A CRITICAL EVALUATION OF THE AIA's *ENVIRONMENTAL RESOURCE GUIDE*: A CASE STUDY OF THE USE OF TECHNICAL INFORMATION IN DESIGN

by

CHRISTINE OLIVE HAMMER

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Major Professor

ABSTRACT

This study evaluates the American Institute of Architects' *Environmental Resource Guide* (ERG). First published in January 1992, the ERG is the AIA's pioneering effort to help architects design environmentally-sensitive buildings.

This thesis examines the ERG from two perspectives—up close as a reference tool for architects and from a distance as one element in a larger system. This thesis has two objectives: 1.) To understand the ERG in the context of a larger social system. Using Everett Rogers' diffusion of innovation theory and research on architects and their use of information, this thesis explores the relationships among the Guide and members of the design and construction system and examines diffusion of the ERG into architectural practice; 2.) To evaluate the effectiveness and user-friendliness of the ERG as an architect's reference tool. The ERG is studied to determine if its content and presentation are useful to practicing architects.

This researcher interviewed 15 architects organized into three groups according to their environmental knowledge and sympathy toward sustainable design. Content analysis was used to analyze interviews and data was organized and quantified according to Social System, Communication Channels, and Content and Presentation of the Guide.

The primary content finding is that the ERG needs to be better oriented to the practicing architect. It needs more technical, specifying, and product information, and the information should be geared to a wide variety of job responsibilities. A secondary content finding relates to the Guide's building material section. Architects either thought cradle-to-cradle analysis of a building material would promote better use of materials, or that it was not useful information for day-to-day decision making. Another content finding is that the material section needs an evaluation methodology to allow architects to make use of the detailed information provided. The primary presentation finding is that the Guide needs to be better organized to match how architects think and work.

To bring more architects into the circle of sustainable design practitioners, many forces must be engaged and strengthened. In general, it is concluded that a combination of more education, economic incentives, and government regulation are necessary to institutionalize sustainable design.

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Chapter One: Introduction

The first issue of *Time* magazine at the end of the 1980's declared the Earth, "Planet of the Year" and outlined four of the most critical environmental problems facing the "endangered earth": biodiversity, greenhouse gases, throwaway societies, and over population (Sancton, 1989, p. 26). Species extinction, increasing at a rate 1000 times the pace in prehistory, is the result of poverty, population growth, ill-advised policies and greed (Linden, 1989, p. 32). Global warming, largely the result of increases in carbon dioxide emissions, threatens to bring about disastrous climatic changes (Lemonick, 1989, p. 36). Large quantities of "waste by-products of civilization", much of it toxic, threaten human health and damage the environment (Langone, 1989, p. 44). World population, one of the most pivotal threats to human survival, is increasing at an unprecedented rate since the Industrial Revolution (Gore, p. 31). While environmental problems have always existed, *Time* magazine's 1989 decision to focus on environmental problems suggests that there may be renewed interest.

There also appear to be new ways of thinking about environmental problems and new solutions. Businesses such as Bristol-Myers Squibb, Polaroid, and Du Pont are analyzing the life cycle of their products to identify environmental improvements in "formulation, manufacture, packaging, distribution, use and ultimate fate" of their products (Epstein, 1994, p. 11). Industrial ecology promotes the reuse of waste from one industry by another. For example, the Herman Miller furniture company sends its scrap fabric to North Carolina where it is made into insulation for car-roof linings and dashboards (Woodruff, 1992, p. 5). World governments, through the United Nations Conference on the Environment and Development, are developing a green accounting system that places value on the damage caused by pollution or the exploitation of resources. Sustainable accounting is the first step in a complicated effort that could lead to better management of resources and wiser policies. The US Department of Commerce's Bureau of Economic Analysis published its first sustainable accounting attempt in 1994 (Beardsley, 1994, p. 102).

As corporations and societies around the world begin to look more closely at new ways by which they can be more environmentally responsible, the architectural profession is also identifying changes it can make in the design of buildings that are more environmentally responsible. While sustainable design—also known as green architecture and resource efficient construction—cannot dramatically reverse any of

the global problems outlined above, this approach can make a small, yet significant contribution to minimize some of them.

Many sustainable design practices are not new. Some principles such as siting buildings to respond to local climate are timeless and common sense. Other practices take advantage of new high-tech advances such as energy efficient windows (Gunts, 1993, p. 49). A more comprehensive definition of sustainable design is offered later in this thesis, but designing buildings using a sustainable approach requires a holistic, multi-disciplinary process and it is still evolving.

Sustainable design examines areas where the design, construction, and operation of buildings all consider the resource needs of future generations by using natural resources in ways that are more efficient and protect wildlife and ecosystems. Sustainable design eliminates or minimizes waste by exploring new uses or processes that turn waste into another resource. In the natural world organic and inorganic systems are interrelated and dependent upon each other for survival. Sustainable design applies this model to how buildings are designed, constructed and operated. For example construction waste, instead of being landfilled, is reused or recycled into new uses.

The American Institute of Architects (AIA) recognizes the need to educate architects about sustainable design. In January 1992, the AIA, with funding support from the Environmental Protection Agency, began publishing the *Environmental Resource Guide*. The ERG, published on a quarterly basis, is intended to provide the latest information for architects on topics related to healthy, sustainable design.

Environmental Resource Guide

The ERG provides architects with "more sensitive ways of minimizing environmental impacts in the course of building projects and beyond" (Environmental Resource Guide, 1992, p. Intro IV 1). It educates architects about the range of environmental issues and helps them ask the pertinent questions such as: "*Will unique or rare ecosystems be threatened by the project? Can the material be recycled or reused at the end of its useful life in a structure? Has your building been designed to facilitate recycling?*"

The ERG is not intended to provide definitive solutions for architects to follow or to

recommend building materials and identify manufacturers. "Due to the fluid nature of research findings on environment issues, the ERG cannot provide a step-by-step guide for environmentally sensitive architecture, since a consensus has yet to be reached on what constitutes a truly 'green' building" (Crosbie, 1992, p. 99).

ERG beginnings

The idea for a resource guide for architects started with an architect who was searching for answers to environmental questions and an Environmental Protection Agency (EPA) representative. The alliance between the EPA and the AIA started in 1990 with architect Bob Berkebile's concept for celebrating the AIA Kansas City Chapter's 100 year anniversary; instead of a commemorative fountain he proposed that the chapter and the profession examine how architects could make a difference environmentally in the next 100 years. At the same time, Erich Bretthauer in Washington DC was charged with developing an innovative EPA program that would preserve environmental resources rather than fining offenders after it is too late to prevent harm. Bretthauer learned about Berkebile's initiative. Together they developed a partnership among the AIA, EPA, and industry to sponsor the research that has become the basis for an information source (the ERG) to help architects design buildings that are more environmentally friendly (B. Berkebile, telephone interview, February 17, 1994).

Existing EPA research on building materials that potentially impact indoor air quality formed the basis for most of the first year's material reports in the ERG. Although the research on building materials was not precisely oriented to the practicing architect, ERG planners decided the available information was valuable enough to publish immediately, instead of waiting several years for the research to become more definitive and entirely architecturally applicable (B. Berkebile, telephone interview, February 17, 1994).

A private consulting firm was retained to write building material analyses. Ten architects and ten scientists reviewed the reports and commented on the material's usefulness to professional practice (B. Berkebile, telephone interview, February 17, 1994).

The ERG was initially conceived as a user-friendly electronic data base architects could access for the latest information, but lack of a common national computer

system, the recognition that some architectural firms did not have computers, and the cost of an electronic system, caused early planners of the ERG to begin the process with a printed document (B. Berkebile, telephone interview, February 17, 1994).

Structure and content of the Guide

The ERG compiles for architects a wide variety of articles and case studies associated with designing buildings that are environmentally sensitive into one convenient source. It is also a compilation of previously published research data that analyze the environmental life cycle of various building materials. These analyses highlight the energy, waste, emissions and health issues associated with each material at each phase of its life. The building material reports describe 1) where a material comes from, 2) how it is manufactured, how much energy is consumed, and how waste is produced from this process, 3) the environmental impact, such as emissions of the material during construction and use, and 4) and the potential for recycling/reusing the material at the end of its useful life (*Environmental Resource Guide*, 1992, p. Intro. IV 6). The phrase cradle-to-cradle life cycle is often used figuratively in such analyses to emphasize that a material or product, instead of being landfilled at the end of its useful life (cradle-to-grave), can be reborn as a resource that can be recycled or reused. One of the challenges in developing the ERG was to establish a widely agreed upon life-cycle assessment methodology to evaluate building materials (B. Berkebile, telephone interview, February 17, 1994).

In the ERG's first year, 1992, which is the focus of this research study, the Guide reached 375-pages. New sections are added quarterly, including updates to building material research. The format of the Guide is an expandable three ring binder so that architects can replace old information with new data as it is published by the AIA. In the first year, the ERG document was divided into four sections: Introduction, Environmental Topics, Case Studies, and References.

The "Introduction" included: a letter from Robert Berkebile, 1992 Chairman of the Committee on the Environment; "Five Actions in Support of the Environment" established by the AIA Board of Directors; an article entitled "Making A Difference"; and "Resource and Environmental Profile Analysis". This section focused on general information that introduces architects to the idea of sustainable design and the ERG. The second section, Environmental Topics, included articles about "Site Design and Land Use", "Natural Resources", "Energy", "Recycling and Waste Management", and

"Environmental Education". The second part of this section, and the primary focus of the ERG, is an in-depth cradle-to-cradle analysis of building materials.

The third section, "Case Studies/Reports" compiled in-depth articles that cover a wide variety of healthy and sustainable design subjects. It includes the article "The Green Office," which exposed architects to a wide variety of health and environmental issues—such as CFC's, transportation, and water conservation— that can be addressed in their own office as well as in the buildings they design. Another article is an interview with solar architect and energy expert, Gregory Franta. Another article, "CFC Bind" is about chlorofluorocarbons, an ozone depleting chemical commonly found in refrigeration equipment and insulation. This section also included case studies of the Frankfurt Child Care Center, the Rocky Mountain Institute and the National Audubon Society, that identify and illustrate specific sustainable design solutions.

The fourth section, "References", is a listing of resources and information for further research, including Periodicals, Catalogs/Information Sources, Books, Environmental Organizations, and members of the 1991-1992 Steering Group of the AIA Committee on the Environment.

Building materials

During the first year, the ERG analyzed the cradle-to-cradle cycle of ten building materials. A series of questions in the ERG, related to cradle-to-cradle phases, help architects assess and evaluate materials. No one building material can perform well on each issue a question raises. For example aluminum is durable and easily recycled but its embodied energy is very high. Building material selection therefore represents an effort to balance conflicting priorities and various negative environmental impacts. Currently, the selection of healthy and sustainable building materials is based on professional judgment or evaluation, as is the case for most decisions. In the future, decisions on which building materials to select may be supplemented by a widely accepted scientific methodology and a data base that identifies how each material performs environmentally.

Who is subscribing to the ERG?

In 1992 there were approximately 900 ERG subscribers, with architects representing the majority of subscribers (L. Jerakis, telephone interview, September 15, 1993).

According to the AIA, less than 25% of their subscribers also include: building material manufacturers such as Dupont and their associations such as the Poly Isocyanate Insulation Manufacturers Association (PIMA); architecture school and corporation libraries; utility companies, and; government agencies such as the Environmental Protection Agency, the Department of Energy, and the National Park Service (L. Jerakis, telephone interview, September 15, 1993).

These subscribers ordered the Guide for a variety of reasons. Although representatives of PIMA read ERG draft reports on insulation, PIMA subscribed to the ERG because they wanted to know "what was being written about them" (J. Blum, telephone interview, September 2, 1994). The architecture library at the University of California-Berkeley subscribes because: 1.) they subscribe to most AIA publications, 2.) there is growing demand for information on "green architecture", and 3.) students, faculty and non-UC Berkeley people asked for the Guide (E. Byrne, telephone interview, September 2, 1994). The Presidio design team of the National Park Service ordered the Guide to learn more about the topic of sustainable design and support the National Park Service's goal to build their facilities using this approach. They also subscribed because they believed the Guide would be a focal point, similar to *Architectural Graphic Standards*, within the architectural profession for information on sustainable design (R. Wallace, telephone interview, September 1, 1994). The utility company, Pacific Gas and Electric subscribes to the Guide based on library visitors' questions on sustainable and healthy building materials and because the company has a stated commitment to environmental preservation (D. Jones, telephone interview, April 27, 1994).

Healthy and sustainable architecture

According to the World Commission on Environment and Development, "Sustainability means meeting the needs of the present without compromising future generations in meeting their own needs" (Wagner, 1993, p. 56). More specific to architecture, it is an approach that lessens the environmental impact of a building's construction, operations, and possible demolition. It considers the environmental consequences of the everyday decisions designers make.

Sustainable design is a holistic approach aimed at producing results in which the whole is greater than the sum of its parts. It combines design practices and technologies from

different disciplines to yield a total building energy savings and waste reduction as well as healthy indoor air. Collaboration between disciplines is therefore necessary to maximize common environmental goals.

A six point framework, as described in the ERG, acquaints architects with the magnitude of issues related to healthy and sustainable architecture. Architects can use the framework as a checklist to cover these issues and to organize an approach to designing healthy and sustainable projects.

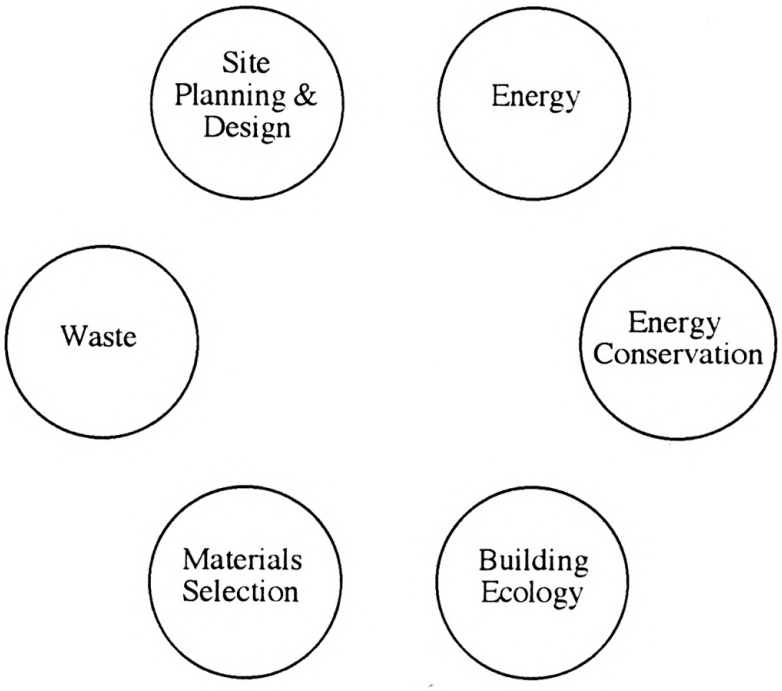


Figure 1 Six Point Sustainability Diagram

Sustainable design uses renewable sources for building materials, such as wool and wood, to alleviate stress on non-renewable resources (Stafford, 1992, p.7). *Materials* with a recycled content, such as insulation from recycled newsprint or tile from recycled glass, close the recycling loop and turn waste into profit. A sustainable approach to building material selection also avoids materials that contain ozone depleting chemicals such as chlorofluorocarbons (CFCs) and volatile organic compounds (VOCs). *Building ecology* refers to indoor environmental factors that affect building users' health and well being (*Environmental Resource Guide*, 1992, p. Topic.VI 1). Avoiding materials that off-gas is

one of the first crucial steps to providing better indoor air quality.

To achieve *energy conservation*, sustainable design uses old strategies such as siting buildings in response to the sun and wind, providing shading from trees, and taking advantage of natural ventilation (Gunts, 1992, p. 49). New technologies include photovoltaic cells and energy efficient glazing. As defined in the ERG, *energy* refers to how energy is used in buildings, where it originates, the energy opportunities from a local climate, and embodied energy. *Site planning/design* responds to issues such as transportation, infrastructure, ecosystems, wildlife and water.

Sustainable design also includes reducing *waste* generated during building construction and operations. Waste is minimized during construction by using building materials more efficiently and recycling construction and demolition waste or by reusing buildings instead of demolishing them. During building operations, waste is composted or recycled.

Sustainable design is inseparable from good design and economic considerations. Environmental concerns are simply another layer of considerations that are incorporated with other project goals and objectives. There is no discernable style associated with sustainable design, although buildings may take on physical characteristics of their region (Berkebile, 1993, p. 112) based on the use of indigenous building materials that are better suited to a regional climate.

Thesis objectives

This thesis examines the ERG up close as a reference tool for architects and from a distance as one element in a larger system. Clearly the ERG is just one written document in a social system made up of many entities —such as government, the construction industry, the AIA, allied design professions, and architecture schools. When the Guide is examined from a distance, it represents an innovation. According to Everett Rogers, a leading theorist on diffusion of innovation theory, an innovation is an idea, practice, or object that is perceived as new to a society or group (Rogers, 1983, p. 11). As will be discussed in more length on page 23, the ERG represents an innovation because it is a new object being diffused into the architectural profession. The topic of this thesis is the ERG as a tool and innovation, not sustainable design as an innovation.

Based on the two perspectives described above, this thesis has two objectives: 1.) To understand the ERG in the context of a larger social system. Using Everett Rogers' diffusion of innovation theory and research on architects and their use of information, this thesis explores the relationships among the Guide and members of the design and construction system and examines diffusion of the ERG into architectural practice; 2.) To evaluate the effectiveness and user-friendliness of the ERG as a reference tool for architects. The ERG is studied to determine if the content and presentation of the Guide is useful to practicing architects. Written documents that match how architects think and work will be more useful and effective documents.

Chapter Two: Review of Literature

Introduction

Rogers' diffusion of innovation theory provides a broad context and theoretical background for this thesis. It predicts the process, conditions, and obstacles associated with accepting or rejecting an innovation, such as the ERG. This background knowledge may be encouragement for those struggling with diffusing an innovation.

However Rogers' theory is too general to discuss the focus of this thesis, which is about how to diffuse an innovation in written form to the architectural profession. A review of literature on architects' use of technical information was necessary to become knowledgeable about characteristics of useful and neglected professional documents and the proclivity of architects to access them.

Thus, to provide an adequate theoretical framework for this thesis, three types of literature were reviewed: 1.) Rogers' diffusion of innovation theory; 2.) critics of Rogers' theory, and 3.) and studies of architects and their use of technical information in design. Everett Rogers' pioneering book, *Diffusion of Innovation*, which laid the foundation for later diffusion of innovation models, was a primary source. The works of Hagerstrand and Brown, were reviewed as critics of Rogers' theory, as well as Rogers' own criticism of his theory. A summary of the literature on architects and information begins on page 18.

Diffusion of innovation

Diffusion of innovation is a concept that refers to the process of communicating an innovation from someone who is familiar with it to someone who is not. To a Peruvian village, the practice of boiling water to improve health and lengthen lives may be an innovation. An innovation may also be a new technology such as the DVORAK keyboard. The DVORAK keyboard, designed in 1932, locates letters to match the required amount of work to a finger's skill and strength. Thus, commonly used letters are located on the home row of keys. The DVORAK keyboard has not been widely diffused to replace the less efficient QWERTY keyboard, named after the first six keys in the upper row of letters.

The DVORAK keyboard story illustrates that even when an innovation may have obvious advantages it is often difficult to get people to use it. In the case of the DVORAK keyboard, vested interests such as manufacturers, typing teachers, and typists themselves resisted replacing the QWERTY keyboard (Rogers, 1983, p. 10). There is a wide gap between what is known and what is put into practice. A common problem is how to speed up an innovation's rate of diffusion.

As viewed from the perspective of Rogers' definition of innovations, the ERG represents an innovation in architecture; it is a new approach, unfamiliar to many architects, that seeks to lessen the built environment's negative impact on the natural environment. As with any innovation, specific conditions and processes exist that influence the diffusion of the ERG into architectural practice. Diffusion of innovation theory is part of this thesis because it provides a larger context within which to understand the process of diffusing the ERG and sustainable design practices into the architectural profession.

Rogers' model

Rogers has studied why some innovations are adopted while others such as the DVORAK keyboard are not. His four point framework include: innovation, time, communication channels, and social system.

Innovation

"An innovation presents an individual or an organization with a new alternative or alternatives, with new means of solving problems" (Rogers, 1983, p. 15). Some new ideas diffuse quickly. Other innovations have a slower rate of adoption. The following five characteristics of innovations help explain different rates of adoption:

- Relative advantage: Is it better than the current idea? A new idea is better if it achieves economic benefits, social prestige, convenience and satisfaction (Rogers, 1983, p. 15).
- Compatibility: Is it consistent with existing values, needs, and past experiences (Rogers, 1983, p. 15)?
- Complexity: Is it easy to understand and apply (Rogers, 1983, p. 15)?
- Trialability: Can it be used on a trial basis? "New ideas that can be tried on the

installment plan will generally be adopted more quickly than innovations that are not divisible" (Rogers, 1983, p. 15).

- Observability: Can the results be seen? The easier it is for individuals to see the results of an innovation, the more likely they are to adopt it (Rogers, 1983, p. 16).

Time

Time and diffusion of innovation are inextricably related in three areas. First a person or a group passing through the innovation/decision process follows a time-ordered sequence of knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1983, p. 21). "The innovation-decision process is an information-seeking and information-processing activity in which an individual obtains information in order to decrease uncertainty about the innovation" (Rogers, 1983, p. 21).

Second, some individuals or groups adopt innovations more quickly than others. Rogers' adopter categories classify members of a social system or individuals based upon the time at which an innovation is adopted. The five adopter categories are: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards.

