditionally been 15 square feet per station". It goes on to show the different area factors used by other colleges, and for various sizes of classrooms, varying from 11.4 to 13.4 square feet. But when their recommendation is posed, they again quote the "traditional" 15 square feet figure and throw in the phrase: "...including space in service area". Thus, tradition is used as the authority to allocate building areas.

The same approach is used (but in the opposite direction) when theoretical studies of what ought to be are used for area factors. Yurkovich, in

1 Matsler, Franklin G., Space and Utilization Standards, California Public Higher Education, published by the Coordinating Council for Higher Education, Sacramento, California, September 1966, page 16.

a recent report recommends as a way "... for determining an objective and appropriate space factor...", that "...typical arrangements must be tried out on paper..."[2] In this approach, the planner is using his expert knowledge to benefit the users; however, unless he bases his solution on extensive field observations, he must also substitute his experiences and values for those of the users.

Thus neither the traditional approach, which surveys and averages, nor the idealistic approach, which seeks paper answers, appear to observe on-going empirical reality as the basis for the assignment of area to activity except in very special cases. Our question is: can observations of on-going campus activities provide new information that is useful for the planning, programing, and design of spaces for learning?

PURPOSE OF STUDY

The need that suggested this prototype study was to develop "space standards" grounded in empirical experience. Secondarily, the question was: can empirical reality provide new data that may be useful in turn as input:

1. For planning, in the normative computation of how much building area a campus must and ought to have built for it.
2. For programing, in the normative computation of how much building area an activity must and ought to have built for it.
3. For design, in the normative description of shapes and relationships of building areas needed for the efficient and effective implementation of educational aims.

---

2 Yurkovich, John V., A Methodology for Determining Future Physical Facilities Requirements for Institutions of Higher Education, University of Wisconsin, Madison, Wisconsin, December 1966, page 20.

PROCEDURE

The procedure was to collect, classify, and examine data on the use of instructional rooms from three sources as follows:

1. Thirty-seven classrooms were examined by a study team consisting of the writer and two summer employees. The area required for each identifiable activity that seemed to have occurred in it was measured (sample, Exhibit 1, Wheeler 202.) Furniture was left as found, and only twice[1] were people at the campus quizzed on the use of a room. An analysis of floor area per activity was made (Exhibit 2).

2. The official Physical Space Inventory dated July 10, 1967 was examined, noting the net area, student stations, and "used as" information for each of the 37 rooms (Exhibit 4, includes Wheeler 202).

3. A special printout of Instructional Activities Occurring in Classrooms in the fall of 1966 was examined, and the number of students in each class meeting was noted for each kind of meeting (lecture, quiz discussion, laboratory, etc.) in each of the 37 rooms (Exhibit 3, Wheeler 202).

OBSERVATIONS AND IMPLICATIONS[2] ON DEFINITION OF TERMS

The first observation concerns the anarchy of words that assails one from all sides in the field of physical facilities. The author once asked eleven different people in the Office of Facilities what referents came to their mind when the word "auditorium" was mentioned. Eleven uniquely different answers were recorded. In order to cover all the answers, it was necessary to describe the use of the word to include any space in which people come together to view an activity. The referents for the word thus included rooms such as arenas (including gyms), theaters, music halls, little theaters, exhibition halls, and lecture halls.

---

1 For Wheeler 209 and Alumni 200

2 The word observation refers to a statement about the data which, was made because there appeared to be an opportunity for corrective action. The word implication refers to a statement of an action which is suggested to correct the condition observed.

A. OBSERVATION - When the term "student station" is used normatively in the Physical Space Inventory to describe what ought to be, it refers to the square feet of floor area which ought to be available for one student at learning and includes a proportionate share of the areas needed for all the other activities occurring in the room. When it is used in the Assignment of Area to Activity (this study) it refers to the floor area taken up by one student at learning but excludes all other activity areas in the room. If it were used to refer to the Instructional Activities Occurring in Classrooms report, it would refer to the number of students registered as attending class in one room at one time. Thus, the referent for the term "student station" is different in each of the three cases, but the description of use of the term, as a place at which a student can be at learning, is identical. And this is to be expected. Yurovich[1], uses five different referents in his definition of a student station: one chair or seat, area of a table, persons, total area of the suite, and equipment. His description of use of the word is "...the facilities required to accommodate one person at a given time".