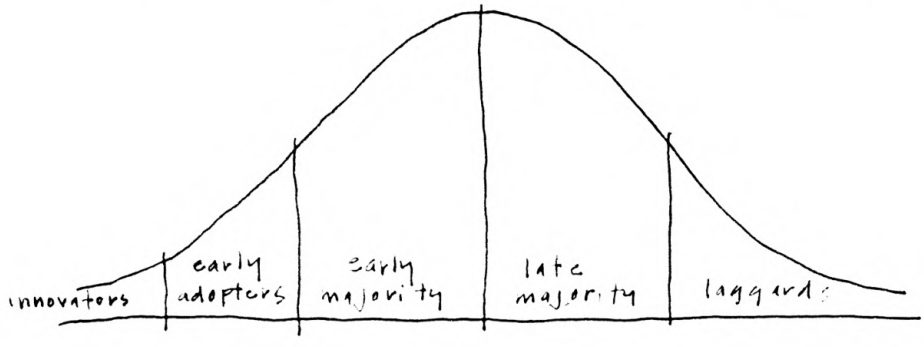


Figure 2 Adopter Categories on the Basis of Innovativeness. (Everett Rogers, *Diffusion of Innovation*, p. 247)

Innovators make up 2.5 percent of the individuals who adopt an innovation (Rogers, 1983, p. 246). Rogers describes them as "Venturesome" because they "desire the hazardous, the rash, the daring, and the risky" (Rogers, 1983, p. 248). They are eager to try new ideas and "are active information seekers about new ideas" (Rogers, 1983, p. 22). Innovators have access to substantial financial resources to cushion them from risks. They have the ability to understand and apply complex technical knowledge and can deal with a high degree of uncertainty regarding an innovation as it is being developed (Rogers, 1983, p. 248). Innovators are involved in cosmopolitan social

relationships. "Innovators have a high degree of mass media exposure and their interpersonal networks extend over a wide area, usually reaching outside of their local system" (Rogers, 1983, p. 248). This characteristic is important in the diffusion process because their cosmopolitan contact launches the innovation into the social system. "Thus, the Innovator plays a gatekeeping role in the flow of new ideas into a social system" (Rogers, 1983, p. 248).

Early Adopters, described by Rogers as "Respectable," make up 13.5 % of the individuals to adopt an innovation. Early Adopters integrate more into a local social system than Innovators. This interaction with similar people helps persuade potential adopters. Potential adopters look to Early Adopters for information and advice about the innovation. "Because Early Adopters are not too far ahead of the average individual in innovativeness, they serve as role models. The Early Adopter is respected by his or her peers, and is the embodiment of successful and discrete use of new ideas" (Rogers, 1983, p. 249). Early Adopters try to maintain the respect and esteem of colleagues by making sound innovation decisions. "So the role of the Early Adopters is to decrease uncertainty about a new idea by adopting it, and then conveying a subjective evaluation of the innovation to near-peers by means of interpersonal networks" (Rogers, 1983, p. 249). More than any other, this adopter category has the greatest degree of opinion leadership in most social systems.

The Early Majority who represent 34% of the individuals to adopt an innovation, "deliberate" for some time before they adopt. The motto for this group might be, "Be not the first by which the new is tried, nor the last to lay the old aside." (Rogers, 1983, p. 248). They will adopt an innovation just before the average member of a social system. This position serves an important link between the Early Adopter and Late Majority. Adoption by this group can set an example for those that are more difficult to change — Laggards. Early Majority individuals interact frequently with their peers but seldom hold leadership positions. "Early Majority follow with deliberate willingness in adopting innovations but seldom lead" (Rogers, 1983, p. 249).

Late Majority, described by Rogers as "skeptical," make up 34% of the individuals to adopt an innovation. Late Majority adopt new ideas just after the average member of a social system. Late Majority approach innovations with skepticism and caution. "Late Majority can be persuaded of the utility of new ideas, but the pressure of peers is necessary to motivate adoption" (Rogers, 1983, p. 250).

Laggards, described by Rogers as "traditional," make up 16% of the individuals to adopt an innovation. Laggards are the last in a population to adopt an innovation, which may explain why they are suspicious of innovations and change agents. Laggards do not hold leadership positions and isolate themselves from the social system. The reference for the Laggard is the past, and they interact with others who have traditional values. "While most individuals in a social system are looking to the road of change ahead, the Laggards' attention is fixed on the rear view mirror" (Rogers, 1983, p. 250).

Third, an innovation's rate of adoption is "usually measured as the number of members of the system that adopt the innovation in a given time period" (Rogers, 1983, p. 23). Rate of adoption refers to the speed with which the innovation is adopted by members of the social system. The rate of adoption is measured using an innovation, rather than an individual, as the unit of analysis. Rate of adoption helps explain different rates of adoption among various units of the social system.

Communication channels

Communication channels, the third element of Rogers' diffusion of innovation theory, are part of the diffusion process because they are used to exchange new ideas among individuals. "Communication is a process in which participants create and share information with one another in order to reach a mutual understanding" (Rogers, 1983, p. 6). "At its most elementary form, the process involves: 1) "an innovation, 2) an individual or other unit of adoption that has knowledge of, or experience with using, the innovation, 3) another individual or other unit that does not yet have knowledge of the innovation, and 4) a communication channel connecting the two units" (Rogers, 1983, p. 17).

According to Rogers, communication channels are categorized either as 1) interpersonal or mass media or 2) originating from either localite or cosmopolite sources. Interpersonal communication channels are face-to-face exchanges between two or more individuals, while mass media communication channels such as radio, television, and newspapers are between a few individuals and a large audience. Localite communication channels are within the social system and cosmopolite communication channels are outside the geographical area of a social system. Interpersonal communication channels are localite and cosmopolite and mass media communication channels are typically cosmopolitan (Rogers, 1983, p. 200).

Cosmopolitan channels are more effective at the knowledge stage; localite channels are more effective at the persuasion stage in the innovation-decision process.

Effective communication channels are matched to appropriate adopter categories.

> "The important differences among these categories suggest that change agents should use somewhat different approaches with each adopter category, thus following a strategy of audience segmentation. Audience segmentation is a diffusion strategy in which different communication channels or messages are used with each audience segment. This strategy has the advantage of breaking down a heterophilous audience into a series of relatively more homophilous subaudiences" (Rogers, 1983, p. 262).

The following discusses each adopter category and the appropriate communication channels.

Since no one else in the social system has experienced the innovation when Innovators adopt a new idea, they establish communication channels and go outside the social system, using cosmopolite channels (Rogers, 1983, p. 201).

Mass media and cosmopolite channels appeal to Earlier Adopters and Early Majority individuals. Interpersonal influence is not needed with Earlier Adopters and Early Majority because "they possess a need for venturesomeness, and the mass media message stimulus is enough to move them over the mental threshold to adoption" (Rogers, 1983, p. 201).

Interpersonal and localite networks are effective with Late Majority and Laggards because they are more persuasive. "But the less change-oriented, later adopters, require a stronger and more immediate influence, like that from interpersonal networks" (Rogers, 1983, p. 201). Interpersonal networks convey subjective experiences of their peers with the innovation. Interpersonal networks are also effective because by the time Late Majority and Laggards adopt there are a number of examples of the innovation around them from which to draw.

Social system

The social system of an innovation represents the "set of inter-related units that are engaged in joint problem solving to accomplish a common goal" (Rogers, 1983, p. 24). Members of a social system may be individuals, informal groups, organizations, or subsystems. While members of the social system may be different, they cooperate

with each other to solve a common problem in order to reach a mutually agreed upon goal. This sharing of a common objective binds the social system together (Rogers, 1983, p. 24).

The social system is important in diffusion of innovation theory because it can facilitate or impede diffusion of an innovation. According to Rogers, "It is unthinkable to study diffusion without some knowledge of the social structures in which potential adopters are located as it is to study blood circulation without adequate knowledge of the structure of veins and arteries" (Rogers, 1983, p. 25). The structure of the social system affects the innovation by establishing norms for behavior. It defines a range of tolerable behavior and serves as a guide or a standard for members of a social system.

Change agents play an important role in a social system. "Change agents influence clients' innovation decision in a direction deemed desirable by a change agency" (Rogers, 1983, p. 312). These individuals influence other individual's attitudes or behavior informally. Change agents facilitate the diffusion of an innovation from its source to its audience. Seven roles can be identified for change agents: 1.) to "develop need for change; 2.) to establish an information-exchange relationship, 3.) to diagnose their problems; 4.) to create intent to change in the client; 5.) to translate intent into action; 6.) to stabilize adoption and prevent discontinuances; 7.) to achieve a terminal relationship" (Rogers, 1983, p. 315-316).

The second review of literature for this thesis covers critics of Rogers' theory, which includes Rogers.

Review of literature on diffusion of innovation

Hagerstrand, like Everett Rogers, is an early researcher whose work helped to develop diffusion of innovation theory. In 1967, Hagerstrand developed the Adoption Perspective, similar to Rogers' theories, which focuses on the adoption behavior of an individual and the communication of information about an innovation. Hagerstrand's Perspective focuses on the demand side of an innovation and the characteristics of individuals who determine adoption (L. A. Brown, 1981, p. 5).

Lawrence Brown, a more contemporary researcher than Hagerstrand on innovation

diffusion theory, focused on the supply side of innovation in his Market and Infrastructure Perspective (L. A. Brown, 1981, p. 7). This Perspective states that the opportunity to adopt an innovation is not equal. Brown believes that adoption first depends upon and is the responsibility of diffusion agencies, such as government, commercial or nonprofit entities. According to Brown, "individual behavior does not represent free will so much as choices within a constraint set and that it is government and private institutions which establish and control the constraints" (L. A. Brown, 1981, p. 8). Unless a diffusion agency makes an innovation available, according to Brown, a potential adopter will not have the option to adopt in the first place (L.A. Brown, 1981, p. 8).

Brown is critical of the Adoption Perspective because it focuses a lot of money and personnel resources upon a small number of people. To Brown it is "person intensive" and does not provide an equal return on investment. A third criticism of the Adoption Perspective is that it does not take advantage of or recognize "commonly used business strategies for diffusing innovation " (L.A. Brown, 1981, p. 289).

Rogers' criticisms of diffusion of innovation research

Rogers recognized many criticisms of diffusion of innovation theory and believes these are opportunities for future improvement of the diffusion field. He has four criticisms of diffusion of innovation research, one of which was raised by Lawrence Brown: the individual blame bias (Rogers, 1983, p. 133). Early research on diffusion of innovation tended to focus on individual responsibility to adopt rather than obstacles within the social system that retard diffusion.

Another criticism of early diffusion of innovation research is its pro-innovation bias (Rogers, 1983, p. 133). Most research on diffusion of innovation focuses on diffusing an innovation and making sure it is adopted by members of a social system. "This bias leads diffusion researchers to ignore the study of ignorance about innovations, to underemphasize the rejection or discontinuance of innovations, to overlook re-invention, and to fail to study antidiffusion programs designed to prevent the diffusion of 'bad' innovations (like marijuana or drugs or cigarettes, for example)" (Rogers, 1983, p. 92).

A third criticism is the recall problem that may occur when subjects in the sample

provide inaccurate answers when asked to recall when they adopted an innovation. Rogers' fourth criticism is the issue of equality (Rogers, 1983, p. 133). "Socio-economic gaps among members of a social system are often widened as a result of the spread of new ideas" (Rogers, 1983, p. 133). For example, in developing nations, farmers with more land, money and more mass communication opportunities are more innovative. Development agencies often favor clients who are innovative, wealthy, educated and information seeking (Rogers, 1983, p. 125). However, Rogers' also cites two studies, Shingi and Mody (1976) in India and Roling (1976) Kenya, that discredit this theory where communication strategies effectively narrowed the socioeconomic gap. (Rogers, 1983, p. 126).

The third review of literature for this thesis is architects and their use of written information.

Architects and information

The information available in the ERG appears to be an extraordinary asset for practicing architects. It conveniently compiles articles, research, and sources that were previously dispersed, on an emerging topic, i.e. healthy and sustainable design. It also provides a framework within which to approach sustainable design. For those architects concerned about the environment and their role, but not sure what to do or what the issues are, the ERG educates by providing both detailed and general information.

Research indicates, however, that architects access written information as a last resort. In one study by Powell it was concluded that, "The researchers reported a remarkable unwillingness on the part of designers to consult written data and a concomitant preference for relying on experience, in part, because consulting written data was seen as time consuming" (Powell, Cooper, and Lera, 1983, p. 274). But research indicates that architects tend to shed information, rather than gather it (Powell, Cooper, and Lera, 1983, p. 284).

A leading British investigator of how architects make decisions has observed that, "Design researchers are beginning to recognize that no matter how good information is from an academic, scientific or technical point of view, if designers do not choose to access it, cannot access it or cannot apply it readily, then it is of no value to them"

(Powell, Cooper, and Lera, 1983, p. 272).

When they do not make use of specific technical information, architects rely on intuition, personal experience, and precedent (Snyder, 1984, p. 16). "In summary of this work, it is clear that designers need to have confidence in their design data as well as fast access to a strictly relevant and easily understandable data base. Without appropriate information on new technical issues it is clear that designers do "back hunches" rather than "spend time trying to clarify issues or attempting to access further explanatory information" (Powell, Cooper, and Lera, 1983, p. 290).

Finding time to read professional journals and stay current on new research findings may be difficult for practitioners of any profession. For example, there are concerns in the medical profession that physicians rely too heavily on advertising and drug sales representatives rather than keeping up with new research (J. Brown, 1994).

Review of literature on architects and information

Much of the research on architects and information has been conducted at the Design Information Research Unit (DIRU) at Portsmouth Polytechnic in Portsmouth, England (designated as *). The following is a summary of the findings from DIRU and other researchers on the content and presentation of information for architects.

Powell (1968)*
- Information must be easily accessed and understood in design terms.
- It must be usable within normal design times and enable the designer to have a "feel" for what he is doing so that he eventually has complete confidence in his proposed solution.
- It must be fully oriented to the designer.

Mathew and Goodey (1971)*
- Examine the subject of the paper critically and extract only those points which are of interest to architects.
- Cut out details of experimental procedures and theoretical background.
- Provide references for further reading.
- Use an architectural vocabulary.
- Make the written material brief and to the point.
- Vary sentence length.
- Use the active voice and direct speech.
- Don't put things in a negative form.
- Don't hedge.
- Give short, pithy summaries at the beginning.
- Use illustrations, scaled if possible.

- Use photographs sparingly.
- Don't use graphs and tables if possible.
- Relate text to illustrations.
- Give information in a form that the architect can easily use.
- Give the actual price or form of comparison.
- Give performance data where possible.
- Leave good margins for punching holes.
- Don't rely on the architects to cut information for filing.

Burnette (1979)
- Publication must be continuous and up-to-date.
- Information must be packaged and ready for use.
- Information must appear consistently in the same format.
- Information must be concisely presented in discrete chunks.
- Information should be couched in operationally useful performance-oriented descriptions.
- Information must be accurate and complete.
- Drawings must be precise and to an easily used scale; evaluation and feedback must be built in.

Ritter (1980)
- Relevance
- Quality
- Designers' perception and acceptance of need
- Identification (can the information be identified?)
- Costs, resources and availability of acquisition, storage and retrieval
- Understanding (presentation)
- Applicability

Lera (1981)*
- Designers need a means of keeping records of key communications, decisions, and assumptions.
- Match information to varying needs of designers at different stages during design (approximate answers and comparative costs are required in the early stages).
- Provide more detailed appraisals of the buildings in journals and possibly the introduction of comparatively analyzed stereotypes.

Mackiner and Marvin (1982)*
- The research gives a strong indication that designers tend to seek written information as a "last resort" when their own experience or that available in the office fails to give either an answer to a problem or the understanding to enable a solution to be worked out.
- Designers use a narrow range of "favorite" references; this research and previous work have explained why they prefer certain forms of written information, and these recommendations should be more widely acted upon.
- Designers need information to be retrievable very quickly, and diagrammatic presentation fits this criterion best.
- Designers need to know the range of information available, especially when undertaking design of the less common types of building.

Lansley (1983)
- Familiarity: an ease of appreciation of the information largely brought about by the choice of language and concepts used to describe the content of the information.

- Focus: the level at which the information is pitched and presented to enable creative designerly behavior.
- Completeness: the level of applicability to the job in hand; enough information to form complete, watertight specifications.

Powell (1983)*

- Designers feel more confident in information approved or certified by a recognized authority since in this way they believe they are transferring the liability for their decision to the authority concerned.
- To facilitate the information transfer process and to promote learning, it is necessary for design information to be individualized to the differing architect/engineers' learning styles and existing knowledge system (four cognitive learning styles relevant to design: divergent/convergent, impulsive/reflective, field independent/field dependent, serialistic/holistic.).
- Change of emphasis in the way design documents are presented; information must be reflective of the designer's process of designing, learning, and development.

These research findings were distilled into the following five-point framework used to formulate interview questions and to evaluate the ERG. Written material must be: easy and quick to access; understood in design terms; matched to the information needs of designs stages; diagrammatic, and; able to instill confidence in the designer so that he or she can make recommendations.

This review of literature revealed how: the architectural profession addresses and shares new research findings; information is used for decision making and how decisions are documented, and; information should be presented so that it is accessible and useful to a practicing architect. The findings from the review of literature were used to develop criteria to evaluate the ERG. The review of literature also provided this author with background knowledge that was useful for subject interviews and changed this author's conceptions about how architects use information.

Chapter Three: ERG Diffusion Model

Introduction

This author developed an ERG diffusion model that combines Rogers' four elements of diffusion with two additional elements, developed by this author, that are specific to this study. Together, these elements help explain why healthy and sustainable architecture is not generally practiced and to uncover weaknesses in the larger system that retard diffusion of this environmentally sensitive approach to design. Specifically the ERG diffusion model includes the following elements:

Rogers'
- Innovation
- Social System
- Time
- Communication Channels

Author's
- Architect's Motivation
- Characteristics of Written Information for Architects

Rogers' elements, the basis of the ERG diffusion model, provide a theoretical context and framework to study and understand diffusion of the ERG into architectural practice. This author's elements, Architect's Motivation and Characteristics of Information for Architects, address other factors that affect accessing and using the ERG. Motivation, according to Powell's research findings, is a key issue in getting architects to consider and learn a new idea. Characteristics of Information for Architects, extracted from research findings from the review of literature, outline specific characteristics of information that would not necessarily increase use of the ERG significantly but would help producers of information for architects better design their written materials.

The following section overlays the ERG diffusion model onto the ERG and the social context in which it exists. Some elements of Rogers' model overlap with this author's element—"Characteristics of Written Information for Architects". These similarities will be discussed later in the section by this name. This section also defines terms.

ERG diffusion model

Consider the ERG's journey from the AIA to an architect and, eventually its use in the design and construction of a healthy and sustainable building. First, the architect needs to hear about the ERG through *communication channels*. Then she or he needs to be *motivated* to spend $125 to subscribe to and use the ERG. The ERG content and presentation, *architects and information,* must be judged to be useful to the practicing architect. The architect must also be *motivated* to apply information found in the ERG. She will do so if she perceives the ERG as providing a *relative advantage*, *compatible* with existing values, *trialable*, *observable* and not *complex.* Once the architect has adopted this approach, she will work with clients, consultants, sales representatives and many others — a *social system* — to apply the information to a project. Potential adopters of an innovation such as the ERG pass through the *innovation-decision process.* They have different *rates of adoption*, and this rate organizes members into different *adopter categories.*

This journey illustrates the role of each element of diffusion identified by Rogers in his innovation theory. It also illustrates elements specific to diffusing a written innovation into architectural practice.

Innovation

For many architects the ERG represents a perceived new approach to certain aspects of the practice of architecture. Many concepts in the ERG are not new. Indigenous materials, energy-efficient technologies, passive solar heating, and climate responsive building siting have been practiced by some architects for many years. Some are timeless concepts. Yet, no matter how old these concepts are, they are perceived as new by many architects. The following discussion applies each of the five characteristics of innovations to the ERG as an innovation to help understand its rate of adoption.

Architects will adopt the ERG more quickly if they perceive a *Relative Advantage*, specifically an economic benefit. They will adopt healthy and sustainable architecture, and perhaps subscribe to the ERG, if this approach to practice can provide a new market opportunity. Those who capitalize on the approach of healthy and sustainable architecture can market these services to clients as additional expertise, exploit these services to gain contracts, or create new markets as experts in

this area. According to Rogers, "It does not matter so much whether an innovation has a great deal of "objective" advantage. What does matter is whether an individual perceives the innovation as advantageous" (Rogers, 1983, p. 15).

Relative Advantage resembles this researcher's "Architect's Motivation" element of the ERG diffusion model. Architects must be motivated to use the ERG, and one of the motivations is capitalizing on a market niche. According to Powell and Nichols, who are experts on architects and their use of information, "Information providers must realize that design time is restricted and, therefore, if a new idea is to be employed, it is often at the expense of some other factor. Designers have to be convinced that a new idea is more valuable than their previous ideas and that exploration will not upset the normal balance of their designing" (Powell and Nichols, 1981, p. 312).

Architects who are concerned about the environment, have been personally affected by an environmental illness, or value energy-efficient architecture are more likely to adopt the ERG because it is *Compatible* with their existing values, needs, and past experiences.

Compared to the other four characteristics, *Compatibility* may be one of greatest obstacles for the ERG and healthy and sustainable architecture. To appeal to more architects, it must be compatible with values, needs, and past experiences of a wider variety of architects. If, for example, "design" appeals to the values, needs, and past experiences of most architects, then the presentation of the ERG and case studies should emphasize how healthy and sustainable concepts can be achieved without compromising design objectives or in a way that actively supports those objectives. In Dorothy Mackenzie's book *Design for the Environment,* for example, a range of products — from architecture to product design — are identified that implement environmental considerations as part of the entire process while also emphasizing aesthetics (Mackenzie, 1991, p. 8).

If architects perceive the ERG as *Complex* and think that they must develop new skills and knowledge to apply it, then it will be diffused more slowly. Although the ERG presents information clearly and simply, it requires a new way of thinking and education about healthy and sustainable technologies and design solutions. This characteristic of innovations may also be an obstacle to diffusing the ERG.

The ERG lends itself to *Trialability* because the approach to designing healthy and sustainable architecture is made up of many parts. Architects could experiment by implementing a single concept, such as an energy-efficient HVAC system, daylighting, or the use of healthy and sustainable building materials.

The *Observability* of using the Guide refers to seeing the results of an innovation, such as installing solar panels. Innovations that provide visibility will be diffused faster because this stimulates conversation and exchange of information. Some concepts within the ERG lend themselves to *Observability*. Others, such as using less toxic glues, do not.

Social system

While there may be other members within the construction community with whom an architect interacts, this thesis includes only the entities mentioned by the architects this author interviewed. These include: clients, allied design professions, the AIA, architecture schools, the construction industry, building material manufacturers, government and public utilities.

As the list suggests, the social system connected with the ERG is broad. The ERG interacts with many groups — some more than others. Architects using the ERG typically interact with project-oriented members of the social system: clients, allied design professions, building material manufacturers, local government, public utility companies, and contractors. As the publisher of the ERG, the AIA interacts with some project-oriented units of the social system but at a different scale. The AIA, for example, interacts with the national organizations of allied design professions. The AIA also interacts with nonproject-oriented units of the social system such as universities and government.

Interaction between the ERG and units of the social system raises awareness. Units of the social system become familiar with the ERG's goals and objectives. Intentionally or not, architects and AIA advocates of the ERG educate and pressure units of the social system to address their role in promoting healthy and sustainable architecture.