IMPLICATIONS 1
That, in making any study of physical facilities, operational definitions for each word used to symbolize reality are needed.

IMPLICATION 2
That each definition must contain both the referents which the word symbolizes, and a description of the ways in which the word may be used in the context of the realities being studied.

OBSERVATIONS AND IMPLICATIONS ON TIMING A STUDY

If it is necessary to correlate data on counts or measures of reality in classrooms, with inventory data and with student enrollment data, the complexity of the task must be considered. It means that the activities of perhaps three different offices at each campus and two or three

1 op. cit., page B-2.

in the Central Administration must be coordinated in gathering the data.

Some comments on each operation are in order:

B. OBSERVATIONS - (1) The actual classrooms could not all be meaningfully measured or counted during the summer. Rooms were often being cleaned or the furniture changed for new functions so that it was difficult to see how they had been used. In the agricultural and technical laboratories, no instruction was occurring and the study team was not experienced enough to be able to tell what activities would be taking place in them. (2) The Physical Space Inventory is meant to be updated on a continuing basis so that the printout taken July 10, 1967 was perhaps accurate only for the day of the last update. (3) The Instructional Activities Occurring in Classrooms printout used information gathered at a single point in time in the fall of 1966, and contains only those rooms being used at that time. As compared to the July 10, 1967 report, some rooms are listed that no longer exist[1] and some are not listed that are now[2] being used.

IMPLICATION 3
That all three data banks must be compiled at the same instant in time as a snapshop of campus activity if they are to be compared and correlated.

IMPLICATION 4
That the moment chosen for gathering data must therefore be while school is in session, at the same time that information on course enrollments is reported by the registrars.

OBSERVATIONS and IMPLICATIONS on AREA PER ACTIVITY

Floor areas could be identified for twelve distinct kinds of activities in classrooms. The areas for these activities are defined, for the purpose of this study as follows (see Exhibits 1 and 2, pages 10 and 11, for example):

---

1 Gymnasium 103 and Home Economics 2 and 4, for example.

2 Wheeler 208, 210, and 213, and Home Economics 3, for example.

1 Instructional Area

Refers to floor area devoted to teacher's desk, lectern, demonstration table, etc., and the floor area needed to access these and other teaching aids such as blackboards, maps, etc.

Describes the space[1] normally used by an instructor when he is presenting information to students in a classroom.

2 Student Station Area

Refers to the floor area devoted to a student's chair, stool, or standing space plus performance areas such as tablet arms, tables, laboratory benches or other equipment, plus any necessary floor area separating these fixtures.

Describes the space normally occupied by one student at learning.

3 Utilities Area

Refers to the floor area devoted to such items as heating radiators, ventilation fans, etc.

Describes the space occupied by fixed items of building operational equipment.

4 Coat Rack Area

Refers to floor area beneath fixed or movable hangers and includes the area taken up by the garments.

Describes the space occupied by student garments being stored.

5 Architectural Area

Refers to the floor area devoted to the building structural members or to nooks, alcoves, or door-swing areas.

Describes the space devoted to intrinsic structural requirements of the building or to instrumental access spaces between functions but which are not needed to fulfill the functions.

---

1 Space in this report refers to the three dimensions (length x width x height) occupied by the people or equipment performing the activity; it describes a functional but wall-less volume of air and its contents.

6 Storage of Equipment Area

Refers to the floor area taken up by instructional equipment such as projectors.

Describes the space used to store instructional aids equipment, exclusive of "instructional space" equipment.

7 Storage of Supplies Area

Refers to the floor area taken up by instructional supplies.

Describes the space used to store instructional supplies.

8 Display Area

Refers to floor area taken up by cabinets or cases containing materials to be observed by students.

Describes the space taken up by display equipment.

9 Preparation Area

Refers to floor area devoted to fixed or movable equipment or counters used intermittently or occasionally by students for special tasks that cannot be done at their stations.

Describes the space taken up by preparation facilities.

10 Circulation Area

Refers to the floor area of the room that is left after deducting all other discrete activity areas listed above (1-9) from the net area of the room.

Describes the space used by students to travel from the doorway to their stations.

11 Instruction - Circulation Area

Refers to the floor area of the room that is left after deducting all (1-9) discrete activity areas and which is used for both instruction and circulation.

Describes the space used by instructors to present information but must also be used by students to travel from the doorway to their stations.

12 Instruction - Circulation - Student Station Area

Refers to the floor area of the room that is left after deducting all (1-9) discrete activity areas and which is used for instruction, circulation and student stations.

Describes the space used by instructors to present information, and by the students at their stations and as they move from station to door.

C. OBSERVATION - Architectural and utilities functions sometimes dedicated substantial portions of the net floor area in a room, thus making it unavailable for instruction or student stations. For examples, see Ag - Eng. 103-104 where folding doors and utilities obstruct 10% of the floor area, and Wheeler 209 where poorly placed doors (plus utilities) obstruct 15% of the floor area.

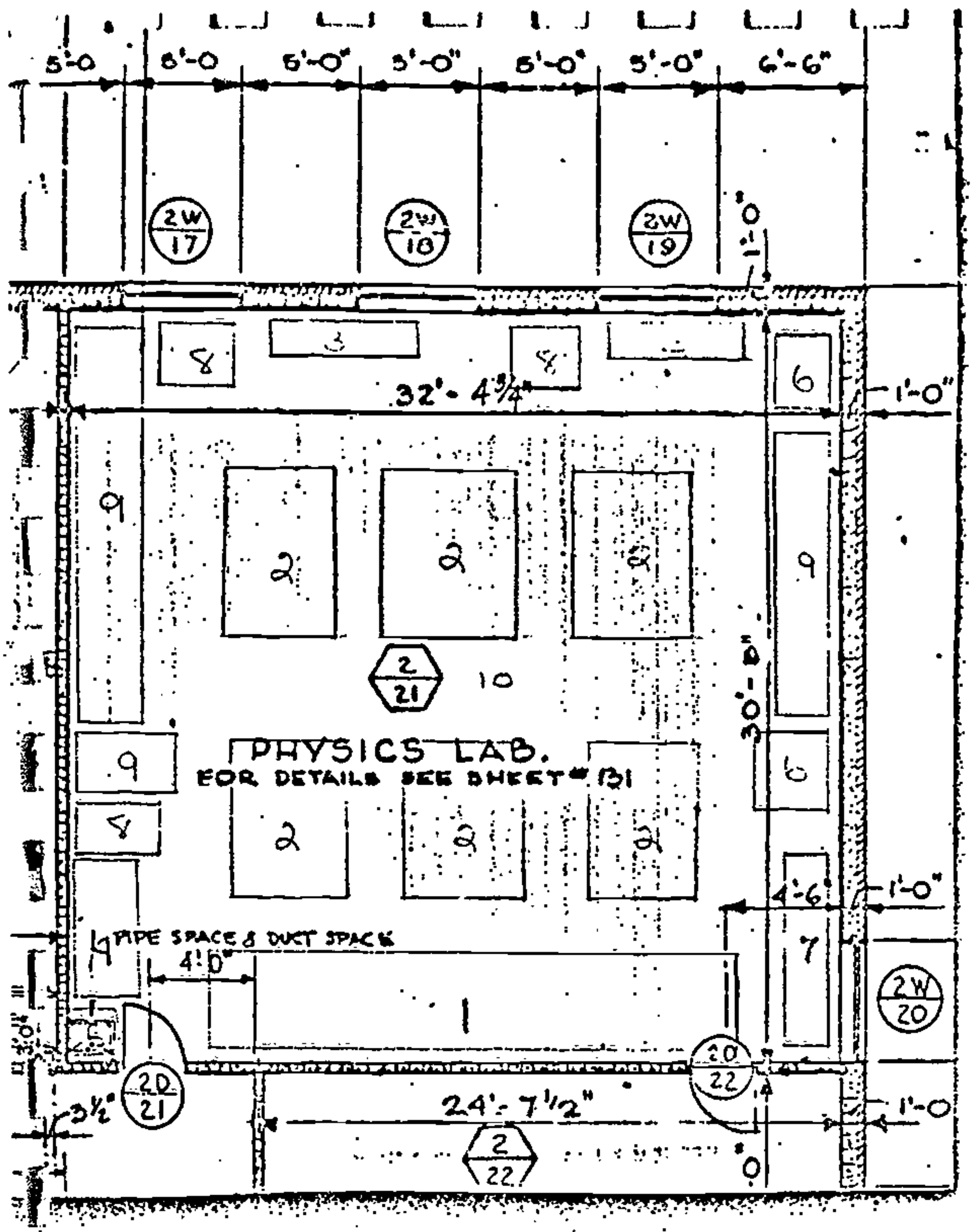
IMPLICATION 5
That a concept of usable floor area (to exclude utility or architectural areas using more than 1% of the net area) would be more meaningful for discussing activity "space standards" than the usual "net area", because it would eliminate areas that are unavailable for the activity.