Ideally, the ERG will succeed in leading members of the construction industry to share and support the ERG's goals and objectives. If this occurs, the social system will be cooperative toward architects interested in designing healthy and sustainable

buildings. Architecture schools will raise awareness and educate student architects regarding the issues and design solutions. Allied design professionals will also be on board and able to help. Products that are less toxic and less harmful to the earth will be widely available. There will be fewer obstacles and more opportunities to design holistic solutions and advance the state-of-the-art.

Development of the social system affects the diffusion of the ERG. Rogers states that "Clearly, there are aspects of diffusion that cannot be explained only by the nature of individual behavior. The system has a direct effect on diffusion, and also an indirect influence through its individual members" (Rogers, 1983, p. 23-24). Strong members of the social system make it easier for architects to apply information in the ERG and practice healthy and sustainable architectural design.

Time

Rogers' adopter categories break down and organize a larger diverse population into smaller homogeneous subgroups based on their rates of adoption. The intent of classifying architects and members of the social system is to understand the perspective of each group in order to improve diffusion of the ERG and promote healthy and sustainable architecture. According to Rogers, the wide variety of sympathy and knowledge toward healthy and sustainable architecture within architectural practice and the building industry social system is typical. "There are also differences in the rate of adoption for the same innovation in different social systems" (Rogers, 1983, p. 23).

Communication channels

Communication channels transmit knowledge about the ERG and healthy and sustainable architecture from the AIA to member architects who don't have this knowledge. Several non-AIA communication channels exist that promote healthy and sustainable architecture and help architects stay current on new practices or technologies. *Earthword*, published by Eos Institute, is a joint project of Architects, Designers, and Planners for Social Responsibility (ADPSR) and the Permaculture Institute of Southern California. The Council on the Environment of the Institute of Business Designers (IBD) in New York publishes *SEED*, Social Ecologically Effective Design. Another informative publication is *Environmental Building News*.

This thesis, however, focuses primarily on mass media and interpersonal channels

from the AIA, which include face-to-face exchanges between architects, articles in *Architecture* magazine and *Memo*, newsletters from local chapters, Committee on the Environment meetings and newsletter, the three national Building Connections videoconferences, and the national convention: *Architecture at the Crossroads: Designing a Sustainable Future*.

Mass media communication channels such as the journal *Architecture*, *Memo*, and newsletters from local chapters inform architects about the ERG. According to Rogers, these communication channels are effective with Innovators and Early Adopters since they have an interest in sharing information. (Rogers, 1983, p. 200). According to Rogers, mass media communications channels would not be as effective as interpersonal communication channels in persuading Late Majority and Laggards to adopt the approach of healthy and sustainable architecture. (Rogers, 1983, p. 201). To Rogers, when Late Majority and Laggards are at the early stages of the innovation-decision process, interpersonal communication channels can overcome resistance and apathy (Rogers, 1983, p. 201).

Architect's motivation

The research literature indicates that architects must be motivated to acquire the ERG and apply the information in it. Powell and Nichols, experts on architects and their use of information, studied architects' use of technical information associated with energy conservation. One of the findings from their research was, "At the moment, fee scales are such that designers feel there is no leeway whereby they can take time to study new areas to improve their design without external motivation or incentive" (Powell and Nichols, 1981, p. 313). Some architects are personally motivated to use the ERG because they have adopted this approach to design. According to Powell and Nichols, architects who have not adopted this approach and are not personally motivated will be motivated by outside pressures or opportunities, such as clients requesting these services, government policies and building code regulations, or the opportunity to capitalize on a new client base (Powell and Nichols, 1981, p. 312 and 313).

Characteristics of written information for architects

Based on the review of literature on architects and information, written material must be easy and quick to access, understood in design terms, matched to the information needs of design stages, diagrammatic, and instill confidence in the designer to make

recommendations.

In summary, the preceding review of literature on diffusion of innovation theory and characteristics of written information for architects and definition of healthy and sustainable design provides a necessary background for the succeeding chapters of this thesis. The author's ERG diffusion model, defined in this chapter, also lays a foundation by identifying the wide variety of factors that affect whether the Guide is accessed by practicing architects. Before specific research findings are discussed, it is first necessary to describe this author's research methodology.

Chapter Four: Research Methodology

Qualitative methodology

While quantitative research methodology seeks to predict and control by distancing researchers from their subjects, qualitative research methodology allows researchers to get close to their subjects and their world (Pyke and McK. Agnew, 1991, p. 135). Quantitative methodology generates accurate and definitive information, typically based on statistical analysis. Qualitative methodology's exploratory approach collects rich, diverse, and complex information. (Pyke and McK. Agnew, 1991, p. 136).

On a practical level a quantitative approach is not useful because there is not a large enough sample of architects to study who have used the Guide and practice architecture using a sustainable approach. According to the AIA a small percentage of AIA members have subscribed to the ERG (L. Jerakis, telephone interview, September 15, 1993).This author's experience while searching for architects and projects to study supports this—there were few clients requesting these services and few architects applying information in the ERG to their practice.

In general the research needs of this study are to discover and expose issues associated with using the ERG and understand the larger context in which it exists. It is not the intent of this research to generalize from the findings to the architectural community. Based on these research needs, a qualitative approach was selected.

A qualitative approach allowed this researcher to understand personal attitudes that affect whether architects order and read the Guide. A qualitative approach also allowed this researcher to understand holistically the construction and design context in which the ERG operates and to expose a wide variety of issues associated with the content and presentation of the ERG from the perspective of practicing architects. Later when the ERG has been available for a longer period of time, it can be studied using a quantitative research methodology. The findings and framework from this research can be used to focus on specific issues.

Sample

Since this research is exploratory and is not intended to provide findings that are

statistically representative of the entire architectural profession, architects were not randomly selected. The table on the next page profiles the architects interviewed.

The names of architects came from a variety of sources. Research began near Kansas City and Robert Berkebile was contacted for referrals. Later, after the author relocated to San Francisco, architects were found through referrals: the AIA ERG subscriber list, and a panelist list from a "Healthy Building" conference sponsored by Architects and Planners for Social Responsibility (ADPSR).

Architects with a variety of job titles, expertise in different building types and employment in different sized firms were sought. Therefore each architect brought a unique perspective based on his or her experiences related to the study.

A sample of 15 architects was organized into three levels according to their knowledge about and sympathy toward healthy and sustainable architecture. Each of these three groups is comprised of five architects.

- HS•HK Architects: High Sympathy and High Knowledge
- HS•LK Architects: High Sympathy and Low Knowledge
- LS•LK Architects: Low Sympathy and Low Knowledge

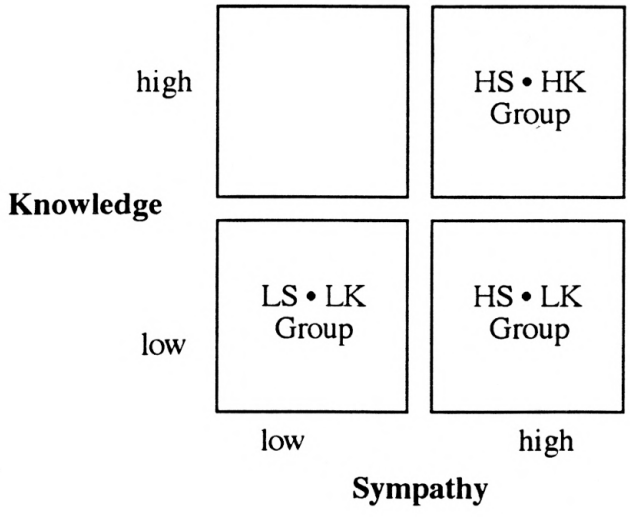


Figure 3 Sympathy-Knowledge Matrix

Table 1—Profiles of Architects

Architect	Job Title	Project Type	Firm Size	Education	Environmental/Energy Coursework	AIA Member
HS•HK#1	Principal	Residential	1	BA Geology/M Arch	Y	N
HS•HK#2	Principal	Residential	1	BA Communication/M Arch	N	N
HS•HK#3	College Professor			BA Art/M Arch	Y	N
HS•HK#4	Principal	Residential	1	B. Arch/M Arch	Y	N
HS•HK#5	Specification Consultant	General	1	B. Arch	N	Y
HS•LK#1	Designer	Commercial	14	B Arch	Y	N
HS•LK#2	Designer	Commercial	4	B Arch	Y	Y
HS•LK#3	Project Architect	Residential	4	B Arch	Y	N
HS•LK#4	Specification Writer	General	10	BED/B Arch	N	N
HS•LK#5	Project Architect	Residential	10	BED	Y	N
LS•LK#1	Project Architect	Commercial	80	BED	N	N
LS•LK#2	Specification Writer	Commercial	80	B. Arch	N	Y
LS•LK#3	Project Manager	Commercial	1,000	BA Poly Science/M Arch	Y	Y
LS•LK#4	Principal	Residential/Commerical	1	B. Arch	Y	Y
LS•LK#5	Project Architect	Laboratories	25	B Arch	N	Y

Selecting architects

Architects were selected over the telephone based on this author's perception of their knowledge of and sympathy toward the ERG. Knowledge refers to how familiar or educated architects are about healthy and sustainable technologies and design solutions. Sympathy refers to an architect's interest in or recognition of the importance of healthy and sustainable architecture. Each group was selected based on their level of knowledge and sympathy toward sustainable design.

Most HS•HK architects have been practicing healthy and sustainable architecture for at least five years. This group includes architects who have subscribed to the ERG and those who have not. To qualify as HS•HK, architects needed to be practicing, teaching, and/or publishing on healthy and sustainable architecture.

HS•LK architects needed to be subscribers to and users of the ERG. They have adopted this approach to building design and are seeking information to educate themselves. They needed to be enthusiastic about healthy and sustainable architecture and the ERG but lack extensive work experience on healthy and sustainable projects. Typically these architects had worked on one project or had incorporated a few healthy or sustainable building practices into their projects. It is assumed that this group is the ERG's primary target audience because they are not very knowledgeable about this topic but they are very interested.

LS•LK architects have not used the Guide. While they may be concerned about the environment, they are not personally motivated to address these issues in their work. It is assumed in this thesis that LS•LK represents the majority of architects.

To qualify as a LS•LK architect, subjects needed to be very inexperienced and unfamiliar with designing buildings using a sustainable approach. (However, the level of awareness and knowledge for architects in California, where all LS•LK architect interviews took place, may be greater than for most architects in the country. California's standards for volatile organic compounds (VOC's) emissions and energy efficiency codes are some of the highest in the country.) Architects in this group, however, needed to be sympathetic enough to participate in the study since they would sometimes be forfeiting personal time to read the Guide and participate in an hour-long interview.

This study assumes that high knowledge architects are a small percentage of the profession. Further, it assumes that most of this high knowledge group are high sympathy. Infrequently occurring LS•HK architects are not significant in their numbers.

Knowledge and sympathy classification parallel to Rogers' adopter categories
There appears to be a similarity between this author's grouping of interviewees by their sympathy toward and knowledge about sustainable design and Rogers' classification of people or groups by their rate of adoption. The following discussion loosely compares characteristics of Innovators, Early Adopters, Early Majority, Late Majority, and Laggards to characteristics of HS•HK, HS•LK and LS•LK and notes similarities.

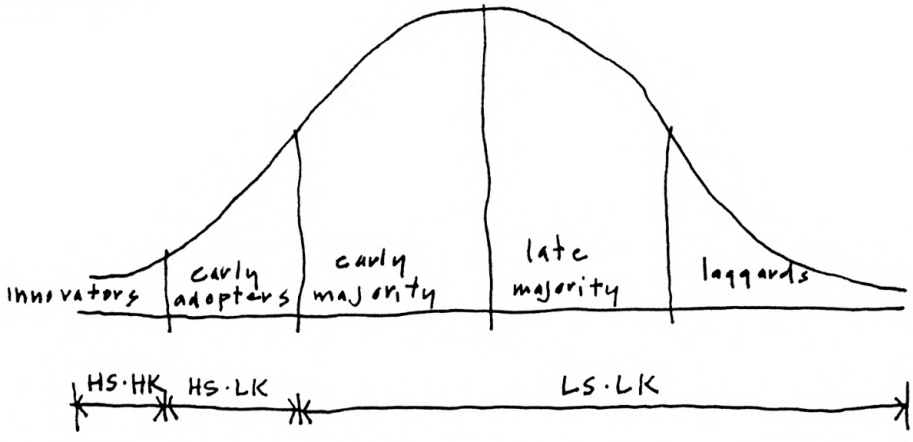


Figure 4 Sample Architects and Adopter Categories Comparison

According to Rogers, Innovators are members of cosmopolitan social relationships. and this is true for HS•HK architects. They belong to professional and environmental organizations, such as Building with Nature, the national AIA Committee on the Environment, and the Sierra Club, and subscribe to magazines and journals to learn about new ideas and to network. Some were serving in lead positions, such as editors or chairs.

HS•HK architects also diffused information about healthy and sustainable approaches to architecture through their interpersonal network of engineers, sales representatives, and other project team members. HS•HK architects raised awareness and educated through face-to-face meetings. HS•HK architects and their networks play an important role in diffusing innovations into the design and construction social system.

Another similarity between Innovators and HS•HK architects is that they understand and apply complex ecological and healthy building design concepts to their work. The third similarity to Innovators is that HS•HK architects are able to deal with the uncertainty of the state-of-the-art in healthy and sustainable architecture while it is still developing. Product literature and Material Safety Data Sheets are sometimes conflicting or incomplete, but HS•HK architects proceed with a solution or recommendation knowing that there is no definitive answer and that they can only make their best recommendation.

HS•LK architects resemble Early Adopters because they link the ERG to their near-peers. A HS•LK architect talked about fielding calls from colleagues across the country asking for advice about building materials. Another HS•LK architect talked about trying to stay informed on these issues so that he is knowledgeable when his peers ask questions. These characteristics of HS•LK architects match Rogers' theory that Early Adopters provide opinion leadership to near-peers.

LS•LK architects demonstrated similarities and dissimilarities to Roger's Early Majority, Late Majority, and Laggard groups. LS•LK architects resemble the Early Majority's characteristic of deliberating for some time before they adopt. One difference is that some LS•LK architects held leadership positions in their firms and Early Majority adopters typically do not. But some LS•LK architects were not leaders with clients. They talked about waiting for clients to ask for healthy or sustainable architectural services before they initiated anything. Negative comments about healthy and sustainable architecture by architects that resemble Late Majority and Laggards were relayed through architects in the sample who commented on what their colleagues thought. For example, according to HS•LK #4, "I think it has been a real challenge with people in my office to think about this. Their reaction has been that this is a lot of hogwash. And then they found out the client required this and the ERG came in handy." This comment resembles Late Majority and Laggard behavior — be skeptical and cautious.

Data collection methods

There are several means of collecting data: interviews, questionnaires, archival research, and participant observation. The survey method was chosen for this research study based on the fact that there was a limited number of architects to study;

a limited collection of case studies in one metropolitan area; and the need to collect data efficiently. Survey methods, which include both questionnaires and interviews, are an "efficient strategy that opens doors for researchers into the world of values, attitudes, beliefs, preferences, aspirations, stereotypes, past experiences, and future plans as well as into the worlds of lies, false hopes, exaggerations, selective and distorted recall, and self delusions" (Pyke and McK. Agnew, 1991, p. 155-156).

Specifically an interview schedule was selected because it combines the efficiency of a questionnaire with the open format of an interview to obtain rich, deep data. Interviews allowed architects to expose their biases, as well as personal experiences with consultants and others in the construction industry they interact with to implement healthy and sustainable design practices. Interview schedules were used "based on the desire to present all respondents with the same stimuli so that they are responding to the same research instrument" (Smith, 1975, p. 170).

An interview schedule, which used open-ended questions was established for each interview. Every effort was made to administer the questionnaire using the exact same wording, question order, and tone of voice (Smith, 1975, p. 170). Interviews were informal and conversational, and, to obtain rich, deep data, subjects were encouraged to talk freely and they often spoke at length. Sometimes when architects responded to issues as they talked, questions were asked out of order to fill in on topics not yet discussed.The in-depth, intensive interviews lasted between 30 minutes to two hours.

Instrument design

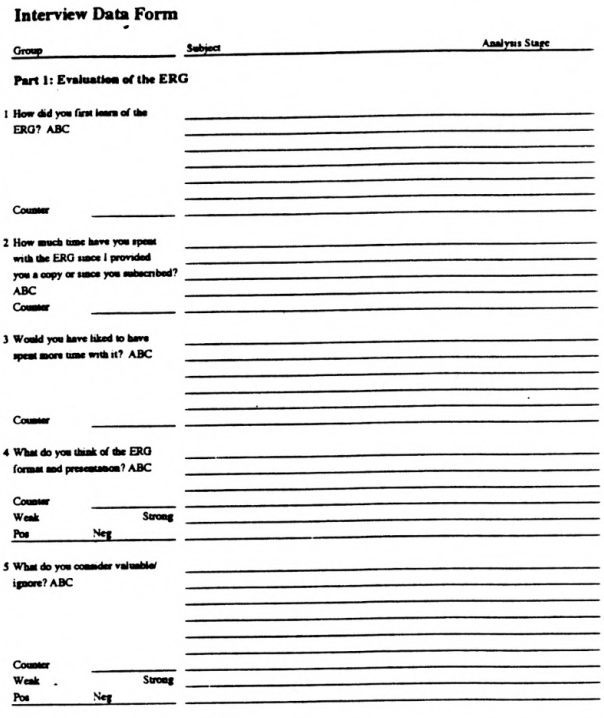
Architects were asked approximately 15–20 questions, which were organized into five areas: 1.) introduction; 2.) format and presentation of the ERG; 3.) experience using the Guide or practicing healthy and sustainable design; 4.) project context in which the ERG was used or healthy and sustainable architecture practiced, and; 5.) characteristics of the user architect.

Questions corresponded to the architect's knowledge about and sympathy toward healthy and sustainable architecture. This approach enabled the ERG to be studied from various perspectives, giving insights from each group. The questions for HS•HK architects toward sustainable design were about their projects, obstacles encountered, and how healthy and sustainable architecture can become more institutionalized. The questions for HS•LK architects who were new to the design of healthy and

sustainable architecture but enthusiastic were about their experiences using the Guide for a specific project. They were asked when and how they used the ERG (quick reference versus ongoing for example). LS•LK architects were asked questions about obstacles to using the Guide and what would motivate them to use it.

From all three groups of architects, data was obtained on the: 1) usefulness and effectiveness of the content and presentation of the ERG and; 2) personal values and biases and the firm's project focus that influence use of the ERG.

The ERG was available during the interview for review and to identify topics discussed by the architect. All interviews were recorded on audio tape to allow this researcher to concentrate on the responses and to sustain a personal relationship with the interviewee (Powell and Nichols, 1981, p. 308). The tapes were transcribed by recording information by hand — word for word — onto an Interview Data Form. The Interview Data Form included the architect's name, Knowledge/Sympathy group, counter to record where on the tape something was said, analysis stage (each tape was listened to three times and space was provided to code where the interview was in the analysis process), questions, and blank pages for overflow data.



Interview Data Form

Group _____ Subject _____ Analysis Stage _____

Part 1: Evaluation of the ERG

1 How did you first learn of the ERG? ABC

Counter _____

2 How much time have you spent with the ERG since I provided you a copy or since you subscribed? ABC

Counter _____

3 Would you have liked to have spent more time with it? ABC

Counter _____

4 What do you think of the ERG format and presentation? ABC

Counter _____

Weak Strong

Pos Neg

5 What do you consider valuable/ ignore? ABC

Counter _____

Weak Strong

Pos Neg

Figure 5 Sample of Interview Data Count Form

Pretest

One pretest was conducted with a representative from the HS•LK architect group. The pretest was conducted to: 1) determine if the questions generated responses that met the thesis objectives; 2) test assumptions regarding architect's responses; 3) expose wording in questions that might not be clear; 4) and establish length of interviews. As a result of the pretest, government was added to the list of members of the architectural social system.

Content analysis

Interviews were analyzed using content analysis. This research technique was selected because data is in the form of words and the technique is effective in analyzing large amounts of data (Krippendorff, 1980, p. 31). Content analysis uses a detailed, objective and systematic analysis of verbal or symbolic communications (Pyke and McK. Agnew, 1991, p. 147).

Objectivity requires that the information be coded into distinctly defined categories. "That is, categories should reflect the purposes of the research, be exhaustive, be mutually exclusive, independent, and be derived from a single classification principle" (Holsti, 1969, p. 95). To be considered systematic it is necessary that the inclusion and exclusion of content or categories be done according to consistently applied rules.

Data coding

Data from the interviews were coded and organized into four categories. The categories were sufficiently distinct that it was not difficult to organize data into independent categories: "ERG Content and Presentation", "Social System", "Communication Channels" and "Characteristics of User Architect". The types of comments that were included in "ERG Content and Presentation" were: evaluation methodology, usefulness to professional practice, and graphic presentation of the ERG. "Social System" included comments on: clients, allied design professions, building material manufacturers, construction industry, AIA, architecture schools, government and public utilities. Comments for "Communication Channels" included sources through which architects heard about the ERG and healthy and sustainable

architecture: magazines, newsletters, or colleagues. The category "Characteristics of User Architect" included coursework they had taken on healthy and sustainable architecture, work experience, size of firm, firm project types and more.

Since the primary focus of this research is the ERG as a written resource for architects, there were many, diverse, and lengthy responses for the category "ERG Content and Presentation". The Data Count form was developed to accommodate the number and length of comments. This form organized data according to two areas: positive content and presentation and the second area, negative content and presentation comments. One comment was recorded on the Data Count form for each issue. That is, if an architect talked about a particular issue at length only one comment was recorded for this issue even though the architect generated many comments to explain his or her point. The number of comments that were generated for each architect ranged from 3-25.

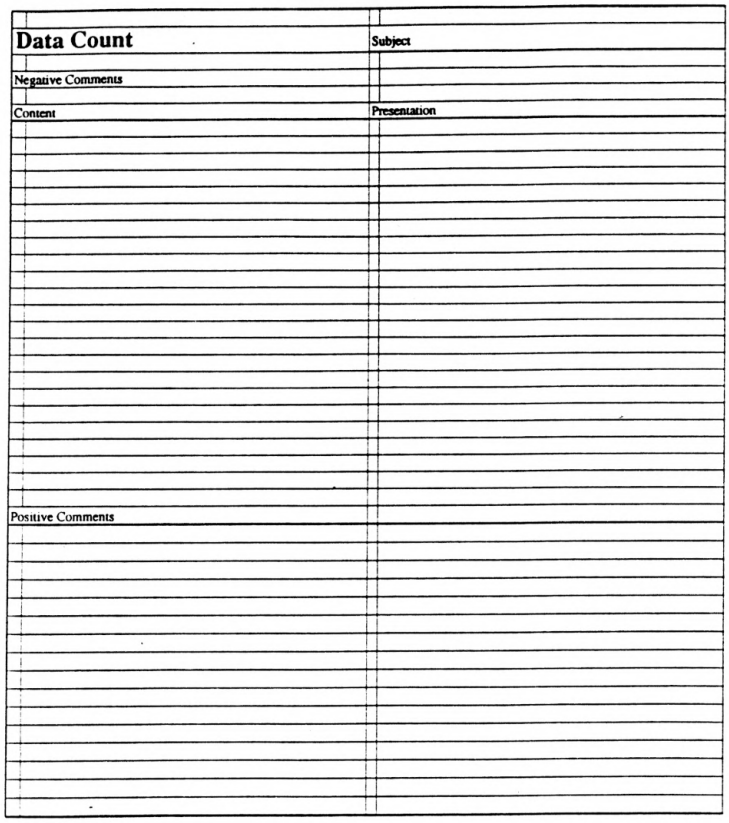


Figure 6 Sample of ERG Content and Presentation Data Count Form

Various interviewees felt more strongly about some issues than others. To determine which comments an architect felt the strongest about the tape was listened to carefully to identify "emotional responses." "Emotional response" is a concept that is operationally defined as comments which were repeated or stated with strong emotional phrasing. (Only two personalities lent themselves to an emotional raising and lowering of their voices. Therefore this criterion was not used.) For example some strong emotional phrases were: "I thought the format was terrible", "One of the things that really annoyed me...", "I don't care whether you've got colored paper or not..." and "I really admire the depth of research."

Emotional comments and comments that were repeated were recorded on the Emotional Response form. Comments were organized into negative and positive comments. The number of emotional comments for each architect was tallied by this researcher. The number of emotional responses for each architect ranged from 1-7.

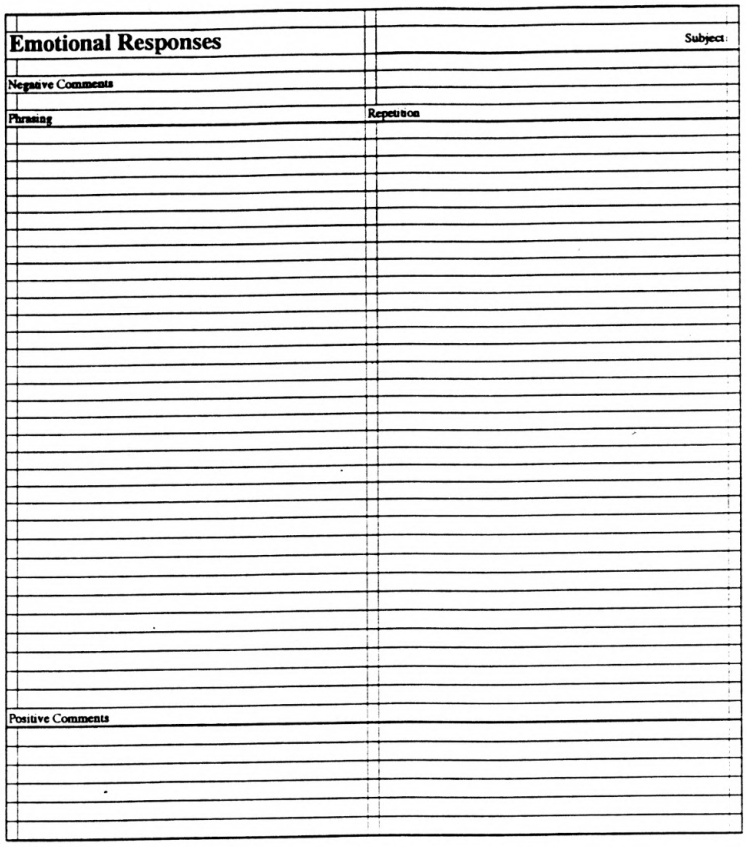


Figure 7 Sample of Emotional Response Form

Comments that were repeated the most *and* phrased using emotional responses were operationalized as Very Strong Comments. Comments that were repeated were operationalized as Strong Comments. (See Chapter Six: Conclusions for Tables No. 4.1 and 4.2 that compile architects' Very Strong and Strong comments.)

The category "Social System" also generated a lot of comments and a separate form was used to record each comment.

Data Count			**Social System**
Constrution Industry	Building Material Industry	Government	Public Utilities

Figure 8 Sample of Social System Data Count Form

There were fewer and shorter coded comments for "Communication Channels" and "Characteristics of User Architects". Data on "Communication Channels" is compiled into Table No. 3 and data for "Characteristics of User Architect" is compiled into Table No. 1.

Analysis

Analysis was primarily qualitative. However, quantitative methods were used to

identify specific patterns in the information by reporting the number of architects who made a certain point. "It is by moving back and forth between these approaches, qualitative and quantitative, that the investigator is most likely to gain insight into the meanings of his data" (Holsti, 1969, p. 11).

Findings from the interviews are analyzed from three perspectives: 1.) each architect as a separate, unique case study 2.) HS•HK,HS•LK, and LS•LK subgroups, and 3.) as a group of 15 architects. Since many individuals raised insightful comments that several other architects did not, findings from each interview are treated as important as findings from the group of architects as a whole. As a whole, for example, many architects commented on the organization of the Guide, but only one HS•HK architect commented on the need for a methodology to evaluate data in the ERG. Analyzing the data according to the three subgroups identifies issues shared by each group. Analyzing the data according to the 15 architects identifies patterns of issues that all groups share.

To analyze interview data, comments from each architect's Data Count form were compiled onto a Master Data Count form. For each issue, the number of architects who mentioned the same point was tallied. Comments that were specific to HS•HK, HS•LK, and LS•LK subgroups were noted. A comment made by at least two architects within a subgroup formed a majority and was defined as a pattern. A comment made by six or more architects from all three groups was operationalized as a pattern for all 15 architects.

Checks on data

Checks on data refers to measures that were taken to assure the quality of research data. To insure that each architect's strongest comments were obtained, this list of comments was checked against question number 22, *If you could rewrite the ERG what would you change?* Typically when asked this question, architects summarized their strongest feelings. If their response to question number 22 was the same as my Emotional Response list, this investigator concluded that the strongest comments were obtained.

Chapter Five: Findings

This section presents findings on 1.) the content and presentation of the ERG, 2.) AIA communication channels and 3.) the development of each member of the architectural social system in relation to environmental issues. The five criteria established to evaluate information for architects (as outlined on the page 21) are also discussed to assess how effective the ERG is as a written source of information for architects. The remaining elements of the ERG Diffusion Model, Time, Architect's Motivation, and Innovation are intangible and are omitted from the following section.

Evaluation of the *Environmental Resource Guide*

The following section identifies and discusses issues raised by architects individually, within subgroups, and as a group of 15 architects. The issues were generated by specific questions that all architects were asked regarding the content and presentation of the ERG, such as: *What do you think of the ERG format and presentation, topics, case studies, graphic presentation*? *When do you use the Guide?* Three questions required a yes or no answer: *Does the ERG instill confidence in you to make decisions and recommendations? Does the format and content accommodate a limited amount of time*? and *Would you have liked to have spent more time with the ERG?*

As previously mentioned within the research methodology section, each architect's list of issues on ERG content and presentation was individually compiled. These issues were consolidated into one master list and a total representing the number of architects who shared the same concern about an issue was generated. Occasionally architects raised the same issues but disagreed. For example, two architects disagreed about the importance of providing information on the origin of a building material. One HS•HK architect believed this would raise awareness with architects and inspire them to consider a material's source while writing specifications. A HS•LK architect thought this information was not valuable and the Guide should focus on information that is more useful to the practicing architect.

The issues are analyzed according to individual architects, subgroups, and as a group of 15 architects. The issues for individual architects are organized into three sections, Strengths, Weaknesses, and other observations from architects.

Subgroup findings

There were only a few patterns identified by subgroups. The common patterns for HS•HK respondents were responses that suggested that opinion pieces within the Guide should be a separate section and the notion that the Guide is too expensive. The strongest pattern was that the majority of Very Strong presentation comments were from HS•HK and HS•LK architects; only LS•LK #1 commented on the graphic presentation of the ERG. A related finding is that all comments on organization came from HS•HK architects except for one comment by a LS•LK architect.

Presentation appears to be insignificant to LS•LK architects and this author speculates that they focused more attention on the basic premise of the ERG and whether or not to apply this information to their work. HS•HK and HS•LK architects have already adopted the ERG and this approach to design and they look beyond the basic premise and content. The LS•LK architect mentioned above as the exception is the architect who had not heard of the ERG but implements many energy efficient measures in her work. She resembles HS•HK and HS•LK architects in that she too is beyond the level of a beginner.

There were no common patterns for HS•LK architects. The common patterns for LS•LK architects are summarized by the assertions that the ERG raised their awareness and the Guide describes a problem, not a solution.

Whole sample findings

There were a few patterns for the entire group of 15 architects. Eight architects liked *Highlights and Suggestions for Architects* and thought the building material section needs an evaluation methodology. Seven architects wished the Guide had more tabs. Seven architects liked the building material section. Six architects wanted information on specific products. Six architects commented on the state-of-the-art. Five architects commented on the holistic approach of healthy and sustainable architectural design.

The following table lists all the issues architects raised and organizes them according to Strengths, Weaknesses, and Observations and groups them by ERG Content and Presentation. It provides a quick overview and visually suggests some general findings from this research study. For example, one general finding is that architects were negative about the ERG's presentation.

STRENGTHS	WEAKNESSES	OBSERVATIONS
Content	**Content**	**Content**
•ERG Environmental Topics	•ERG Introduction	•State-of-the-art of healthy and sustainable design
•ERG Case Studies/Reports	•ERG References	•Healthy and sustainable architecture is a holistic approach
•Raises awareness	•Data in the ERG must be quantified, presented in consistent language and units of measure	•Should the ERG provide project specific information for solutions or a springboard to obtain more information?
•The ERG provides support and credibility	•Lack of indoor air quality and environmental life cycle rating systems	•Spirituality of the Guide
•Compiles a lot of data	•Lack of product information	•When is the Guide used during the design process?
•Not radical or risky	•Lack of conceptual information	
Presentation	•Usefulness to professional practice	
•Hierarchy of order within building material section	•The Guide covers only a few of the many building materials	
	Presentation	
	•Organization	
	•Graphics vs. words	
	•Graphics	
	•Tabs	
	•Size of the Guide	
	•Assembling the Guide	

Table 2 Overview of Findings

Strengths

Environmental Topics

As previously mentioned, the main focus of the ERG and this section is in-depth cradle-to-cradle analysis of building materials. This section of the ERG was by far the most popular. Architects who had not seen the Guide before they were interviewed spent most of their time reading this section., and architects who use the Guide access this section the most. A HS•HK architect said he reads it word for word.

While most architects enjoyed reading this information, they disagreed on how useful it is to the practicing architect. One HS•LK (#1) who thought this information was valuable, did not think it was technical enough. "I want information in the Guide, so I know [how] bauxite is mined and this is the environmental damage [from] processing. This type of information is not as clear in the ERG and I would prefer more of this information. When you read that 80 percent of bauxite comes from Jamaica, it doesn't really tell you what you need to know." "I'd really like to know what happens, what type of consumption in dollars, what it costs to produce bauxite." He used this information to conduct further research where he thought the ERG left off. After learning how aluminum ore is mined, for example, he contacted various suppliers to learn more. This architect's appetite for in-depth material analysis was an exception.

Other architects who liked this information thought that increasing the understanding of the origin of building materials might encourage architects to use materials more wisely. But to most architects the building material section primarily raised their awareness.

A minority thought that the information was not useful in professional practice. HS•LK #2 said, "I don't need to know how bauxite is mined. I need specification information."

There were few comments on the articles within the Environmental Topics section. HS•HK #2, who thought the energy article was not useful to the practicing architect, said, "The energy sections were broad brush and not something anyone could use. You couldn't specify, based on this information, a heat exchanger. You wouldn't even know whether it was appropriate to a situation." A HS•HK architect interested in site design thought this section is weak, short and that much more detail is

necessary.

Case Studies/Reports

Three architects skimmed the case studies, five ignored them, three read and liked them, and four just read one case study, typically the Rocky Mountain Institute or Audubon Society. Architects who ignored or skimmed the case studies either ran out of time and didn't get to case studies located at the back of the ERG. To a specification writer the case studies were not useful to his work. Nonetheless many thought the case studies were a good idea to include. HS•HK #4 architect thought the case studies were the best section of the ERG. LS•LK #1 said,"I thought the Rocky Mountain Institute was good. It shows a whole collection of things that you can do and obviously not everybody is going to do all these things. But it gives you an idea of some of the options and there are a lot of them." HS•LK #2, commenting on the case studies, said, "They are good to include, when you've got free time to look at them, because it helps you avoid reinventing the wheel."

Raises awareness

Overall the ERG helped LS•LK architects understand the link between their design solutions and preservation of the environment. Three LS•LK architects commented that the ERG made them stop and think about the the relationship between architecture and the environment. According to LS•LK #4, "I think this raised my awareness — you can't just look at your own little project. Everybody's doing this. It has a major impact on the environment. I was amazed reading here how much energy depletion there is for the incandescent and the fluorescent bulb." Another LS•LK (#2) said, "I think most of what's going on here raises our level of consciousness about the issues rather than directing us immediately to a solution. Maybe the solutions will ultimately become more clear. So I think this is a starting point. I don't think this is something you can take and say 'this is going to solve all our problems.' I'll read this for the next project so I'll know exactly what materials to use and what I'm going to do to make it a healthier, better building."

The ERG provides support and credibility

The ERG educates architects. Knowledge and AIA support is necessary and useful to persuade clients and members of the design team. According to HK•HS #4, "You need facts, like the way Harper's Index is set up, to make your case." "I think the ERG is very good though, it provides a large body of evidence to say yes, this is the

magnitude of the problem and here is some specific information to address the problem."

Having an AIA supported document provides credibility. HS•LK #4 used the ERG to support her arguments. "I brought this book into one of my project meetings. I just said that this is something the AIA put out and it's not specific to architectural projects. I use it as a guide for some of my decisions and wanted to share it with you so you would understand my decisions."

Compiles a lot of data

According to HS•HK (#1 and #4) and LS•LK (#5) architects, the ERG compiles research on building materials, in-depth articles on specific topics, and descriptions about healthy and sustainable projects and consultants into a single source and this is very valuable. HS•HK #5 returned from an Architects and Designers for Social Responsibility (ADPSR) conference on Healthy Buildings with pages of information he intended to organize. He never got around to it. HS•HK #1 commented, "It takes someone who is really devoted to this to get the magazines and books. This consolidates it into one place." Many respondents felt that the ERG neatly compiles information that is otherwise dispersed in a variety of disciplines and sources.

Not radical or risky

LS•LK #3 was surprised and relieved that measures in the ERG were not radical or controversial. To him, the ERG suggested that, "the rest of the profession is doing this so you don't need to be quite the trail blazer."

Hierarchy of order within building material section

Hierarchy of order also applies on a smaller scale to the order of information within the building material section: the single page of *Highlights and Suggestions for Architects*, Life Cycle diagram, and in-depth material analysis. HS•LK #1 and LS•LK architects #4 and #5 liked this aspect of the Guide because the predictable format allowed them to more easily reference the Guide since they knew where certain information was located.

Weaknesses

The first two issues below address ERG sections "Introduction" and "References".

Introduction

The first section of the ERG introduces and educates architects about the ERG and the need for healthy and sustainable architecture. This section seeks to persuade and inspire. Two of 15 architects said they ignored this section; the majority did not have any comments about it. Most went immediately to the building material analysis and other more practical information.

References

Only one architect, a HS•LK, perused the References section, the majority of architects skipped this section. According to HS•LK #1, "The Bibliography is enormous, so if you want to dig through and find stuff you can – but there are only so many hours in the day."

The following description of respondent-perceived weaknesses of the ERG describe very specific issues associated with accessing the ERG and how the information needs to be improved to be useful for the practicing architect.

Data in the ERG must be quantified, presented in consistent language and units of measure

According to two HS•HK (#4 and #5)and two HS•LK (#2 and #3) architects information in the ERG needs to be quantified to be useful. For example, levels of emissions of VOC's, CFC's, or formaldehyde from paints, carpet, or particleboard need to be quantified to scientifically define the composition of a particular material. Quantifying information helps architects make more substantiated recommendations in addition to relying on intuition and personal judgment. For example HS•LK #3 liked learning about the amount of energy consumed to manufacture linoleum. This issue will be discussed in more depth under "Usefulness to Professional Practice".

Data in the ERG needs to be presented in a consistent language and units of measure. HS•HK #2 gave an example found on page Topic I-9652 7. To describe air concentrations of TVOC two different units of measure are used here: mg/m^3 and $mg/m^2/h$. "Like indoor air quality. People talk about concentrations of hydro carbons in milligrams/cubic meter — which is kind of the standard but there's often data in parts/million or other units of measure. So cross comparisons (are needed) to get to optimizations — what's a better solution to the situation? Even though we're drowning in numbers, the numbers don't let you compare different things."

Evaluation methodology

Some information in the ERG is quantified such as, "Total embodied energy is estimated at 19,200 BTUs per pound" (*Environmental Resource Guide*, 1992, p. Topic I-5011 1). According to HS•HK #2, evaluation methodologies need to be developed to make this type of data more useful and meaningful and he spent the majority of a two-hour interview talking about this issue. To this architect the number alone does not tell architects whether this is an efficient amount of energy or an inefficient amount of energy to produce a material. He suggested a rating system to compare materials. Such a system would define and organize the current mixture of information into a new set of words and statistical categories. Once evaluation methodologies are developed, architects can make comparisons between materials or evaluate entire systems. According to HS•HK#4 this information can be used to calculate long-term costs.

Architects in all three groups talked about the need for an evaluation methodology to make data in the ERG more useful. An insightful LS•LK respondent, #5, who recognized the need to make decisions more quantitatively, said, "We need a systematic way of doing things, rather than someone just telling us answers, because the answers don't last very long. Somebody invariably comes along and changes the formula." According to HS•HK #2, "This information needs to be useful and consistent, not unsubstantiated hunches." Several evaluation methodologies need to be developed, according to this respondent, to improve the state–of–the–art: an ecological and health material rating system and life cycle evaluations.

HS•HK #2 suggested using rigid testing standards like the American Society of Testing Materials (ASTM) testing procedures to begin defining the toxicity or environmental life-cycle evaluation of materials. With "ASTM, the study is set up a certain way. You come up with data, you come up with a number, and if that's reputable, its uniform. You get the same results. Different materials tested using the same methodology will give you numbers to make comparisons. It needs to be standardized. These numbers are just flying around and this feeds the polemical aspect of people making claims that can't be substantiated."

Healthy building material rating system

A healthy building material rating system would define the toxicity of building materials. It would quantify the amount of off-gassing, the chemicals that are off -

gassed, and how long chemicals are off-gassed. An ideal healthy material rating system would combine all these issues into one rating.

HS•HK #2 suggested "a 24-hour (after installation) outgassing index" and then a "one year later rating." "The index would tell us a material with a 2 rating may be safe but a 10 rating is bad and can't be used. And then you could weigh this sort of index by the material that is being out-gassed depending upon how bad the chemical is." HS•LK #2 thought a range to define high to low emitting levels would be useful. She suggested a rating system so she would know when she was achieving a "B" rating for VOC. She wanted to know what the next best thing would be if she could not achieve an "A" rating. "I'd like to use a product where you know you've done a good job to try to meet (environmental criteria) but you've also (achieved) performance."

Sustainability building material rating system

A sustainability rating system would examine the life cycle or cradle-to-cradle process of generating a material and rate how environmentally benign it is. Life cycle assessment calculates the total effects related to manufacturing a product. It quantifies the amount of energy and resources needed to produce a material and waste generated from the manufacturing process.

According to HS•HK #5, "the beginning of the study is knowing that it takes 34,000/ X material–65,000 BTU/ X material. We've got to take this data and put it into a total building analysis to figure out what to do with this information. They have a long way to go and this is a beginning."

The ERG recognizes the need for life cycle assessment and it is forthcoming. According to the ERG editor, "First we will focus on the more obvious environmental pluses and minuses. Down the road, the new and complex field of life cycle analysis will add many insights to what we know about the environmental impact of even the most common construction materials, such as aluminum" (*Environmental Resource Guide*, 1992, p. Intro IV 5).

A sustainability rating system would also help provide scientific definition to words like natural and nontoxic. As HS•HK #2 said, "Why is limestone natural, but a quart of oil not? These words are over used and mean different things to different people."

Product information — or lack thereof

The ERG also does not identify specific products and manufacturers and HK•HS #4 speculated on why it doesn't. The AIA may want to remain neutral and non-commercial and it is difficult to identify truly environmental and healthy products. There also might be legal difficulties; they would invariably leave someone off, and it would be difficult to keep current.

Six architects from all groups commented that they would like information on specific products. HS•HK #5 commented, "I'd like to see the recommendation of products and let me decide, knowing all the facts, whether I want to save energy and go with the cheapest product on the market or go with more expensive material that is more environmentally benign. It's a difficult decision because you're balancing function and economics with saving the environment."

HS•LK #4 said, "When they say don't use adhesives with high VOCs, I'd like to see some brands of adhesives they might recommend. So often you look at all these sealants, the product literature, they never say anything about VOCs. They never say anything about the content of some of these materials. So you say, yes I know I'm not supposed to use it but I don't know what I'm supposed to use." HS•LK #3 thought manufacturers should be identified because this is the "right thing to do" and it helps humanity.

HS•HK #4 said that the ERG lacks information on "manufacturers, specification criteria, and how to determine if materials are more or less environmentally sound."

Conceptual information

Conceptual information refers to general information needed at the beginning of the design process. For example, architects and their clients set design parameters at the beginning of a project: Will there be one parking space per person? Will the building be located in a remote location away from public transportation? What size will the building be? How many square feet per person?

A HS•LK architect and LS•LK architect commented on the lack of conceptual information in the Guide. The Guide doesn't help architects think about how large a house or parking ramp should be. The Guide doesn't help LS•LK#3 address these types of issues with developers who are only concerned with leasing a building. "One

thing we haven't touched on, before you specify the building materials, is design parameters. The *why* of a 1,600-car garage versus a 600-car garage. That's a real difficult thing. Implicit in all this is that we should be on the side of a 600-car garage. In fact, that's what we'd like to get from our firm's design principals, and we try when we can to educate our clients to do that. But more often than not we're building a project where they are consuming huge amounts of fuel for people to get to work."