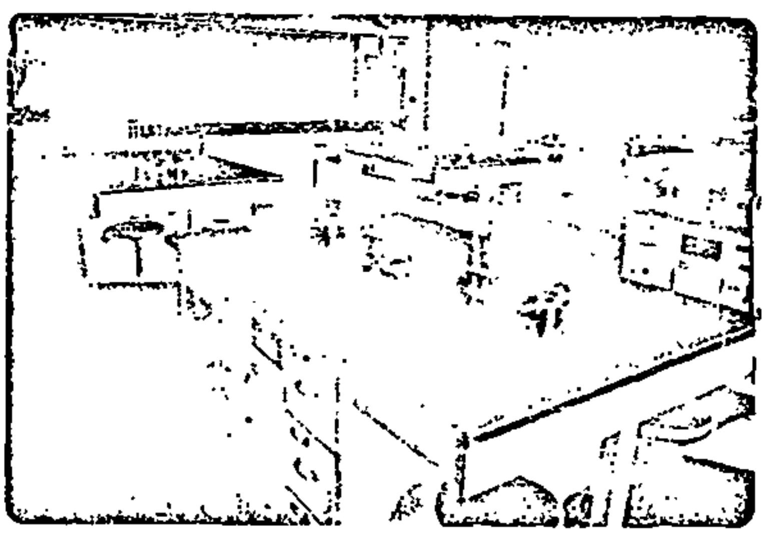
D. OBSERVATION - That some architectural floor areas could be eliminated by redesigning the location of entrance doors. For example, in Wheeler 209 the door could be moved from the center of the wall to the front corner. This would eliminate the architectural area and increase the student stations by nine. Similar opportunities exist in Ag - Eng. 103-104 combined, An-Hus 1 and Wheeler 208 (over 10% of the rooms observed).

IMPLICATION 6
That the examination of existing classrooms for efficient design of the floor area will reveal opportunities for alterations to increase the potential seating capacities of some rooms.

IMPLICATION 7
That the normative description of classrooms in facility programs could include room design criteria that would entail more efficient use of floor areas.

Exhibit 1.





Wheeler 232

Worksheet for Assignment of Area to Activity

Campus:

Building: Wheeler

IDENTIFICATION

Room: 202

Date: 8/3/67

INFORMATION GATHERED IN THE ROOM

Instruction: Name: General Physics
Equipment: Instructor desk 10.55'x2.5'; Supply storage 3.7'x3.05'

Students: Station Size: 3.0'x3.0' assuming a 3.0'x1.0 seating area = 9.0 sq. ft.
Arrangement: 6 benches, 4 each = 24
Chair Size: Stools
Performance: 3.0'x2.0' counter

Miscellaneous Comments:

ASSIGNMENT OF AREA PER ACTIVITY

Code #	Activity	Sq. Ft.	% of Area
	Net Area: W23.2x D30	696	100
1	Instruction 16.9x6.1	103	14
2	Student Stations 24 x 9.0	216	31
3	Utilities 2.6.7x1.0	13	2
4	Coat Rack	7	1
5	Architectural 1.7x2.8	5	1
6	Storage Equipment 2x5.8x2.5	29	4
7	Storage Supplies 3.7x3.05	11	2
8	Display 3.x3x1.2	11	2
9	Preparation 11.5+(18.7x2.5)	58	8
10	Instruction-Circulation	243	35