This issue was the primary concern for HS•LK #3. To him, the ERG is a small step in changing a larger system. He's frustrated with our society's general approach: how we use resources, get to work, lay out our cities. "The whole concept of how we build in this country needs to change."

Usefulness to professional practice

In every field, there is a dialogue between research and practice. To be useful, research needs to be translated into information that speaks the same language as the practicing architect and to address the issues which concern practicing architects. This means making the ERG user-friendly and relevant.

Making the ERG user-friendly generally means matching information in the ERG with the ways that architects think and work. It includes organizing the Guide according to the design process and various job titles, graphically presenting the Guide to appeal to a visual profession, providing quick and easily accessible information, and many more things.

According to research by Powell (1968) and Mathew and Goodey (1971) on architects and their use of information, information must be quick and easy to access. "He continually has to balance the time expended on any one issue against the importance of that issue (or the risk that would result in him not giving it due attention). Clearly, if a designer can get useful information quickly then he will use it. But a typical comment from designers was that, 'if I cannot find the answer quickly, I ignore it' " (Powell and Nichols, 1981, p. 310).

Architects in all groups did not describe the Guide as quick and easy to access. HS•HK #1 said, "Some parts were boring and obvious and could have been said more quickly." Later she said, "The Guide assumed you have plenty of spare time to read and didn't mind being talked through some basic material." HS•LK #5 found the

ERG easy to get around once you're familiar with it, but colleagues who have picked up the Guide cold had difficulty finding the information they needed. LS•LK #4 said, "I need the information to be concise and to the point."

The *Highlights and Suggestions for Architects* page is a good format for architects. The bullet format allows them to skim and get a quick overview. And there are specific directives they can readily apply before moving to their next pressing issue. Eight architects volunteered that they liked *Highlights and Suggestions for Architects*. Unfortunately, most of the ERG is not written in a bullet format.

Making information in the ERG relevant includes translating data into forms suitable for standard practice, quantifying information, selecting topics that are useful to the practicing architect, providing information that instills confidence, and giving specification information.

One HS•HK respondent did not think the ERG was successful at translating technical information into information useful for the practicing architect. The ERG attempts to distill information, but to the typical practicing architect some of the information is still unusable. "Two yardsticks will help architects evaluate this information. First the state of Washington is proposing that the combined emissions from all products used in new Washington state office buildings cannot result in air concentrations of TVOC exceeding .5mg/m^3 (Bayer and Papanicolopoulos, 1990). Second, EPA has proposed a classification of low-emission materials and products based on emissions of TVOC (Tucker, 1990). Maximum emissions for floor coverings are .6mg/m^2/h at about 30 hours after installation" (*Environmental Resource Guide*, 1992, p. Topic I 9652 7). According to HS•HK #2, "Besides being unreadable, these sorts of VOC emission data cannot be evaluated due to inconsistent methodology and poor fit between data and standard practice."

Quantifying information is necessary because architects are not knowledgeable about what constitutes a safe amount and rate of emission. Providing a numerical value or range helps them evaluate information about building materials. HS•HK #2 said, "The Guide should also recognize and try to get at quantifying this information. And it appears the Guide doesn't recognize this need. This is the next step to really make this information valuable." HS•LK #2 commented, "Anything that sets guidelines to help architects design is useful. If we know a quantifiable thing that we can specify,

then we know what we're dealing with at least. But when you get nebulous, like the ADA (Americans with Disabilities Act), it isn't necessarily helpful."

A good example of quantified information is Exhibit A: Major constituent of Commonly Used Categories of Sealants on page Topic.I-7920 7. Two architects commented on the usefulness of this information. According to HS•HK #1, "Those are the things (Exhibit A) I want to come back to and use."

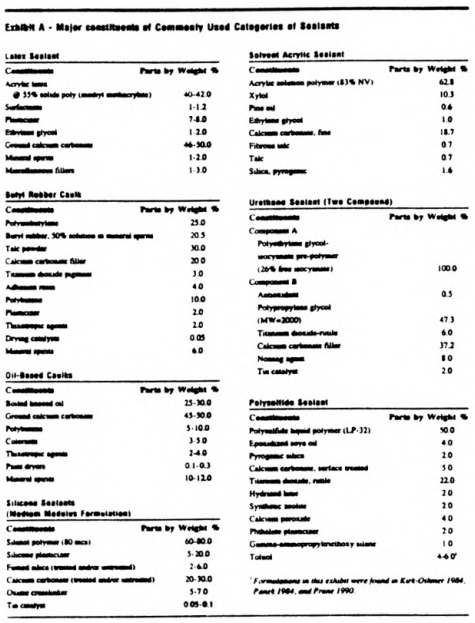


Exhibit A - Major constituents of Commonly Used Categories of Sealants

Latex Sealant

Constituents	Parts by Weight %
Acrylic latex @ 55% solids poly (methyl methacrylate)	40-42.0
Surfactants	1-1.2
Plasticizer	7-8.0
Ethylene glycol	1-2.0
Ground calcium carbonate	46-50.0
Mineral spirits	1-2.0
Miscellaneous fillers	1-3.0

Butyl Rubber Caulk

Constituents	Parts by Weight %
Polyisobutylene	25.0
Butyl rubber, 50% solution in mineral spirits	20.5
Talc powder	30.0
Calcium carbonate filler	20.0
Titanium dioxide pigment	3.0
Adhesion resin	4.0
Polybutene	10.0
Plasticizer	2.0
Thixotropic agents	2.0
Drying catalysts	0.05
Mineral spirits	6.0

Oil-Based Caulks

Constituents	Parts by Weight %
Boiled linseed oil	25-30.0
Ground calcium carbonate	45-50.0
Polybutene	5-10.0
Colorants	3-5.0
Thixotropic agents	2-4.0
Paint dryers	0.1-0.3
Mineral spirits	10-12.0

Silicone Sealants (Hooham Modelers Formulation)

Constituents	Parts by Weight %
Silanol polymer (80 mcs)	60-80.0
Silicone plasticizer	5-20.0
Fumed silica (treated and/or untreated)	2-6.0
Calcium carbonate (treated and/or untreated)	20-30.0
Oxime crosslinker	5-7.0
Tin catalyst	0.05-0.1

Solvent Acrylic Sealant

Constituents	Parts by Weight %
Acrylic solution polymer (83% NV)	62.8
Xylol	10.3
Pine oil	0.6
Ethylene glycol	1.0
Calcium carbonate, fine	18.7
Fibrous talc	0.7
Talc	0.7
Silica, pyrogenic	1.6

Urethane Sealant (Two Component)

Constituents	Parts by Weight %
Component A	
Polyethylene glycol-isocyanate pre-polymer (26% free isocyanate)	100.0
Component B	
Antioxidant	0.5
Polypropylene glycol (MW=2000)	47.3
Titanium dioxide-rutile	6.0
Calcium carbonate filler	37.2
Nonsag agent	8.0
Tin catalyst	2.0

Polysulfide Sealant

Constituents	Parts by Weight %
Polysulfide liquid polymer (LP-32)	50.0
Epoxidized soya oil	4.0
Pyrogenic silica	2.0
Calcium carbonate, surface treated	5.0
Titanium dioxide, rutile	22.0
Hydrated lime	2.0
Synthetic zeolite	2.0
Calcium peroxide	4.0
Phthalate plasticizer	2.0
Gamma-aminopropyltriethoxy silane	1.0
Toluol	4-6.0*

*Formulations in this exhibit were found in Kirk-Othmer 1984, Panek 1984, and Prane 1990.

Figure 9 Exhibit A - Major constituents of Commonly Used Categories of Sealants

To LS•LK #2, the Guide includes a number of topics that are too broad and not useful to the practicing architect. "When it gets to global climate change, we're generally interested in this topic, but it doesn't directly impact our job immediately. So we're not going to have a big professional interest in terms of projects. You may be interested in topics that relate in a broad way to architecture."

As previously mentioned the Guide received mixed response on how well it instills confidence. One means of instilling confidence is to identify products that are approved or recommended by an institution or a manufacturer. Architects then believe they have transferred responsibility if something goes wrong. Comments about liability came from LS•LK #2. "Or maybe the manufacturer hasn't been in business very long; so that we had warranties to rely on, we would be taking a chance if they went out of business...It depends whether manufacturers that have been around for a

while that we do business with are going to switch over to more environmental products. Or whether people will start a new plant. We prefer someone who has been around. Then we have more confidence, rather than someone that comes out of nowhere. If the product fails we would be taking the first bullet. And there's a lot of litigation these days — we want to be careful with what we do."

LS•LK #3 said, "You choose a glass untried. If there's some manufacturing or performance nightmare, it's thousands of square feet to replace. I'm worried about new technology or a new material that is environmental or energy-efficient and the client is unhappy with it. Larger firms can't take that risk because of the liability or cost to replace an entire building. Testing, warranties, and guarantees would lessen the risk for the architects, as would knowing they weren't the first person to use this product."

The Guide does not provide specification information. Specification information translates data that architects can apply immediately to a specific need. Four architects, representing views expressed by all groups, said the ERG needs to include specification information. HS•LK #2 had very strong feelings about ANSI and ASTM standards. "In writing a spec, we need to know ANSI standards. I don't need to know how it was mined or manufactured. I need to know whether it complies with ANSI and ASTM standards." She suggested providing ANSI and ASTM information to specify steel studs in the steel section of the ERG.

The Guide covers only a few of the many building materials

In its first year, the ERG covered ten building materials. HS•HK #5 had strong feelings that the Guide does not include enough building materials. According to HK•HS #5, "They are following this slowly, one topic at a time, but I haven't seen anything in division 13, 14, and 15. They are not comprehensive. The materials they did cover are very thoroughly researched. But there are hundreds of materials out there they haven't addressed." Recognizing that this was the ERG's first year of publication and that it is arranged on a subscription basis with new materials added with each issue, he believes that there are many building materials that need to be addressed. LS•LK #3 commented that he would be more likely to use the ERG if it covered more materials.

Organization

One of the most common criticisms of the ERG was its organization. Seven architects, representing all groups, did not like how the ERG is organized. To HS•HK #3 this was her number one complaint about the ERG. Organization refers to the overall theme that combines the components and the ordering of information into that theme. According to a HS•HK #5 the ERG should ask, "Who is the reader and how does the reader want information organized?"

HS•HK #2 and LS•LK #5 architect thought that the ERG appeared to be a hodge podge of information without a particular theme. HS•HK #5 said,"I'm more linear in my thinking and they are more gestalt. They throw out topics and leave it to the reader to organize these topics into a coherent whole that winds up as a design of a building."

To HS•LK #3, the ERG organization mixed education and resource functions. "Is this a resource Guide or an educational tool?" Very busy LS•LK #4 emphasized measures that would make it easier to access. "I'd like to have it organized a little differently so that it can be a resource guide."

HS•HK #2 had a similar comment. He thought the Guide was a combination journal and handbook, but neither one. To him, a journal typically includes exploratory articles, is scientifically based and non-biased, and advances the state-of-the-art. It would serve the function and command respect similar to the *New England Journal of Medicine* in the medical community. To this architect, a handbook is a manual that provides "how to" information. To this HS•HK, the ERG mixes these together but doesn't do a good job at either.

This HS•HK (#2) believes that a clear distinction between fact and opinion would strengthen each section. "One of the things that really annoyed me about it was a mixture of hard information and opinion pieces. Those things came at you willy nilly and you weren't sure if you were about to read a fluffy opinion piece or get some hard facts. So there was editorial failure in not putting the information together in a compact form."

HS•HK #4 suggested that there should be a separation between philosophical and technical information. "But maybe there needs to be two manuals: one is a

philosophical overview that is general and another is technical information. Maybe there has to be a way of categorizing so there is general to specific information. You'll have different volumes so it doesn't look so big." This architect later suggested a Guide with three parts: "The first section would be philosophical to explain why we should be doing this. The second section would provide reasons why and facts to use with clients for arguments, and the third thing would be information on specifications and how they link with products."

The organization of the ERG could be improved by considering the design process, job responsibilities, and the types of information needed at each phase. HS•HK #5 states that "They have addressed materials from beginning to end, as raw materials, but they haven't addressed the design process from beginning to end. If the Guide was written for all phases it would include information for the bid process, construction, and occupancy." He drew the following diagram and described environmental measures architects could take within each phase.

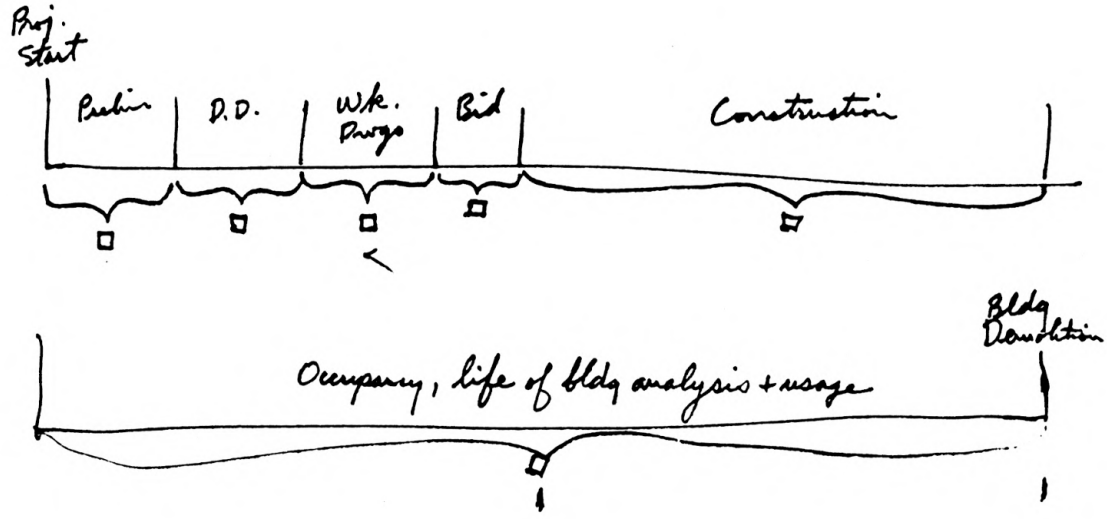


Figure 10 Phases of the Design Process

According to the same architect, "Materials need to be in a separate section because of the nature of the construction process. Selection of materials usually doesn't happen in the same point in the process as site design and land use. And they are done by different people."

Organizing the Guide according to the design process establishes a hierarchy of order.

First general information is provided for conceptual planning. Then technical information for detailed design is at the end. HS•HK #3 thought organizational problems could be improved by moving sections around in a different order. The Global Warming section should be located in the beginning, with in-depth information at the end.

Graphics versus words

Based on the review of literature, architects think visually and prefer diagrams over text. The ERG is primarily words without much visual variety. According to LS•LK #5, "We are a visual profession, it's hard for us to read tables and text." The first comment from LS•LK#5 at the beginning of the interview was that the Guide was "too full of words." HS•HK #1, who has written a book and edits a newsletter and is sensitive to writing styles, commented, "Visually it was all the same. It could have used some magazine tricks like pulling quotes to scan and know what you're getting into." Busy LS•LK #4 prefers bulleted information. "That's when things come to life for me. It's hard for me to read just a bunch of text. It's like reading history."

Graphics

A few architects commented on the graphic presentation of the Guide. HS•LK #2 felt very strongly about using the name of a building material on the bottom of the page instead of its CSI number. HS•HK #5 found reading the Guide very difficult — the type was too small and dark. HS•HK #3 thought the papers and ink were very beautiful, but she didn't understand why some pages were a different color than others. One architect liked the recycled paper; one said it was too fancy. HS•HK #1 liked the generous amount of white space on pages. HS•HK #5 thought the Guide should include metric measurements.

Tabs

Another strong finding is that seven architects from all groups want more divider tabs to make the ERG more accessible. According to HS•LK #1, "it would help within the Environmental Topics if they had more dividers. It was hard to tell when you're in materials, natural resources, energy, etc." LS•LK #4 suggested providing tabs that would appeal to busy practicing architects. "I'd like it to be more organized, more subdivided. When they're talking about lighting, provide a lighting tab so I can really make the most of this information."

Size of the Guide

LS•LK #5 and #2 commented on the size of the Guide as a deterrent to finding information and accessing the Guide. A LS•LK (#5) architect speculated that thinner documents are probably used more by the profession than thicker documents. Another LS•LK (#2) commented that the ERG wasn't user-friendly because you had to wade through so much material to find information.

Assembling the Guide

A LS•LK architect (#5) complained about the inconvenience of assembling the Guide i.e. the need to replace old pages with new pages. He said it reminded him of his clerical position during World War II. His distaste for this task was emphasized by the fact that the October 1992 issue had not been put into the binder yet. But this was also the case with HS•HK #5 and HS•LK #2.

Observations

The following issues are other observations architects had on the ERG: they are neither indications of strength or weakness.

State-of-the-art

State-of-the-art means the "level of development reached at any particular time, usually as a result of modern methods" (Woolf, 1977, p. 1136). The state-of-the-art in energy-efficient architecture is very advanced. The performance of heating, cooling, and lighting technologies can be quantified and evaluated to determine their level of effectiveness. The state-of-the-art in healthy and ecological building design is not as advanced. State-of-the-art in this thesis therefore focuses on the building materials, technology and designs solutions that are a part of creating healthier indoor environments and reducing the impact of the construction and operations of buildings on the planet.

The state-of-the-art in indoor air quality is advanced enough to know that source removal and increased ventilation improve indoor air quality. Materials can also be tested in laboratory settings to identify harmful toxins. But the quantity of toxic fumes a material emits or what quantity is harmful is not known. As discussed under Evaluation Methodology, the design and study of healthy buildings has many numerical quantities "floating around", according to HS•HK #2, such as the VOC

levels for paint. To this respondent the state-of-the-art is not developed enough yet to give such measures meaning.

The state-of-the-art for defining what constitutes an ecological building material hasn't been determined yet. What constitutes a material that is less damaging to our air, water, natural resources, and the planet in general? A product that is made from recycled materials? A material made from natural, renewable materials such as wool? What if the dyeing process generates large amounts of toxic waste water? Each material has tradeoffs. Some materials, such as aluminum, are destructive to the environment when mined and require large amounts of energy to manufacture, but are durable and recyclable.

The state-of-the-art was indirectly mentioned by HS•HK and HS•LK respondents through comments on their frustration with evaluating building materials based on ecological and healthy criteria. According to HS•HK #5,"It's not a simple decision to say let's save the environment and use steel over aluminum, because steel takes less energy to produce over aluminum. There are so many tradeoffs and I think architects need to be aware of those tradeoffs when they make those decisions on design."

But the state-of-the-art is not a deterrent to HS•HK and HS•LK architects. They accept the state-of-the-art and make the best recommendations they can based on the research and knowledge available. According to Rogers "Innovators are able to cope with high levels of uncertainty about an innovation than are other adopter categories. As the first to adopt a new idea in their system, they can not depend upon the subjective evaluations of the innovation from other members of their system" (Rogers, 1981, p. 22).

Two LS•LK architects commented directly on the state-of-the-art. To them, the ERG and healthy building design is too esoteric and undefined, and they aren't sure about the difference it will make or how to quantify this difference. The state-of-the-art is an obstacle to them in using the ERG. According to LS•LK #5, "We don't know enough about "green" and what the parameters really are...It's a bit far-fetched, but in the last few years people have got very good ways to describe relativity, whereas 20–30 years ago in school nobody could tell you what it was about. But it's only been recently as people have found good, clever ways of giving analogies or metaphors which allow you to understand what relativity is all about. My sense of the whole idea

of "green" at the moment is that it's still in that kind of early stage of theory. People understand what's going on in concept but they don't have very good ways of expressing what to do about it."

This LS•LK architect typically qualified his comments with, "based on the state-of-the-art, the ERG is..." To him, the Guide is a record of the state-of-the-art, and should be viewed as such.

LS•LK #2 had similar feelings. "You can be aware that there is a problem without knowing exactly what to do about it in the real world. That's kind of where we are in the sick building syndrome. Our consciousness is being raised but people are still debating over what to do. We could use less carpet or plywood without formaldehyde. There's a few things you could do to minimize. Automatically introducing more fresh air will probably make it better, but how much better? It's a very new field. We're (his firm) sort of watching it but feeling there isn't all that much we can do. But given an actual project there's a limit as to what we can really do." This LS•LK architect was hesitant to comment on the ERG based on its state-of-the-art. He said he would prefer to comment on the Guide in a couple of years when the science and Guide are more developed. Once the state-of-the-art is more developed, LS•LK may be more likely to use the Guide and apply the information.

Healthy and sustainable architecture is a holistic approach

Healthy and sustainable architecture is a combination of measures that add up to a whole that is greater than its parts. Energy-efficient windows, insulation, and passive solar siting, for example, contribute to future energy-efficient operation of a building. This environmentally sensitive approach requires architects to think of a building as a system and the design process as a collaborative effort to respond to interrelated issues.

Five architects talked about a holistic approach to healthy and sustainable architecture. HS•HK #1 said, "In addition to a lot of information, it is a sense of the whole, and how you make a whole place work, and how you approach something as a whole. And that is the thing that needs to happen for a full education." HS•HK #4 thought that the profession was becoming too specialized and getting away from solving problems holistically. "Once again, Renaissance and Modernist architects thought about cities and materials — we need to get back to that."

LS•LK #5 commented, "the subject is new to me and can only be approached in a holistic way. I don't think anyone has a hold of this. For example, I'm working on a laboratory for plasma fusion — it's a way out science. The architect is trying to keep us all under control and he meets with each consultant one at a time so he can keep the thing in his own ball park. But since it is such a way out science, I think we should all be working together as a team. It's like the design of the America's Cup — all these things interact together. As with green architecture, it's very hard at the moment to know how you do that."

Architects had mixed opinions about whether the Guide exposes architects to the interrelatedness of issues and the need for a holistic approach. The ERG raised HS•LK #1's awareness of interrelationships — this was the most important thing he discovered from the Guide. "This is a holistic process, because it demonstrates you can't do this in a vacuum." Two HS•LK respondents didn't believe that the Guide combined and presented all the pieces into a holistic approach.

Project specific information for solutions or a springboard to obtain more information

The Guide is intended to help architects become more knowledgeable about the issues and to ask the right questions. The Guide does not attempt to provide project specific solutions. Some architects, however, commented that they would like to see specific information. Other architects accept the ERG as a springboard and conduct further research on their own.

Five architects, HS•LK and HS•HK alike, use the ERG as a a starting point in a process of obtaining more information to make decisions and recommendations. They obtain manufacturers' information, Material Safety Data Sheets, and network with other architects to help them make recommendations. HS•LK #5 architect, who accepts the ERG as a springboard said, "I just use it for general information. For instance, in the carpet section it talks about different types of glue. We then go to the manufacturer and ask what types of glues they provide and what test data is available on a specific product. The Guide is more general. Once you get the data back from the carpet manufacturer (test reports), you can come back to the Guide and it helps you understand what these numbers mean."

Architects in all groups wish the Guide provided project-specific information instead

of simply educating them. LS•LK #1 said, "What is most helpful is when they tell you a solution that you can use or that other people can use rather than just presenting a problem and stating a solution in generalities. It would be more helpful if they had some specifics on what people have done. For instance, they say with concrete there is a problem with demolition. And then they say explore alternatives for demolition. Well, for instance what have other people done?" HS•HK #3 observed that, "then it says specify less toxic sealants. Gee, what are they? What are some guidelines to finding them. The type of guidelines that would be useful are those that don't have the following chemicals in them, or look at silicon sealants without X chemicals in them."

Architects who are critical of the ERG's springboard approach want hard answers. To HS•LK #1, who wishes the ERG had more project-specific information, the ERG "created more questions than answers." LS•LK #3 is not motivated to conduct further research. "Because there is no real answer you have to read through a whole bunch of stuff and at the end you're a little more informed, but you don't have an answer. You're still called upon to use your own judgment and other factors that are outside, such as the client's proclivity, and the procedures contractors are used to."

HS•HK #3 expressed the need for the ERG to suggest alternatives to a product that is not environmentally benign. "For example, with sealants they tell you the issues and composition but they don't tell you what to look for as an alternative as a quick reference, such as other binders. So I would go to their *Highlights and Suggestions for Architects* and there are various chemical compositions so a lot of different kinds out there most are petroleum based. So I want to go find one that is not petroleum based that had more benign composition. But I don't really know how to do that."

While the ERG does not provide specific project information at this stage of its development, this study suggests that LS•LK respondents will not spend time becoming educated on the issues to make decisions. They want information that is ready to be applied.

Spirituality of the Guide

Discussion of spiritual aspects of the Guide was not prompted nor widely volunteered, however two HS•HK architects independently offered opposing views. Specifically, HS•HK #1 commented that the ERG does not give spiritual importance

to these environmental and health issues. "But still there's this feeling I could read all this and go why? I still wouldn't know why I should care. Or how to act. Here I am, a busy architect — you read all this stuff and it can be abusive. Reading all this, there's so much waste and so much pollution and so much energy used. Instead of, like oh right, this is because we love life and we love the planet and we love making beautiful places that are also not harmful. It's so full of information but it lacks that sense of spirit."

Conversely, HS•HK #2 was concerned that the ERG and the Committee on the Environment appear exclusive or "a kooky California thing." According to this architect, information in the ERG needs to be scientifically substantiated in order to be taken seriously by architects, and it should give the impression that it is not solely for a closely-knit clique whose Guide only appeals to architects with certain values.

When is the Guide used during the design process?

For the HS•LK architects who have used the Guide for specific projects, there was consistent use of the Guide during two phases: schematics and specification writing. HS•LK #4 primarily writes specifications so her use of the Guide is limited to her job title. While writing a specification, she sits at the computer with the ERG and composes and revises the specification. She takes out all the "black" things (environmentally incorrect things, such as some mahogany), so the spec still looks normal. She adds environmental measures and materials such as, "air out space for a minimum of x hours." HS•LK #5 architect uses the case studies, articles and other general information during the schematic design stage and the material section during specification writing. HS•LK #1 and HS•HK #5 used the ERG for anecdotal information and a "data resource."

Future topics suggested by architects

Architects volunteered topics and issues they would like to see added in the future. HVAC was mentioned as an area critical to energy efficiency. One architect in California would like to see water covered, and predicted that this would become a growing concern throughout the country. Architects suggested specific guides on how to write recycling construction waste into a specification. One architect would like a sample green specification. Another architect would like an environmental checklist to help her quickly cover issues.

How effective are the AIA's communication channels in diffusing the ERG?

The AIA's mass media and interpersonal communication channels inform architects about the ERG and educate them about healthy and sustainable architecture. Before the national Building Connections videoconferences the AIA used primarily mass media communication channels to inform architects about the ERG. The AIA has established interpersonal communication channels through it's Speaker's bureau. For example, Susan Maxman and others promote the ERG with architects through lectures. The following table identifies the sources each architect mentioned.

	HS•HK Architects	HS•LK Architects	LS•LK Architects
Interpersonal			
Robert Berkebile		2	
William McDonough	1		
SF Chapter President	1		
Member-local Committee on the Environment		3	
Chris Hammer*			1
Boss*		1	
Firm Librarian*			1
Mass Media			
AIA Memo	1	1	2
AIA *Architecture*		1	1
AIA Local Chapter Newsletter	1		
AIA mailing	1	1	

*NonAIA source.

Table 3 Interpersonal and Mass Media Communication Channels

The effectiveness of the AIA's communication channels can be evaluated individually and collectively. Individually, communication channels are studied to determine the strongest and weakest sources. Collectively, communication channels are studied to determine if architects are hearing about the ERG.

As the table illustrates the most common source was AIA mass media communication channels, specifically *Memo*. (The total for mass media is 9 and the total for interpersonal is 7, with non-AIA sources disqualified.) This finding supports Rogers' theory that mass media communication channels are the first source through which Innovators and Early Adopters hear of innovations.

Interpersonal communication channels were a close second. Another finding from the data is that no LS•LK respondents had heard of the ERG through AIA interpersonal sources and four of the five are AIA members. This finding suggests that face-to-face encounters by AIA sponsored speakers, the most effective source with this group of architects, are not reaching the architects they need to reach. That is, Late Majority and Laggard architects are not attending or being drawn into lectures, for example, on sustainable design. These groups of architects need to hear face-to-face what architects can do for environmental preservation and based on my research they are not getting this exposure.

This author's face-to-face exchanges with three LS•LK respondents supports Rogers' hypothesis that this communication channel is effective with Early Majority, Late Majority and Laggards. When this researcher was first trying to set up an interview, it was difficult to persuade these architects to participate in this research — mostly because they were busy. At the end of the interview, they appreciated this researcher's persistence which had moved them to read the ERG.

Face-to-face exchanges were so effective with this group that each of the architects said that they would be using their new knowledge to take specific actions at their firms. Face-to-face exchanges encouraged them to think of small things they could do, such as changing the product list at their firm, looking into a utility sponsored rebate, or conducting "brown bag" lunch seminars on the ERG. Although this group is not ready to change their firms' comprehensive approach to practicing architecture, they were ready for small steps. (Whether these face-to-face exchanges with them have manifested into action is unknown at the time of this writing.)

The second means of determining the effectiveness of the AIA's communication channels is to examine if architects are hearing about the ERG and are aware of it. The table suggests that architects are hearing about the ERG, since only one architect had heard of the ERG for the first time through this researcher. The sample however

was biased, with two groups of architects, HS•HK and HS•LK, selected because they have adopted the healthy and sustainable approach toward building design and are active in communication channels associated with it.

This author believes that most architects have not heard of the ERG. This judgement is based on efforts to find LS•LK respondents to interview. Many architects this author spoke with had not heard of the ERG. Based on this experience of this author, it is reasonable to conclude that the current interpersonal and mass media communication channels are not effective in informing architects about using the ERG.

Other supporting data about how unaware architects are about the ERG is the observation that 8 of the 10 eligible architects in the sample had not even seen the Guide or subscribed before this author contacted them. (The five HS•LK do not qualify since they were selected based on the criteria that they had heard and used the Guide). Three HS•HK architects had not subscribed because it was too costly and they had been depending upon other communication channels besides the AIA to gain and share information. The primary reason LS•LK respondents had not subscribed was they have not adopted the approach of sustainable architecture.

The ineffectiveness of existing communication channels in diffusing the ERG is emphasized by LS•LK #4, a perfect candidate for subscribing, who had not heard of the ERG until this author contacted her. She includes many energy efficient measures in here work, such as: natural daylighting, energy-efficient HVAC systems, low–e argon glass windows, insulation, and passive solar in her designs. At the time of our interview she was reading *Earth in the Balance* by Vice President Al Gore. She's an AIA member, but does not read *Architecture* magazine or other architecture journals. She only reads her local chapter newsletter and *Memo*. She does not go to AIA functions or interact with other architects much. After the interview was set-up, she read about the Building Connections videoconferences in *Memo*.

HS•HK #5 does not think the AIA is promoting the ERG enough, "I've gotten the quarterly update, but I haven't seen any literature on the market inviting other people to subscribe." Later he said, "the AIA needs to do better marketing, they're too timid."

Improving AIA communication channels will be discussed at more length in the

Conclusions. See page 94.

How well does the ERG promote healthy and sustainable architecture?

There appears to be a communication gap between most architects and the producers of the ERG. Most architects don't know what the ERG is nor can they grasp the issues and concepts associated with healthy and sustainable architecture. Both HS•HK and LS•LK respondents commented on the gap between architects and the ERG. Both groups think the ERG won't be the mechanism that will bring the profession to this approach that lessens the environmental impact of the construction and operation of the built environment. These HS•HK and LS•LK respondents believe other mechanisms must be developed to fill the void.

HS•HK #3 provided her perspective of looking at the ERG from a distance. "This won't be the mechanism that would push it (this approach) into the mainstream. I think once someone in the mainstream caught the fever, I need to start looking at this, then they'll come to the ERG."

LS•LK #5 said that he did not understand healthy and sustainable issues completely and was looking for a mechanism that will educate him. He commented, "I'm not looking for confidence from the ERG, I'm looking for an approach, where would I start, some way to get into the problem. For example (when the ERG talks about) what are supply water pipes made of? Well I don't know the issue." Later he said, "I'm willing to be converted but I'm having a difficult time getting into the subject–here the Guide didn't help–but I don't think a text book can do it, examples and videos will help."

According to LS•LK #1, "This book is helpful, but a lot of people won't read it. So in terms of my office, I think it would be more helpful if we had some seminars on these subjects."

Based on the observations of HS•HK and LS•LK architects, the ERG needs a visual introduction to the topic of healthy and sustainable architecture. This researcher recommends that classes, seminars, workshops and other mechanisms be developed to educate architects about the relationship between architecture and the environment. These face-to-face means of communication help architects understand the issues and

their role in the process of addressing them.

How does each member of the social system affect dissemination of the ERG and healthy and sustainable architecture?

In this section, each member of the social system is analyzed according to its effect on the diffusion of the ERG. There is a direct relationship with a few members of the social system and diffusion of the ERG, specifically the AIA, building material manufacturers, and government (EPA). The AIA for example, directly affects how architects hear about the ERG or learn information by means of the ERG. Other members of the design and construction social system, such as architecture schools or allied design professions, do not directly affect diffusion of the ERG.

This section also discusses how each member of the social system affects diffusion of the larger concept of healthy and sustainable design. Members such as clients have a more significant role compared to the construction industry which contributes in small ways and for one phase of the design process. The following begins this section's focus on the social system with a discussion on the rate of adoption for each member of the social system member.

Classification of members of the architectural social system

An in-depth analysis of members of the architectural social system and how they relate to the design and construction of buildings that are environmentally sensitive, was not conducted nor was it the focus of this research study. Architects nonetheless expressed both positive and negative comments about various members of the social system and these were used to classify members according to Rogers' adopter categories. HS•HK #5, who was knowledgeable about Rogers' diffusion of innovation theory, used Rogers' adopter categories to talk about rate of adoption for specific entities in the construction and design community.

To supplement the perspective of interviewees, background research on some members' business environmental initiatives was conducted and used to classify members. For example research was conducted on utility companies to determine how many of them have demand side management programs. Sometimes a clear picture of a member's rate of adoption was difficult to determine because of conflicts between architects' perspectives and background research on an organization in the

social system.

According to Rogers, there will be a range of interests about an innovation among members of a social system. "There are also differences in the rate of adoption for the same innovation in different social systems" (Rogers, 1983, p. 23). Different rates of adoption between members of the architectural social system may be due in part not only to just the interest and commitment of a social system member, but also to the state-of-the-art, level of exposure to healthy and sustainable architecture or resistance to changes that are necessary to implement healthy and sustainable concepts. Change may be inherently easier for one member compared to another.

Clients

The support and vigilance of clients is instrumental in implementing sustainable design objectives. To implement a comprehensive approach to sustainable design as well as smaller more incremental measures, the consent and input of clients is critical. Clients who are knowledgeable or concerned about environmental issues establish specific goals for their project which may become case studies from which others can learn. Clients who are not interested or knowledgeable retard diffusion of healthy and sustainable architecture.

The rate of adoption for clients appears to be mixed, therefore some have been classified as Early Adopters and others have been classified as Late Majority. Architects complained about the lack of knowledge and resistance by their clients. But clients were also leading LS•LK architects on the topic of healthy and sustainable design. Some clients were leading in small measures such as policies that ban the use of CFC's, and others were already implementing a comprehensive healthy and sustainable approach to building design.

When committed clients find committed architects, or vice-versa, there is no confusion — both are supportive of preserving the environment and/or supporting energy efficient designs. The architect and client challenge and reinforce each other and together they explore possibilities. There is also not any confusion when uncommitted clients retain uncommitted architects. There is a conscious or unconscious understanding that healthy and sustainable concerns are not priorities; this may be the most common relationship. Problems arise when committed clients retain uncommitted architects and when committed architects are retained by

uncommitted clients. This combination of relationships is the focus of the following discussion.

Committed clients motivate uncommitted architects to become more environmentally aware. They require them to meet sustainable and healthy design goals and objectives, support their time to become more knowledgeable, and invest in design solutions and technologies that have long-term economic and environmental benefits. All LS•LK architects, for example, report that they would respond if clients requested these services. To LS•LK #3, "My firm is ready to cheer them on, but you sort of have to hear them say it first. It's a funny little dance that you do." LS•LK #5 said, "The company is neutral to it, but some colleagues would be interested if a client came around." This particular architect ordered the Guide in response to an institutional client that wanted the design of its new social and natural sciences building to mirror its environmental curriculum. LS•LK architects studied in this research are not hostile toward healthy and sustainable architecture. Like most architects, they react to what clients want.

LS•LK architects probably won't implement healthy and sustainable architecture until a client comes along. Two LS•LK architects interviewed are reluctant to spend non-billable time studying the ERG and applying the information if there isn't a specific project in which to apply this knowledge.

Uncommitted architects are fearful of risks with unfamiliar solutions and technologies. LS•LK #3 said, "The other thing that would make a difference is an owner that would be willing to take a gamble. We talked about an ice storage system for X Park, and that owner wants to do it."

Committed clients lead uncommitted architects in issues that they learn about in the mass media. Four architects talked about clients who asked them to address off-gassing, radon, CFCs, halon, and foam insulation. According to LS•LK #1, "For example, the University of California sent around a directive a couple of years ago saying no one was to use foam insulation or use CFCs." A residential client was interested in paint and carpet that wouldn't irritate her allergies. Innovative clients or those concerned with health issues will continue to play an important role in raising awareness and forcing architects to implement healthy and sustainable design solutions and technologies.

Clients who are not knowledgeable about or committed to healthy and sustainable design retard diffusion. Three HS•HK architects commented that uncommitted clients are a major obstacle to applying healthy and sustainable design solutions. To HS•HK #2, educating the client is one of the biggest struggles in trying to implement healthy and sustainable design objectives. (Two other HS•HK don't apply. One is a university professor and the other is a specification writer whose clients, other architects, are receptive to his suggestions.) "It's very, very difficult to persuade a client that is not interested already to take an interest."

The most significant concern, especially for uncommitted clients, is budget. Clients are reluctant to pay for HVAC systems that are initially more costly or for building materials, such as linoleum, that also require more maintenance. Eight architects commented that this was a concern. According to LK•HS #5, "Some clients respond, 'yes we would like to do something — but only if it doesn't cost too much.'"

Architects working with resistant clients can try to educate them and can address long-term costs. HS•LK #1 said, "A client will adopt a philosophy if you have the facts and they agree with those facts. The client needs those facts because they are responsible to someone else."

Slightly committed HS•LK #2 was concerned about her professional obligation to her uncommitted clients. "And that goes back to clients also. They're looking to you for good input and expect that this product will last a long time. I can't say this product is going to perform. So I went with the standard (paint) manufacturers that did have low VOCs, or as low as I could find...I used California standards because they are tougher than anyone else's, but I wasn't going to use (radical) paint standards."

Architects in different groups stated that the type of client affects whether healthy and sustainable concepts are implemented. LS•LK #3 commented, "Lobbying against use of it (the ERG) to some extent are our private developer clients. I think our institutional and corporate clients want to do a better job. If you look at our project with X oil company, I think they feel that an environmentally active and sound oil company is just good business. It's good public and community relations." HS•HK #2 agreed. "Some institutional clients who really have this 100-year perspective are easier to convince. Especially in the energy area and because some of the more

harmful materials have been developed because they are low cost. I think the initial costs are amortized more easily by an institution." LS•LK #1 said, "Some clients are interested, some aren't. But clients are always interested in energy costs in commercial and institutional."

Allied design professions

Engineers, landscape architects, interior designers and other allied design professionals can make an integral contribution in diffusing and implementing healthy and sustainable architecture. Like architects, they can provide an impetus to clients and the design team in general. For the design of environmentally sensitive projects, allied design professions are essential team members. According to HS•LK #1,"We've also discovered that it can't be done without good consultants. This is very critical."

The responsibilities of allied design professions, including those concerned with HVAC systems, building envelope, and site orientation, contributes to the energy efficiency of a building. Collaboration between architects and allied design professionals, especially engineers, maximizes a building's energy efficiency. Engineers advise on lighting, HVAC equipment and layout, exterior wall design, passive energy sources, operable windows, long-term operations, solar panels, and many more areas. Architects rely on engineers to consult with them on their designs and to provide engineering solutions. According to HS•LK #4, "I see it (sustainable design) as a great opportunity to communicate with each other (the consultants) instead of everyone falling back on the established, old ways."

Indoor air quality also depends on collaboration between disciplines. For example, providing adequate ventilation and specifying nontoxic materials both contribute to indoor air quality but they are the responsibility of different project team members.

Allied design professions also need to be commited to this approach and knowledgeable about how their discipline contributes. According to HS•LK #1, "A good consultant has to share the same points of view that we have and be an expert so they can tell you when you're wrong and they can challenge you." LS•LK #1 commented, "I believe we have power to push these things over the engineer to some extent but they have a lot more knowledge. But when they are resistant, the architect doesn't know enough about their system, about what they should do, and we don't

know that what they are doing is wrong or that there is another alternative."

The rate of adoption for allied design professionals appears to be very slow based on all the negative comments about engineers and lack of comments on the innovations from other disciplines. One positive comment was made about a civil engineer and one negative comment about an interior designer. According to HS•LK #5, "Some interior designers specify what they are used to and don't consider indoor air quality." But most comments were about mechanical engineers. HS•HK #5 believes engineers are laggards.

To many architects, mechanical engineers are not perceived to be interested in or familiar with their role in energy efficiency and indoor air quality and their profession lags behind. According to HS•HS #2, "The mechanical engineering community needs to be reached — they're dinosaurs. They resist innovation and they prefer to do things the way they have always done them and are mostly concerned with being cost effective."

Seven HS•HK and HS•LK architects commented on the frustration of working with engineers who aren't interested in these issues. HS•LK #4 challenged her engineer at the beginning of a project to explore new and creative solutions that addressed indoor air quality and energy efficiency. He met her suggestions with resistance and apathy. "Sometimes it's like talking to a brick wall with engineers...It's definitely new to them." HS•LK #2 said, "Sometimes structural engineers roll their eyes with these suggestions. It's up to the architect or person who hires the consultant to set the tone and adjust for the additional time it may take. You have to let them know up front." HS•HK #2 asked his mechanical engineer to switch refrigerator units based on the crisis in CFCs. "He refused to do it — he said there weren't any alternatives."

A LS•LK architect and a HS•HK architect had different experiences. HS•HK #4 commented "If you look hard enough you'll find consultants to work with." And LS•LK #4 said, "I've never met resistance with my mechanical guys. And they advise me. I look to them to bring me up to date on what I need to do in terms of insulation. I had a lighting consultant who had to meet all the Title 24 requirements. He told me what I could use, what I could not use. He tried to steer me toward more efficient kinds of lighting."

American Institute of Architects

As the publisher and sponsor of the ERG, the AIA has the most significant role in diffusing the ERG. The AIA determines pricing, the information included, how it is presented, and how architects hear about the ERG. The AIA also determines: how much emphasis and funding this topic receives within the national organization; interaction between units of the social system, and; support to Innovators that furthers development.

Diffusion is retarded because the cost of the ERG may be to too high for architects. Three HS•HK architects cited cost as the reason that they did not order the Guide, although this group is also the least likely to need the ERG. HS•HK #2 resented the AIA charging anything. To him, architects implementing information in the ERG are providing a societal benefit and should not bear the financial burden. HS•HK #1 who thought the ERG was too expensive suggested a two digit price.

The American Institute of Architects can help diffuse healthy and sustainable architecture by taking a leadership role. Through increased emphasis and funding within the national organization, interaction between members of the social system, and support to Innovators that furthers development, the AIA can communicate sustainable design is a priority.

Partnerships between the AIA and other members of the social system help create an understanding among all the parties. An HS•HK (#1) architect suggested how this relationship might work: "The steel industry says, you've pointed out this weakness, and we want you to know we're doing research here to deal with that." Partnerships between the AIA and the building construction industry brings about a common language, which makes the ERG's task easier.

According to HS•HK #5, the AIA could also mandate action on urgent issues such as stopping the use of harmful materials such as CFCs and halon. According to him the AIA has taken a position against mineral fiber fire proofing in place of cementious fiber fire proofing and the AIA could do the same with more materials that are known to be harmful. This architect thinks the AIA is the only as well as the best entity to do this. "The AIA doesn't owe any debt to a specific industry — they can call it as it is and say we need to stop using CFCs."

The rate of adoption for the AIA appears to be mixed: therefore some components have been classified as Innovators and others have been classified as Late Majority. Considering the state-of-the-art and the AIA's past role in diffusing innovations within the architecture profession, authorization of the ERG by the AIA is pioneering. While environmentally benign products, technologies, and practices are still evolving, the AIA has begun diffusing this information into the profession before the science is fully developed. They have institutionalized information and communication channels.