INFORMATION FROM INVENTORY

Inventory Print-out 7/10/67 - Room: 202 Stations: 24 A.S.F: 970

Instruction Type: 1300 Science Laboratory

INFORMATION FROM THE REGISTRAR

Section-Hours @ # Students, from Class Enrollments Print-out, Fall, 1966
Lecture - 3 @ 21, 19
Laboratory - 1 @ 11, 7, 17, 17, 16

E. OBSERVATIONS - (1) That the newer tablet arm chairs have increased the floor area per student station by 0.5 feet, or about 11%, because of the increased front-to-back dimension. Partly as a result, in rooms with efficient use of floor area, the average area per chair (including all other functions occurring in the room) to 11.2 in Wheeler 213 (arranged in columns). This latter figure would increase to 12.0 if the furniture were effectively arranged as suggested for Wheeler 214 (below). (2) That the design of access (front, side, or rear) to the student chair determines how they can be arranged in a room, and (3) that the way the chairs are arranged determines the student station size. For example, the chairs in Wheeler 208 and 209 are identical but the student station sizes differ by 12%. (4) That the chairs in some classrooms can be rearranged for more efficient and effective use of the room. For example, Wheeler 214 can be rearranged into four rows of 10 chairs each for 40 stations vs. the present 36, and at the same time the instructional area would be increased by 2.0 feet in depth and a 4.0 foot wide aisle created down the side which would free the coatrack of the chairs that are now positioned under it.

IMPLICATION 8
That the examination of existing classrooms for efficient arrangement of furniture will reveal opportunities for rearrangements to increase the potential seating capacities of some rooms.

IMPLICATION 9
That the normative description of classrooms in facility programs could include furniture design and arrangement criteria that would entail more efficient use of floor areas, more effective design of the room, and reduced space needs for student stations.

IMPLICATION 10
That the so-called "space utilization" reports on current operations are badly named. They report on the percentage of the time that rooms and student stations are used, and not on "space" or floor area. Because they look no further than to count the number of chairs in a room, the efficient use of space or floor area is taken for granted and never assessed. Thus, the space utilization reports are really station utilization reports, and any examination of the utilization of rooms actually involves two considerations: the utilization of floor area as measured against normative criteria; and the utilization of student stations as measured against the time available for use.

IMPLICATION 11
That a "space standard" of 12 square feet per student station is adequate for classrooms of 40 students.

F. OBSERVATION - Student chairs are spaced from 1 to 6 inches from side or rear walls.

IMPLICATION 12
That there is a curtain of space (functioning as space) up to 0.5 feet in depth in front of walls that students may be seated next to, which must be taken into consideration in the planning, programing and design of classrooms.

G. OBSERVATION - The functional use of rooms that don't have fixed student station equipment (lecture hall seats, lab benches, etc.) tends to change over time. Examples were mentioned above in the section on Timing the Study, and others are Wheeler (a new building) Rooms 203, 204, 208, and 209, none of which carry the same functional title on the registrar's printout as was shown on the architect's drawings.

IMPLICATION 13
That the dedication in design of rooms to specific functions may be operationally restrictive because inflexible, impose a conservative environmentonto educators that is not responsive to their rapidly changing needs, and be wasteful because it builds in the necessity for future remodeling.

H. OBSERVATION - There is a significant mismatch between class enrollments and the number of student stations in a room. It can be seen in Table 1 (page 15) that a full third of all class meetings use less than a quarter of the seats and that only a quarter of the classes need over three-quarters of the available seats. As a result, the rate of utilization of student stations can be seen to be largely determined by the numbers and sizes of rooms that are available for use.

IMPLICATION 14
That the normative procedures used by the State University for projecting the numbers and sizes of classrooms[1] needed in the future does not entail a high utilization of rooms, and that a new method based in reality is needed if high utilization is a value in planning.