Pressure to address environmental issues within the architectural profession, however, came from the grassroots, not the AIA. Innovators have been out ahead of the AIA for many years. Four HS•HK architects spoke negatively toward the AIA, commenting on the AIA's lack of leadership on these issues. According to HS•HK #2, "The AIA has not committed enough resources on this — too much money goes to entertainment and graphics." Based on the perceptions of these four architects, AIA leadership, except for former president Susan Maxman, has been classified as Late Majority.

The AIA Committee on The Environment (COTE) has been classified as one of the primary innovators within the social system because it has met the state-of-the-art at its point of development and is attempting to refine and process new information for application into the profession.

Change agents within and around the AIA have improved the AIA's emphasis on healthy and sustainable architecture. Change agents started the ERG and the Committee on the Environment. These individuals keep the topic alive within the AIA. They campaign for healthy and sustainable architecture to AIA members and other units of the social system. According to Rogers, "As a bridge between two differing systems, the change agent is necessarily a marginal figure with one foot in each of two worlds. His or her success in linking the change agency with his or her client system often lies at the heart of the diffusion process." (Rogers, 1981, p. 315).

To HS•HK #5, architects are innovators within the social system because they are creative and think holistically. They are considered by HS•HK architects in this study to be ideal vehicles for change in the building industry because they have a reputation for being innovative. They are also the natural choice to initiate and implement

environmentally responsive changes within the construction industry. They have a natural interest in the quality of environments and a professional obligation to protect the health, safety, and welfare of the public.

Conversely ERG diffusion may be retarded if the ERG and Committee on the Environment (COTE) are perceived as relevant only to a select few. HS•HK #2 thought that the ERG and the COTE are too "ingrown," pointing to the use of a commercial entity like Environmental Outfitters as a reference. "But I think that citing their product literature as evidence is a really bad practice. Because, a very large part of what we're trying to do is debunk the product literature of manufacturers that really don't care about the issues." He suggested that a professional journal with a reputation would be more credible and neutral. He also didn't believe that it was easy to participate and contribute articles to the ERG unless you were part of the AIA's network.

Architecture schools

Architecture schools play a key role in exposing architecture students to the role architects play in environmental preservation and restoration and educating them about specific design solutions that are more energy-efficient or lessen the impact of building construction and operations on the earth. Having such background while still in school increases the likelihood that this perspective and knowledge will be applied in later professional practice.

Based on a 1992 HUD study of architecture schools, a survey by The Energy Foundation of graduate programs in architecture schools, and architects' comments on their education, only a small percentage of architecture schools are addressing environmental issues and energy efficiency in their curricula. Therefore this entity of the ERG social system is classified as Late Majority.

According to the HUD study, the majority of architecture schools do not raise awareness, provide coursework, or dedicate curriculum to the design of healthy and sustainable buildings. According to The Energy Foundation survey, eight graduate programs in architecture schools teach energy related courses: University of Southern California, University of Oregon, University of Minnesota, University of Colorado, Boulder, University of California, Berkeley, New Jersey Institute of Technology, and Massachusetts Institute of Technology, and Rensselaer Polytechnical Institute (Wall,

1993). Six architecture schools provide coursework with a sustainable design focus: University of Oregon, Eugene, Ball State University, Kansas State University, University of California, Berkeley, University of Kentucky, and the University of Virginia. (Wall, 1993).

None of these schools devote their entire curriculum to healthy and sustainable architecture. The closest is Ball State in Muncie, Indiana. Here two required design studios and two Environmental Systems courses incorporate sustainable design issues and solutions. The program also has strong support from its Dean and the school promotes itself in the market as offering an architectural education in sustainable design. The architecture school also benefits from a Provost who is interested in environmental issues, has a established a mission statement and a campus-wide committee to address these issues (R. Koester, telephone interview, September 16, 1993).

At the University of California, Berkeley, HS•HK #3 teaches a course called "The Politics of Building Materials." The ERG is the main textbook for the course. Students conduct original research similar to the topics in the ERG and write research papers. Her university also offers a course on environmental planning.

Based on the HUD research, "one or two professors introduce the concepts of sustainability, while other schools may have a whole center devoted to a specific aspect of sustainability" (Wall, 1993). For example, within the School of Architecture and Allied Arts and the University of Oregon, Eugene climate analysis for design, environmental control systems, and solar heating coursework and research on local solar energy is conducted through the Solar Energy Center (Wall, 1993).

Out of fifteen architects interviewed in this study, nine received some coursework on efficient or alternative energy systems, including passive solar design. A HS•LK (#2) architect commented that she was in school shortly after the 1970's oil embargo and coursework was offered in response. Two older LS•LK (#2 and #5) architects did not receive any energy-efficient coursework since they were in school after World War II when the consumption of natural resources was not a concern. LS•LK #2 recalled Pacific Gas and Electric's inducements that promoted an all-electric-house to homeowners. According to LS•LK #2, "The more energy you could use the more wonderful it was." None of the architects interviewed had been offered coursework on

indoor air quality in school. Two HS•HK architects (#1 and #3) were self-taught in these areas. Three HS•HK (#1, #2 and #3) architects thought that coursework on healthy and sustainable design should be offered, and even required. A HS•LK respondent (#3) thought the ERG specifically should be used in coursework, since current teaching materials are "old and dead."

To further promote and advance healthy and sustainable architecture, architecture schools should train student architects to work with other allied design professionals, such as engineers and landscape architects. This experience, which could be offered in a multi-discipline design studio, will better prepare them for the collaborative process necessary for creating healthy and sustainable architectural projects.

Construction industry

The construction industry has a smaller and simpler role to play in diffusing healthy and sustainable architecture i.e. through efficient installation of materials and measures to insure indoor air quality, and recycling demolition and construction waste. Contractors improve indoor air quality by allowing toxic materials to air out before they reach the job site or providing enough time for air infiltration before occupancy. The construction industry retards diffusion of healthy and sustainable architecture by not educating members or by resisting architects with earth-friendly practices.

HS•HK #3 who worked in the construction industry for ten years before she started teaching said, "There is no one really putting anything together for the construction industry." With her wealth of experience and knowledge, this architect was this author's primary source for data on the construction industry. Based on HS•HK respondent #3 and this researcher's own experience, institutionalizing the measures that industry can take has been slow. Therefore this member of the social system is classified as a Laggard.

To appeal to Contractors, this HS•HK #3 suggested targeting issues that affect contractors: efficiency and economics. To HS•HK #3, "They are only interested in this stuff if it allows them to make and save money."

Two architects talked about incorporating measures into specifications to direct contractors to implement indoor air quality measures and to recycle construction and

demolition waste. HS•HK #3 said, "Architects can change the way the construction industry operates through specifications, such as don't use X glue." HS•HK #5, who was discussing what architects can do environmentally throughout the design process, included specifications "...and then there are a whole bunch of issues that might be recommendations during construction. This is the recycling of the demolition waste or giving the contractor instructions that make the construction process more environmentally responsive."

It was surprising to hear the perspective of LS•LK #3 who was reluctant to implement construction waste recycling on the job site because he believed that architects did not have this authority with contractors. "Someone like the AIA has a problem with us telling contractors how to run their project. Because we're not responsible for construction means or methods, the Owner can tell them how to do anything, like work on Sundays. We're in the position of influencing the Owner more directly than the contractor. So you could have a scenario where the AIA has a case study in *Engineering News Record* showing where some big organization was recycling, conserving materials, and cutting the waste in construction. Then we could lobby ourselves to influence owners to write that into the General Conditions."

Building material manufacturers

Building material manufacturers can support diffusion of sustainable architecture by analyzing their products' or materials' life cycle and identifying and implementing environmental improvements. As more companies manufacture building materials by means of an earth-friendly process or for long-term healthy operations architects will have more products and materials from which to select.

The attention manufacturers give to their manufacturing processes is partly due to pressure from architects. Architects ask sales representatives about the content of a product or how it was manufactured, which raises awareness and, ideally, makes them change the ways their products are produced. HS•HK #5 and three HS•LK architects (#1, #4, and #5) had asked sales representatives questions or put pressure on them to change their product. HS•HK #5 said, "When you are talking to a sales rep about a particular product that he's selling, you can always ask him a few questions about its environmental safety record or their manufacturing process. You can really put these sales reps on the spot by asking some environmental questions. The ones that are in environmentally responsible companies will be comfortable with these questions and

will answer them. The companies that are non-environmental in their orientation will ignore the question or will change the subject...Everybody you work with in the entire construction industry can be an environmental resource if you ask them the right questions and push them in the right direction."

HS•LK #1 surveyed window manufacturers to determine the efficiency of their shipping procedures, such as whether trucks are full when they leave and return to the plant. "The intent was also to get the suppliers and salesmen to recognize that these are the questions this office is going to ask...I think that's what it's going to take. Because those questions are not from just a few architects, but from all architects. And I see it gaining a lot of momentum."

Architects typically spoke negatively about building material manufacturers. To the interviewees, sales representatives were not knowledgeable about the environmental characteristics of their products. It was stated that it is difficult to obtain accurate and informative product or company information with which to evaluate a product or material Neither the marketing information nor Material Safety Data Sheets (MSDS) are judged helpful.

MSDS, which are required by state and federal regulations, are forms from the manufacturer that identify hazardous materials. MSDS include the name of products on material labels and supply information on chemical identity composition. Designed to inform employees and employers in the work place, they provide information about physical hazard properties, flammability, flash point, explosiveness, hazard combustion in the air, and health hazard effects. They also provide information on health symptoms caused by over exposure (Bower, 1989, p. 45-46).

Sales representatives' lack of information about a product's environmental composition, such as how much of a material is made from a recycled material, was a common frustration among the architects interviewed. HS•LK #1 said, "Manufacturers are reluctant with this information; the salesmen are completely lost and not prepared to answer questions, and the literature doesn't cover environmental information and those that do, make a special point of covering it." HS•LK #5 said, "The reps usually don't have the answers off the top of their head; they have to go back to their office, pull the report, and send the information to you." HS•LK #4

commented, "You call the reps and they don't know. In a lot of ways it's just as new to some of these reps as it is to us."

Architects talked about manufacturers that don't provide accurate information or jump on the environmental bandwagon when they are only marginally responsible. "You get so many different claims from manufacturers," said LK•HS #3. Later he said, "I can imagine companies wanting to be listed in the ERG and pushing themselves — and they shouldn't be listed because only a small part of their operations implement environmentally correct measures." According to a HS•HK #2, "I mean what we're saying is you really shouldn't trust the manufacturer of an item to be responsible for it's environmental qualities."

Manufacturers retard diffusion of the ERG when their marketing information does include environmental information, such as composition, and is in a different language than the ERG. Carpet information from the manufacturer, for example, may not be explained in terms of what the ERG has established as criteria. The language employed by the ERG and by manufacturers is often different. Architects not personally motivated to address health and sustainability issues nor willing to research products may give up on the current difficult process of relating the product information to the ERG.

Three architects researched materials further by obtaining Material Safety Data Sheets and two architects expressed frustration with this form of information. HS•LK #1, "You can find out a tremendous amount of information, but if you're not a chemist you may not fully understand it. And the environmental impact isn't always that specific. It does say handle carefully, wear gloves, and that sort of thing. But that's an OSHA issue — where they are concerned about the person handling it. But it doesn't really talk about the end user coming in contact with off-gassing or the manufacturing process." HS•HK #2 commented, "They're a joke, there are so many harmful chemicals and so many products that contain anywhere from a trace to substantial amounts. And the MSDS don't provide formulas because they are proprietary. But you need these formulas to figure out this information."

Government

Government supports or retards diffusion of the ERG through continuing or discontinuing EPA funding of the ERG. In this example, economic support helped to

diffuse written information on healthy and sustainable architecture into the private sector.

Government leadership has been inconsistent in establishing an energy-efficiency policy and this retards diffusion of energy efficient building designs. Clear guidelines are necessary to direct a culture that does not emphasize conservation of natural resources. According to LS•LK #5, "Energy rich countries like the US — that culture impacts our attitudes and this is hard to change. We can't deal with heat now, we have to have air-conditioning." Lack of government leadership slows diffusion of energy-efficient architecture. It also discourages or suggests there is no urgency for architects and their clients to address energy efficiency. According to LS•LK #5, "Nothing is putting pressure on me to be altruistic and concerned with the future — and there's no incentive." And there are many obstacles within architectural firms that discourage designing energy-efficient buildings, including time pressures, shrinking fees, and lack of support within the firm.

Government leadership can support diffusion of healthy and sustainable architecture through a variety of mechanisms, including policies, programs, taxes and fines, research funding, and building codes. These mechanisms can be organized into two areas: economic and legislative. The government can affect a wide variety of areas, including energy efficiency, indoor air quality, toxicity of building materials, and more. Considering the breadth and depth of government force, this unit of the social system has the greatest ability to make changes to use resources more efficiently and provide healthier built environments. According to HS•HK #3, change will occur when "clients push it up and government pushes it down."

Government retards or supports diffusion through funding and fines. HS•HK#3 suggested using government research grants to focus and eventually direct the private sector. "I think having governmental tax incentives, to encourage companies to be one way or another more environmentally benign in their practices (sic). These will be the things — money will be a part of that. And maybe further down the road government will make research grants available to toxic carpet glue manufacturers to do research on some things that work better."

The second area where government affects the diffusion process is through regulation and building codes which can mandate and motivate architects to implement specific

measures. Architects in all groups commented that force will be the primary motivation. According to LK•HS #4,"Only by force will the masses turn to the ERG. Codes and or lack of available resources will force this." According to HS•HK #1,"I've drilled multi-home developers and they basically say, 'we have to look at costs, and what we can sell a house for, and we don't make changes if they're not mandated.' That's a pretty sure sign that a lot of developers/builders will only change as the code requires."

Government has been categorized as Early Adopters based on architects' comments about energy and clean air legislation in California. Categorization is also based on the EPA funding of the ERG.

Specifically California's energy code, Title 24, forces architects and their clients to implement energy- efficient measures. Enacted in 1974 by the California Energy Commission, Title 24 "prescribes, by regulation, ...building design and construction standards that increase the efficiency in the use of energy for...new buildings." (California Title 24, The mandatory measures are heating, cooling, service hot water, automatic time switches, occupancy sensors and demand ventilation controls.)

Title 24 forces architects, especially LS•LK architects, to implement energy saving measures. Three LS•LK architects mentioned California's energy law. Said, LS•LK #4, "Title 24 has made us more aware out here even though California's climate is mild and more forgiving."

California also has tougher clean air requirements. According to HS•HK #5 "California has a more elaborate series of requirements for volatile organic compounds (VOC's) and this has a much bigger impact on what we can and can't do in painting and this is calling the shots." LK•HS #2 in Kansas City used California's code as her benchmark. "I use California's standards because they are tougher than anyone else's..."

Building codes support healthy, sustainable architecture when they include regulations that improve indoor air quality, emphasize material and even space saving. According to HS•LK #3, some legislation in Scandinavia discourages construction of large homes. Six architects believe government codes are behind the needs of the times and do not reflect the concepts associated with healthy and

sustainable architecture. Their comments were directed toward codes that need to be rewritten to accommodate this approach. According to HS•HK #4, "Building codes are regressive, dead." HS•LK #3 agreed, "I don't know what kind of communication the UBC has with the AIA, but the next big hurdle is to change the codes. The codes are written in a 50's and 60's mentality." The codes, he felt, do not reflect this new way of thinking in reducing waste and using materials more efficiently. He suggested saving materials by changing the placement of studs, "should 2x4's be 16" O.C. or can they be 20" O.C.?"

HS•HK #1 did not think codes would resolve the complexity of this approach. "From an artist's perspective, I know a lot of this stuff is hard to codify — it doesn't line up easily. Take tropical hardwoods. Different organizations saying different things. So I would like to see things in code and in law, but I don't want that to be the only thing that happens. And I'd like the codes to be responsive so that as peoples' understanding changes, the codes do too."

This same HS•HK architect had positive experiences working with her local building officials to implement healthy and sustainable design solutions. "At the county level, a really competent building department, or one that just gets out of the way is best for me. The ones in the middle are not useful. In Sonoma County I've regarded them as an ally because they've got good plan checkers. They made it tough on a foiled, bubble, reflective insulation — astro foil. The County said [the] documentation wasn't good on the material. It turned out to be a calculation problem, not a material problem." "On a rammed earth building, the County had seen one other rammed earth building that was well documented, so they were open, cooperative and helpful." "The government doesn't get too worried about different finish materials for health reasons. Mostly they get worried about insulation and different kinds of structure."

None of the architects interviewed had specific problems with local building officials in trying to implement alternative solutions. This may, however, be due to the sample of architects interviewed. Two HS•HK architects are not part of the construction side of architecture and the projects of many HS•LK architect architects were not yet under construction. This author speculates, and the following HS•LK architect and LS•LK architect agree, that building codes create inefficiency and waste and have not changed to promote healthy and sustainable practices.

A HS•LK architect and LS•LK architect speculated on problems that they may have with building officials. HS•LK #1 said that government would resist installation of a water recovery system. "The problem is that when you speak of government, the government would say, well gee that's nice if you want to take all of your water off your roof and you want to water your lawns, but you can't because of some law... It takes a tremendous amount of foresight by government. I don't think Kansas City government has the foresight or the federal government." LS•LK # 2 also thought that the government could be a detriment. "I could envision some government codes, I can't think of any specifics, that were contrary to environmental goals."

The architect who is knowledgeable about diffusion of innovation research — HS•HK#5—believes government has been slow in promoting or requiring sustainable design practices, probably because he's using building officials as the representative government entity. To him government bureaucrats are laggards. "If architects have the willpower they could be on the cutting edge. But they tend to be too conservative in their thinking because they have to deal with bureaucrats. And bureaucrats are laggards. They don't want to stand out and you can't convince a bureaucrat to change. They follow the rule by the letter."

Public utilities

Public utility companies support sustainable design by establishing relationships with architects in their service areas to emphasize energy conservation. Through utility funded rebates and educational programs, public utilities help architects design energy efficient buildings and in return, reduce a building's energy requirements. Utility companies recognize that Demand Side Management (DSM) is a practical and inexpensive alternative to the building of new power plants (Bryan, 1993, p. 35).

According to research conducted by the Utility Data Institute (UDI), approximately 45 public and municipal utilities provide building design programs for the construction community (Utility Data Institute, 1992 pges. 5-3 - 5-5). A few utility companies have energy resource centers to help design professionals design energy efficient buildings, they are: Southern California Edison, Bonneville Power, Portland General Electric, Pacific Gas & Electric (Bryan, 1993, pges. 35-37). Based on these research findings and architects' comments on Pacific Gas & Electric (PG&E), utility companies are classified as Early Adopters.

Most of this researcher's interviews took place in the San Francisco area and PG&E was mentioned by four architects. PG&E emphasizes energy conservation for many reasons. Not only does it have an enlightened board of directors, PG&E is not allowed to build more nuclear power plants, and growth in California constantly increases demand. PG&E has more than 60 residential and commercial programs that encourage energy conservation. PG&E's relationship with the construction community is uniquely close; they sponsor many San Francisco AIA Chapter events and they have subscribed to the ERG.

PG&E uses the Pacific Energy Center to help the construction community learn to save energy through energy-efficient technologies and design solutions. Built in 1990, the Pacific Energy Center displays energy-efficient systems for residential and commercial settings, offers courses, and provides a hotline for architects, homeowners, and others to get answers to their technical questions.

PG&E's programs include a rebate program to encourage investment in mechanical and electrical systems that bring energy use of a building 15% below the state mandated energy code. PG&E pays expensive initial costs for these systems.
The finding that three LS•LK architects were familiar with the Pacific Energy Center suggests PG&E is successful at establishing a relationship with architects in the Bay area. These architects mentioned attending classes, visiting the Pacific Energy Center, or participating in PG&E's rebate program.

How effective is the ERG as a written source of information for architects?

The following discussion evaluates the ERG based on the five criteria outlined earlier based on a review of the literature on architects and information.

When architects were asked whether the ERG instills confidence in them to make recommendations for their clients, seven answered yes, two architects were undecided, and six architects said no. The Guide in general is not understood in design terms since many architects wish it provided project specific information. Three architects said the ERG does not provide information to meet the needs of each design stage. When architects were specifically asked if the ERG accommodates their limited amount of time, eight answered yes, two architects were undecided, and five architects said no. Architects were not asked if the ERG is appropriately

diagrammatic, but two architects commented that the ERG is more words than graphics and a quick glance at the ERG reveals this.

Each of these criteria relates to the content and presentation of the ERG and more will be discussed in greater detail under this section. But in general, the ERG falls short on meeting the five criteria. The content and presentation of the ERG needs to more completely match how architects think and work. According to Powell and Nichols, "In such technical/scientific documents, designers feel that little regard is given to the nature of how information is used in design when the majority of problem situations are dealt with quickly, parsimoniously, and almost unconsciously on the basis of past experience; this prestructuring is a powerful inhibitor of change" (Powell and Nichols, 1981, p. 309).

Architect's motivation

When HS•HK and HS•LK architects adopt the approach of healthy and sustainable architecture, they are personally motivated to order the Guide and apply the information it contains. LS•LK architects will require an external mechanism to motivate them to make use of the ERG. While they are concerned about the environment, they are not personally motivated to implement measures in their work. LS•LK #4 said he has too many other pressing issues and deadlines to meet without also spending time trying to implement designs that respond to these issues. "On a day-to-day basis, there are too many real world problems that have to be solved. This seems like the kind of thing you could put off." Later he said, "We got by without it (the ERG) before and now it's here — we still can get by without it. If it had very specific information in it where if we didn't do something it would be of a catastrophic nature, then we would make time to look into it." LS•LK #5 said, "There's a lot of pressure within the field to make money and you have to be very committed to add this information. You'd be working overtime and unpaid."

Financial incentives motivate architects when they recognize an opportunity to use this approach to help build a new client base. According to HS•LK #1, "I also see it becoming a huge marketing tool for offices. We're getting a lot of calls from people saying, 'we want to do this.' They (these architects) see a potential market and want to find out if it's really true."

Chapter Six: Conclusions

Summary of findings

The fifteen architects this researcher interviewed revealed a wide variety of content and presentation issues associated with using the AIA's *Environmental Resource Guide*. The tables on the next two pages are a compilation of the issues about which the architects felt strongest.