---

1 Neither the Matsler nor Yurovich reports discuss this problem.

CAMPUS 2837
BLDG WH - *Wheeler*
ROOM 0202
TYPE 1300 - *Science Lab.*
STATIONS 24
A.S.F. 970

STATE UNIVERSITY OF NEW YORK
OFFICE OF FACILITIES RESEARCH
INSTRUCTIONAL ACTIVITIES OCCURING IN CLASSROOMS

PAGE NUMBER 149
REPORT 15668
DATE 14/70/01

DESCRIPTION	COURSE-SEC		DAYS	FROM	TO	ENROLLMENT
LECTURE						
LOWER DIVISION						
HUMANITIES						
ENGLISH	101	18	MWF	1400	1500	21
ENGLISH	101	34	MWF	1000	1100	19
				TOTAL ENGLISH		40
				TOTAL 0		40
				TOTAL 1		40
LABORATORY						
LOWER DIVISION						
MATHEMATICS + PHYSICAL SCIENCE						
PHYSICAL SCI	101	01	TU	1300	1500	11
PHYSICAL SCI	101	02	TU	1500	1700	7
				TOTAL PHYSICAL SCI		18
PHYSICS	111	01	W	1500	1600	17
PHYSICS	111	02	TH	0800	1100	17
PHYSICS	111	03	TH	1400	1700	16
				TOTAL PHYSICS		50
				TOTAL 0		68
				TOTAL 4		68
				TOTAL ROOM 0202		108

Exhibit 3 Page 14

Table 1

NUMBER OF SECTION HOURS BY QUARTILE OF SEATS AVAILABLE THAT MET PER WEEK IN EACH ROOM, FALL 1966, AS SHOWN BY THE INSTRUCTIONAL ACTIVITIES OCCURRING IN CLASSROOMS (EXHIBIT 3)

Room Number	Seats Counted	Section Hours per Quartile of Seats Counted				
		1st	2nd	3rd	4th	5th
AH 1	53	5	9	5	5	
AL 100	10	0	2	0	0	
AL 103	12	0	0	0	2	
AL 200	24	0	11	0	0	
AL 203	49	2	7	11	7	
AL 204	56	1	7	13	1	
GY 101	30	0	0	7	5	
GY 102	42	2	4	11	2	
GY 103	36	0	3	5	9	
HE 1	20	0	0	0	8	2
HE 2	25	0	0	6	0	
HE 200	51	4	18	15	2	
HE 201	36	1	12	10	3	
HE 203	46	0	13	13	3	
HE 204	48	5	5	10	2	
WH 100	142	13	6	6	2	
WH 106	24	1	0	2	4	
WH 107	16	1	0	0	0	
WH 108	26	3	1	6	7	
WH 109	24	0	1	2	11	
WH 202	24	0	2	3	6	
WH 203	24	0	6	8	9	
WH 204	30	0	4	14	8	
WH 205	36	2	14	0	0	3
WH 207	45	3	4	18	0	
WH 209	27	2	0	4	20	
WH 210	32	0	3	11	2	5
WH 213	42	0	13	8	9	
WH 214	36	3	4	18	9	
WH 215	36	0	2	27	3	
WH 216	35	0	14	6	2	
(593) Totals		48	155	239	141	10
100%		8	26	40	24	2

I. OBSERVATION - As can be seen in Table 2 (page 18), there are substantial mismatches between the inventory-register information, and actual counts or measures of reality in classrooms. While the study team made no attempt to search out the reasons for these differences, three are hypothesized:

- The inventory-registrar student station count seems to be based on planning space standards of how many stations ought to be in the room in the target year. As a result, 27 of the 37 rooms show differences with today's counts. And in 17 of these rooms, the registrar's count is less than the number of chairs in the rooms.

- Over one-third of the net areas differ by more than 5%. Most of these differences can probably be traced to procedural or definition difficulties between the Central Office and the campus.

- The other two-thirds of the rooms differ by less than 5% and appear to be the difference between the architect's figure for the room and what it actually measures. The measures are identical in only two rooms.

IMPLICATION 15

That a confusion exists between what "is" - the reality of the present and what "ought-to-be" - the normative standards toward which we are building. Both kinds of information are important: the "is" to determine the efficiency of utilization of student stations and to match with registrar's data, and the "oughts" to project the goals that have to be built for. They are compared with each other to calculate the efficient utilization of floor areas, and to measure the progress being made toward the goals.

PHYSICAL SPACE INVENTORY
LIST OF RECORDS ON FILE

2837

[ER]ROR [ME]SSAGE	ACTION CODE	BUILDING ABBREV	BUILDING CHANGE	ROOM NUMBER	ROOM CHANGE	ROOM TYPE	NUMBER OF STATIONS	SQFT AREA
		WH		0110		5000	0002	00480
		WH		0111		5000	0002	00240
		WH		0112		5000	0002	00234
		WH		0113		1001	0030	00490
		WH		0114		3001	0002	00250
		WH		0115		3001	0002	00240
		WH		0116		5000	0014	00384
		WH		0117		5000	0001	00282
		WH		0117		1350	0000	00398
		WH		0120		1350	0008	00198
		WH		0121		1350	0000	00198
		WH		0126		4000	0001	00290
		WH		0131		4000	0001	00165
		WH		0132		4000	0017	00504
		WH		0133		4000	0001	00177
		WH		0135		4000	0100	04982
		WH		0160		5000	0001	00144
		WH		0170		5000	0000	00108
		WH		0200		3001	0002	00246
		WH		0201		1450	0002	00246
		WH		0202		1300	0024	00970
		WH		0203		1400	0026	00738
		WH		0209		1400	0028	00618

Table 2

COMPARISON OF STUDENT
STATIONS AND AREAS OF CLASSROOMS

(See Exhibit 4 for "Inventory" data)

Room Number	Student Stations Counted	Student Stations Registrar	Student Stations Inventory	Net Areas Measured		Net Areas Inventory
AE 1	12	NOL	15	1 813		1 802
103	42	NOL	30	520	*	572
104	35	NOL	30	520		528
106	18	NOL	21	739		726
AH 1	53	45	45	735		768
AL 100	10	10	10	1 704	*	1 098
103	12	10	10	599		609
200	24	24	24	878		888
203	49	55	55	622	*	653
204	56	56	56	621		636
GY 101	30	24	24	891	*	1 245
102	42	45	45	462		466
103	36	35	35	589		589
HE 1	20	20	20	788		777
2	25	25	25	398	*	444
4	24	15	15	490		476
200	51	45	45	486	*	779
201	36	35	35	339	*	399
203	46	35	35	420		399
204	48	45	45	513	*	79
WH 100	142	125	125	1 318	*	611
106	24	24	24	989	*	1 042
107	16	12	12	594		618
108	26	24	24	967		998
109	24	24	24	982		960
202	24	24	24	696	*	970
203	24	26	26	722		738
204	30	28	28	600		618
205	36	26	26	1 089		1 132
207	45	45	45	963		970
208	40	NOL	8	474	*	546
209	27	35	35	468	*	492
210	32	40	40	492		492
213	42	35	35	480		492
214	36	35	35	480		492
215	36	35	35	480		492
216	35	35	35	480		492

* Difference between measured and inventory of 5% or more.

CONCLUSIONS

It is concluded that this study provided sufficient empirical data on the assignment of area to activity to have a substantial influence on the development of "space standards" for the planning, programing, and design of spaces for learning. For example, the following recommendations have been made for improving the planning of spaces for learning:

- A new planning standard of "usable" floor area (Implication 5).
- The examination of existing classrooms for efficient and effective architectural design, and compilation of the best usages for normative purposes in programing (I-7), computation of normative space factors for planning purposes (I-11), and the remodeling of poorly designed rooms (I-6) for better space usage.
- The examination of furniture sizes and arrangements for the same purposes outlined in the previous statement (I-8 and 9).
- The programing and design of "universal" rooms of various sizes that can be used interchangeably for administrative functions, classrooms, non-science labs, faculty or secretarial offices, recreational, or any of the many other functional titles put on spaces that do not contain fixed (built-in) equipment (I-13).
- For instructional rooms, abandoning normative approaches to the projection of room sizes and numbers needed, and instituting a procedure based in reality (I-14).
- A reduction of floor area space factors for instructional rooms (I-11).
- Abandoning the "space utilization" concept and adopting two efficiency measures in its place--floor area utilization, and student station utilization (I-10).
- Storing room inventory data on both what actually exists and on the normative expectations for rooms, so that the efficient use of floor areas can be assessed (I-15).