The primary content finding is that the ERG needs to be better oriented to the practicing architect. It needs more technical, specifying, and product information. It also should be more geared to a wide variety of job titles and responsibilities. The second comment finding relates to the main focus of the Guide, the building material section. Architects either thought cradle-to-cradle analysis of a building material would promote better use of materials or that it was not useful information for day-to-day decision making. The third finding is that the materials section needs an evaluation methodology in order to allow architects to make use of the detailed information provided. Without this evaluation component, the information, according to the interviewees, is not useful. The predominant finding on the presentation of the ERG from all architects was related to the Guide's organization. According to the sample, the organization needs to match the design process, separate journal and handbook functions more clearly, and determine which function the Guide intends to serve.

Future research

As more architects subscribe to the Guide, more architects may be using it for specific projects. A limitation of this research study was the small sample of architects who subscribe to the Guide and were applying the information to their work. A larger sample of architects who have used the Guide for a specific project would provide opportunities to examine in more depth how and when the Guide is used for a specific project. Future research could study what specific changes were made in the respondent's projects as a result of using the ERG. Findings from this research could advise ERG editors about the exact information that is useful to practicing architects. A larger sample of architects also suggests the possibility of using a different research methodology such as a self-administered questionnaire.

Table 4.1—Architect's Very Strong and Strong Comments

	Content	HS•HK 1	HS•HK 2	HS•HK 3	HS•HK 4	HS•HK 5	HS•LK 1	HS•LK 2	HS•LK 3	HS•LK 4	HS•LK 5	LS•LK 1	LS•LK 2	LS•LK 3	LS•LK 4	LS•LK 5
U	**It needs more technical information to specify.**				•											
U	**I think they should list positive (environmental) products**				•											
U	**I need to know spec information, such as criteria for building materials to meet ANSI and ASTM standards.**							•								
U	**Information in the ERG that does not impact my job immediately, I overlook.**												•			
U	The ERG does not address everyone (all job titles) in the architecture profession.					•										
U	It's not technical enough.						•									
U	I wish the Guide had more specific information, such as products and solutions.										•					
U	It is more helpful when the ERG tells me a solution I can use rather than just presenting a problem.											•				
U	It's too full of words.															•
U	You're really asking architects to look at a problem rather than a solution.															•
M	**You need to have this background on materials to understand the damage that is done to the environment.**				•											
M	**Indepth material information is good, understanding their origin and disposal might encourage better use.**				•											
M	**The Guide helps to understand what the rules (critieria for evaluating building materials) are.**						•									
M	**I enjoy the background information (on building materials), but the practical information is more useful.**										•					
M	I'm glad to see good indepth material analysis from cradle to grave.					•										
M	I'm not going to refer to the mining and manufacturing background on a material such as aluminum and steel .							•								
M	If it had more materials I might use it.													•		
E	**You can have all the facts in the world but if you can't evaluate them where are you?**	•														
E	**The Guide lacks a methodology in which to evaluate building materials.**		•													
E	**Architects need to have short and long term cost information to justify environmental decisions.**				•											
E	**ERG has indepth information on steel, paint etc but how do I look at all materials that go into a building?**														•	
E	You've got to take that data and put it into a total building analysis.					•										
C	**The ERG doesn't give you the full picture.**						•									
C	The Guide doesn't get at big picture issues, like what's the size of an environmentally sensitive house.								•							
S	**The Guide is a record of the state-of-the-art, but the state isn't high right now.**														•	
SP	**It's so full of information that it lacks a sense of spirit.**	•														
A	**The whole text raised my awareness of all the issues by giving me an overview.**														•	
I	**It's (the ERG) a good start.**				•											

Table 4.2—Architect's Very Strong and Strong Comments

	HS•HK					HS•LK					LS•LK				
Presentation	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
O **The Guide has a very understandable format.**	•														
O **I had the most problem with the organization; I didn't sense there was an overall structure.**			•												
O **The information doesn't follow the design process, from preliminary planning through construction.**					•										
O The Guide is a combination of journal and handbook, but neither one.		•													
O The opinion pieces and information should be separated from the technical information into their own section.		•													
O I suggest they organize the Guide according to the CSI 16 division format.					•										
O The organization is episodic.															•
AC **CSI numbering isn't as helpful as the name of the material, preferable on each page.**							•								
AC I'd like a checklist where I can go through it to see if I've hit every aspect.														•	
G **The ERG is too difficult to read, the type is too small and dark.**					•										
G **Visually it was all the same.**	•														
T **If it could be tab-oriented, something that makes the manual easier to use, insert info, and browse.**												•			
T **I'd like to see materials treated as a separate tab.**					•										
R **A lot of the material was repetitive.**	•														

Responses to Specific Y/N Questions	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Does the format and content accommodate a limited amount of time?	U	Y	N	Y	Y	U	N	N	Y	Y	Y	Y	Y	N	N
Does the ERG instill confidence in you to make decisions and recommendations?	N	N	Y	N	Y	N	Y	Y	Y	N	U	Y	U	Y	N
Would you have liked to have spent more time with the ERG?	Y	Y	Y	U	N	Y	Y	Y	Y	Y	Y	U	U	Y	U
How many hours have you spent with the ERG since I provided you a copy or since you subscribed?	5	10	5	1	24	8	.5	10	20	40	2	2	2	2	16

Table 4.3—Architect's Very Strong and Strong Comments

Key

U= Usefulness to Professional Practice
M=Building Material Section
E=Evaluation Methodology
C=Conceptual Information
S=State-of-the-Art
SP=Spirituality of the Guide
A=Raised Awareness
I=It's a Good Start
0=Organization of the Guide
AC=Accessing the Guide
G=Graphics of the Guide
T=Tabs Between Sections
R=Repetitive

Dark pattern indicates that subjects have used the guide for specific projects. 

As the Guide grows, adding more articles, case studies, and building materials reports, future research should focus on the effectiveness of the Guide. Specifically, research should identify which section is the most useful, and within each section, which article, case study, and report was the most useful and why.

As previously discussed, the present research study used Everett Rogers' diffusion of innovation theory and his four elements of diffusion. One element, the social system, was particularly useful in this research study and as a result many issues were exposed. Future research could study the design and construction social system in more depth. Specifically, building material manufacturers and the national organizations of allied design professionals and the construction industry could be surveyed to identify and assess their environmental initiatives and concerns.

Conclusions

Many obstacles retard diffusion of the AIA's *Environmental Resource Guide* and healthy and sustainable design into the architectural profession. Some obstacles are inherent to all innovations, and some relate specifically to written information and an architect's motivation to access written information. Still larger obstacles relate to the rate of adoption and support of the social system.

To bring more architects into the circle of sustainable design practitioners, many forces must be engaged and/or strengthened. In general, more education, economic incentives, and government regulation are necessary to institutionalize sustainable design. The following discusses the obstacles and suggests recommendations for how these obstacles can be overcome.

According to Rogers the newness—a characteristic of innovations—of sustainable design negatively impacts diffusion of the ERG. Although some practices are timeless, a sustainable design approach is new to most architects and other professionals. Allied design professionals and the construction industry are not fully educated about sustainable design measures and what role their professions play. Some design solutions and procedures are not fully developed, sanctioned and ready for codifying.

The content and presentation of the Guide has been discussed at length in this

research study. To improve the quality of written information for architects, publishers and ERG editors should consider the findings of this research study when planning and preparing documents for practicing architects.

But even if the ERG was more precisely geared toward the information needs of practicing architects, a fundamental obstacle associated with architects' use of information still would retard diffusion of the ERG. Studies on architects and their use of information have shown architects access information as a last resort to resolving a design problem, if at all.

There is also the larger obstacle of an architect's motivation to access the Guide and apply information in it to their work. Very committed architects educate themselves about sustainable design practices, stay current on new developments and raise these issues with clients. Uncommitted architects, and those not yet exposed to a client interested in sustainable design, will not access the Guide or apply sustainable design measures to their work. According to Powell and Nichols, these architects will be motivated by financial incentives, clients, and legislation (Powell and Nichols, 1981, p. 309). These motivators will be discussed at more length later in the discussion about the ERG's social system, but first it is necessary to ask how can the AIA's communication channels be improved to increase diffusion of the ERG?

Communication Channels

More mass media exposure is necessary to reach early adopters who are interested in healthy and sustainable architecture but have not heard of the ERG. *Memo* should be used to increase awareness of the ERG since this was the most common source available to all groups who had heard of the ERG. This author also suggests the AIA use the national, institutionalized mass media communication channels of other units of the social system, such as government agencies and allied design professions to network and diffuse the ERG. Announcements and order forms for the ERG should be published in ASID, ALA, CSI and other newsletters, for example, since these professional organizations and members may benefit from the articles and information on site planning and interior building materials.

Based on Rogers' research on communication channels and adopter categories, AIA interpersonal communication should target early majority, late majority and laggard architects. The content and presentation of the lectures by Robert Berkebile, Susan

Maxman and other representatives of the AIA should raise awareness about the relationship between architecture and the environment thereby encouraging early majority, late majority and laggard architects to experiment with small measures in their projects.

Another interpersonal communication channel the AIA should implement, suggested by a HS•HK architect, is sending editors and EPA representatives on a promotional tour, similar to the process conducted by book publishers. Architects who were interviewed wanted to know who wrote the Guide and where the information came from. Personally hearing how the ERG started and the AIA's relationship with the EPA might legitimize and encourage architects to adopt it for use.

This author suggests strengthening the role of local chapters by establishing or supporting a Committee on The Environment to promote the ERG and sustainable design. One benefit of the local setting is that it allows architects to interact with colleagues with whom they can identify. An effective means of change is when each member of a category sees someone like themselves change. According to Rogers,

> ".... most people depend mainly upon a subjective evaluation of an innovation that is conveyed to them from other individuals like themselves who have previously adopted the innovation. This dependence on the communicated experience of near-peers suggests that the heart of the diffusion process is the modeling and imitation by potential adopters of their network partners who have adopted previously" (Rogers, 1981, p. 18).

Smaller group settings available in chapters may be effective in persuading potential adopters if they hear directly about the interests and experiences of their colleagues. It also allows them to clarify or obtain additional information. Another benefit of strengthening the role of the chapter Committees on The Environment is that it establishes future support at the local level should national leadership fade.

Local Committees on The Environment can be established by motivating chapter presidents or local change agents to start a Committee. This author suggests using the ERG subscriber list for potential members. The Committee can organize speakers, classes, and other interpersonal communication channels to raise awareness about the ERG and sustainable design. Strong programs are needed to link potential adopters to the ERG. These programs can perform a basic yet important role in raising awareness. As previously mentioned, the group theme for LS•LK was that the ERG raised their

awareness and for one LS•LK architect it made her think about the cumulative effect of the construction process and building operation on the environment.

Another interpersonal communication channel this author suggests is setting up a ERG book display at local chapter offices. The ERG needs more exposure. A book display will let architects page through the ERG personally and this may help them decide to subscribe. Each local chapter should have plenty of copies of the ERG available for architects to buy.

The mass media communication channels of local chapters should also be stronger. Only one architect heard of the ERG through their local AIA Chapter newsletter.

Social System

The following section offers recommendations for how the members of the design and construction social system, which directly relate to diffusion of the Guide, can better support diffusion of the Guide. This section also offers recommendations for how members of the social system can support the general concept of healthy and sustainable design.

Clients are in a pivotal role to retard or support the application of healthy and sustainable measures in buildings. In a client-architect relationship where the client is less commited than the architect, architects could raise these issues with clients, educate them about the environmental issues and design solutions, and be well versed on arguments that convince clients to invest in measures that have long-term energy conservation and environmental benefits.

Conversely, in a client-architect relationship where the client is more committed than the architect, architects need to shake skepticism based on the idea that environmental issues are just a holdover from the 70's. Environmentally sensitive approaches in the 90's include issues such as pollution prevention and material life-cycle analysis in addition to energy concerns. Architects, as well as other professions and industries, should consider adjusting and expanding their way of thinking to include new issues and new ways of addressing environmental problems.

To some sustainable design experts, however, most architectural firms will continue to follow a general trend of specialization and use consultants as needed to meet a

client's sustainable design objectives (Haas Smith, 1995, p. 26). Environmentally committed architects, they believe, will probably remain a small percentage of practitioners. Furthermore, the current market for sustainable design services appears to be small but growing. The clients that are interested in this approach are corporate, institutional, governmental, and non-profit groups where a commitment to the environment is part of their mission (Haas Smith, 1995, p. 26).

Each design discipline needs to identify and become more knowledgeable about the areas within their control so that they can contribute to the design and operation of buildings that are environmentally sensitive. The national organization within each discipline needs to establish communication channels to diffuse information about healthy and sustainable architecture to members. The ERG for example, which is comprised of many topics that relate to various disciplines, could be a valuable resource for allied design professions. Exposing the ERG to other professions would also help disseminate the Guide.

To diffuse the ERG into architectural practice the AIA can provide support through the provision of funding, personnel, and resources. The AIA should also support the efforts of change agents. The AIA needs to nourish new innovations coming into the field from individuals on the cutting edge — HS•HK architects. It needs to edit their materials, refine them into scientifically substantiated information, and orient their ideas to practice.

To support and develop the general concept of sustainable design, the AIA needs to provide overall leadership. The AIA can use its neutral, respected position to raise awareness and lobby for change among other members of the building social system. For example, using its leadership position the AIA can: encourage architecture schools to provide coursework that exposes students to these issues and design solutions; encourage utility companies to establish relationships with architects, and; encourage building material manufacturers to incorporate measures into their manufacturing procedures that are more environmentally sensitive. In general the AIA needs to actively foster and organize dialogue among all members of the building industry social system. This role would require the AIA to commit more personnel and financial resources that it may not have.

Architecture schools can promote sustainable design by providing more coursework.

Instructors should also incorporate environmental considerations, as they apply, to all courses. For some environmental issues, this approach, compared to specialized coursework devoted to sustainable design, may be more effective because it establishes a way of thinking. Environmental issues should be just another consideration equal to other decision making criteria. Incorporating a sustainable design approach into the curriculum however—in addition to requiring financial commitment for faculty and resources—may be perceived as a detraction or competition with the traditionally aesthetically driven architectural training.

Architecture departments could simply raise awareness by inviting "green" speakers to campus, creating a "green wall" that illustrates books, articles, conferences, and other resources, or setting-up a department recycling program. Environmental awareness and education does not need to originate with a school's administration and faculty. Through their school's AIAS chapter, students can initiate and organize programs.

The ERG is an ideal text for coursework that includes sustainable design issues because it: exposes students to the depth and breadth of issues associated with sustainable design; is a one-stop-source of articles and reports, and; provides an indepth bibliography for further research. Exposure to the ERG in school might increase the likelihood that the Guide will be accessed later in professional practice.

The construction industry needs to recognize the role it can play at the job site in waste management and indoor air quality. The construction industry needs to educate members and raise awareness about using materials efficiently, recycling wood, metals, cardboard and other waste, and salvaging materials in lieu of landfilling them. Currently the economic benefits of recycling varying from city to city and material to material. The construction industry also needs to educate members about construction practices that limit the amount of toxins such as airing out materials before they reach the job site.

Building manufacturers have an important role to play in diffusing the ERG and healthy and sustainable architecture. AIA staff and members need to lobby manufactures to alter how their products or materials are manufactured. This may be easier however, for some manufacturers than others and modifying procedures and/or installing equipment that lessens a company's environmental impact may be costly.

Many argue that environmental regulations make the US less competitive globally and cost jobs (Meyer, 1993, p. 12). Others argue that companies that invest in environmental compliance and emission reductions will never generate a positive financial return (Walley and Whitehead, 1994, p. 46).

The AIA and manufacturers also need to interact to make the Guide a more effective tool for practitioners and product information more compatible with the ERG. Manufacturers need to report changes they have made in how their materials are manufactured and present this information, in their marketing literature for example, using technical information that will enable architects to evaluate and compare products.

Government funding can help to diffuse the ERG, specifically through continued EPA funding. Other government funding is necessary to study the toxicity, environmental, and energy efficiency of products, develop new products and materials such as windows that are more energy-efficient, and support advancements in the state-of-the-art such as product evaluation methodologies. Current federal budgetary concerns however, may jeopardize government funding of such programs.

More than any other unit of the social system, government has the power to mandate change through regulation, and it appears this will be necessary to motivate architects and their clients. More national and state legislation is necessary to motivate architects, especially in the area of energy efficiency where technologies and procedures are more developed and there are economic benefits. For example, Title 24, California's building energy efficiency code, requires architects to design buildings that are energy efficient.

While government has the authority to mandate change, passing legislation that brings about change is difficult and complicated. Concerned that government environmental regulations have gone too far, the new Republican controlled Congress proposes cost-benefit analysis and risk assessment for rules with a total price of $100 million or more (Regan, 1994, p. 102).

Through tax-related incentives and disincentives, government can also bring about changes, such as the recently proposed BTU tax. This tax represents a new approach to taxation since it would tax "bads", like pollution instead of only "goods" like

income (Morris and Lewis, 1993, p. 13). While the BTU tax was innovative, and promised to be effective in raising revenue while encouraging energy conservation, it was quickly rejected by Congress and special interest groups, like oil producing western states, in favor of a more narrow transportation fuel tax ("Energy Taxes, Please," 1993, p. 9).

Many utility companies are using Demand Side Management (DSM) programs to help architects achieve energy efficiency in their building design. Pacific Gas & Electric's innovative programs and facilities sets an example for utility companies across the country. However a recent effort to deregulate utilities may jeopardize energy conservation programs for architects. Deregulation would introduce competition into electricity production, and to some, competition would undermine energy efficiency efforts that had been shielded from market forces (Passell, 1995, p. C1).

At a 1993 workshop at the AIA in Washington, a group of sustainable design experts and EPA futurists debated the future of sustainable design. Their ideas and recommendations included the need for more information exchange among professionals, more successful green projects, and tools for calculating life-cycle costs (Rejeski, 1993, p.3). These next steps, along with the contributions and support of all members of the design and construction social system, will help advance sustainable design efforts in the US.

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APPENDIX

Informed Consent

TO: Interview Subjects
FROM: Chris Hammer

1. I am a graduate student at Kansas State University.This is a research project for my Masters of Architecture.

2. I am evaluating The American Institute of Architect's (AIA) *Environmental Resource Guide*. (ERG). I am interviewing a wide variety of architects on their response to the ERG. My research is independent from the AIA.

3. The length of the interview is approximately 1 to 11/2 hours.

4. I will be asking a series of approximately 25 questions. The questions are divided into six sections: introduction, environmental resource guide format, presentation and content, architect's experience using the guide, project context, characteristics of the user architect, and summary.

5. I do not foresee any reasonable expected risks or discomforts to the subjects or others.

6. For some subjects who have not seen the ERG and are interested in it, they will have an opportunity to read the ERG and possibly add to their knowledge on this subject. For all architects I interview, my research provides a forum to share their comments on the ERG to the American Institute of Architects and the EPA.

7. There are no alternative procedures or courses of treatment.

8. I will be sharing my results with the AIA but the names of architects who are interviewed will be confidential. When direct quotes from architects are used in my thesis, architects will be referred to as Architect #1, for example.

9. If you would like to contact someone with questions on my research feel free to call my advisor Gary Coates, Department of Architecture, Seaton Hall, Kansas State University, Manhattan, KS 66506,913-532-5953. If you have questions about your rights as a subject feel free to contact John P. Murray, Chair, Committee on Research Involving Human Subjects, 103 Fairchild Hall, Kansas State University, Manhattan, KS 66506, 913-532-5510.

I,_____, agree to participate in this research study at Kansas State University to evaluate the AIA's *Environmental Resource Guide*. I understand that participation is voluntary and neither refusal to participate nor early withdrawal will involve any loss of benefits to which the subject is otherwise entitled.

ERG Interview Questionnaire

Introduction

Group A, B, C

- How did you first learn of the ERG?
- How much time have you spent with the ERG since I provided you a copy or since you subscribed?
- Would you have liked to spend more time with it?

Environmental Resource Guide format, presentation and content

Group A, B, C

- What do you think of the ERG format and presentation?
- What do you think of the topics that are covered in the ERG?
- What do you think of the case studies that are covered in the ERG?
- What did you think of the graphic presentation of the ERG, including diagrams and drawings?
- What do you consider valuable or ignore?
- Does the ERG instill confidence in you to make decisions and recommendations?
- Does the format and content accommodate a limited amount of time?

Architect's experience using the guide

Group A

- Could you comment on the ERG's ability to diffuse environmentally conscious architecture into the mainstream?
- Could you comment on the ERG as a communication tool to educate architect's on environmentally conscious architecture. Are there other methods that are more effective?
- How can this approach to architecture become more institutionalized?
- How can the system in which the ERG operates better support the guide's goals and objectives better? Such as the architectural schools, AIA, government, construction industry.
- Do you encourage clients to think about these issues?

Group B

- Have you used the guide for a specific project or client? If so, what was your experience in using the guide?
- Describe the process in which the guide was referenced. Quick answer to a question or reading whole sections at a time?
- What information was most useful?
- What information did you use at each stage of the design process?
- Do you encourage clients to think about these issues?

Group C

- Have you used the guide for a specific project or client? If not, why not?
- (If they respond it's too new and risky.) How can the ERG and/or the system accommodate this need?
- (If they respond it is too expensive.) What pricing would facilitate its use?
- (If they responded there are no clients requesting these services.) Would they use the ERG to expand their knowledge to apply measures that are inconsequential to clients such as particleboard? If not, why not?
- (If they respond this approach to architecture will upset the normal balance of their designing.) How so?
- (If they respond the information in the ERG is not practical and easily applicable.) How can the information be improved to meet this need?
- (If they respond there isn't enough project time to spend on researching and applying environmental and energy efficient measures.) How can the ERG or the system make this easier?
- (If they respond there are too many project or system obstacles for applying information from the ERG.) Such as?
- Could you give me three obstacles to using the guide?
- Are there some important issues you face that you would like the ERG to cover?
- What would motivate you to use the ERG?
- Is this a fad?

Project Context

Group A, B, C

- In your work experience what were the client constraints and opportunities that influence making environmental decisions?
- In your work experience what were the constraints and opportunities from the site that influence making environmental decisions?
- In your past experience what were the constraints and opportunities from the building type, that influence making environmental decisions?
- In your past experience what were the constraints and opportunities from consultants, that influence making environmental decisions?
- What were the constraints and opportunities from the government, that influence making environmental decisions?
- Any client, site, building type, consultant, or government constraints to making environmental decisions.

Characteristics of the User Architect

Group A, B, C

- What is your previous work experience and training?
- Have you had any coursework that addressed environment and energy efficiency issues?
- What are the personal, group, organizational, resource, and institutional influences within your firm that influence using the ERG?
- What other sources of information, if any, have you heard of green architecture, such as colleagues, magazines, industry, or the government?

Summary

Group A, B, C

- If you were asked to rewrite the ERG what would you change?
- What did you learn from the guide?