March 23 PANEL:
RFP RESEARCH AWARDEES
1 **Sherry Ahrentzen, PhD**
Arizona State University
2006 RFP Recipient

ACTIONABLE KNOWLEDGE:
A RESEARCH SYNTHESIS PROJECT FOR AFFORDABLE HOUSING DESIGN PRACTICE

Actionable knowledge for a profession reflects an integrated and comprehensive—yet always evolving—body of systematically-derived research that addresses use-inspired issues and practices, and that is used by practitioners and policy makers.

> **Evidence-based health practice means integrating the best available clinical evidence from systematic research with individual clinical expertise.** If we take our own selfish selves as examples, *when we visit a physician* we want to know that she is current on the latest medical and health research when considering our ailments. But we do not want her to simply treat us as a standard textbook case. We want her to consider our own individual situations, history, circumstances. We want her to work with us in deciding when best to apply medical research findings to our particular situation, and when not. A physician's expertise is reflected in the thoughtful identification and compassionate understanding of individual patients' predicaments, situations and preferences in making clinical decisions about their care. Indeed it is that expertise that determines whether the research evidence should be applied to the individual patient at all and, if so, how it should be integrated into a clinical decision.

The crux is *how to foster an evidence-seeking design culture.* That is a question I do not directly answer here. Here I attempt to address how to start building a foundation for *evidence-informed* practice within architecture and ADHP in general.

> Evidence-based design practices within the healthcare industry have made significant strides in the last decade. This is a different animal from the housing industry. But *evidence-informed* design does have its appeal to business leaders and public officials.

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Figure 1: D. Kirk Hamilton's 4 Levels of Evidence-Based Practice
(Adapted from Hamilton, 2003)

	ACTIVITY	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Interpret the Evidence	Read material to stay current on emerging research	★	★	★	★
	Use critical thinking to interpret implications of research on current project	★	★	★	★
	Collect success stories and historical data on completed projects	★	★	★	★
Hypothesize and Measure	Perform applied research as a practitioner on real projects		★	★	★
	Hypothesize intended results of design interventions		★	★	★
	Measure the results associated with design interventions		★	★	★
Share Results Publicly	Report unbiased project results in the public arena, writing and speaking			★	★
	Perform independent 3rd-party postoccupancy evaluations			★	★
	Improve understanding of research methods through advanced education			★	★
Meet Academic Standards	Collaborate with credible academic researchers and social scientists				★
	Publish research results in peer-reviewed journals				★
	Write academic thesis or dissertation on evidence-based design topic				★

A leading proponent of evidence-based practice, architect D. Kirk Hamilton details 4 levels of such a practice, each level representing an increasingly rigorous stage of commitment and methods (see Figure 1).

There is an implicit assumption in Hamilton's model that level one activity—reading the material to stay current on emerging research—is the easiest. But it can be most challenging. Research can offer complex and sometimes contradictory insights, demanding comparison, criticism, evaluative judgment and synthesis beyond simply reading a series of articles. Most professionals can hardly keep abreast of new research developments.

The Stardust Center for Affordable Homes and the Family is a new community design and research center at Arizona State University whose mission is to serve the needs of organizations, neighborhoods and professionals in creating quality homes in vibrant, sustainable communities. One undertaking currently under way is the Research Synthesis project. The methods and procedures for this come from health care, health policy and management professions. In the scientific community literature, traditional research reviews are a standard practice of summarizing research. Yet these traditional reviews often lack transparency in how the researchers identified and collected the evidence to include in their publications. And they often lack a use orientation.

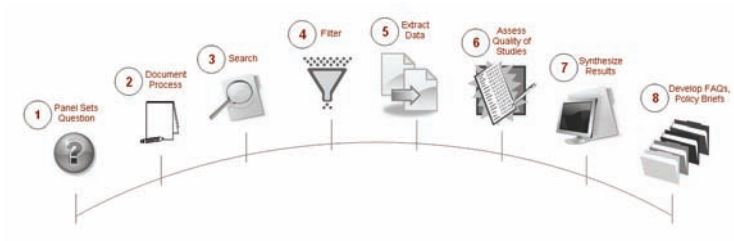

Figure 2: Steps in the Research Synthesis Protocol

RS is a carefully crafted, systematic, and effective methodology stressing transparency of process. We characterize RS as a review of a clearly formulated question that uses systematic and explicit methods to identify, select and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review. Results are summarized in: (a) one-page FAQ-oriented overview; (b) two to three page summaries (or briefs), with both graphic and narrative description; and (c) a technical report that provides more detail of the process and individual studies that form the basis of the synthesis. Our process consists of 8 steps described below and outlined in Figure 2.

1.1 Panel Establishes Use-Inspired Research Question

Potential Research Questions for Research Synthesis

- Under what conditions does affordable housing impact (positively, negatively) surrounding property values?
- What type of inclusionary zoning policies, and within particular economic and housing contexts, result in significant increases in affordable housing units for households working in the area?
- What aspects of housing quality and design impact children's health and development?
- What aspects of affordable housing impact children's educational performance?
- Under what conditions (e.g. socio-economic; site, building and unit design; cultural) does higher density affordable housing affect crime and safety?
- What aspects of housing quality and design impact (negatively, positively) household stress?
- What are the most successful ratios of market-to-affordable units in a mixed income development (MID) that result in positive social interaction and sense of community?
- What important site, design and equipment (e.g. playground) features in MID result in positive social interaction and sense of community?
- What are the costs and benefits (to residents, to neighborhoods, to community) of accessory units?

1.2 Filtering Studies Using Eligibility Criteria

Inclusion and Exclusion Criteria for PV Issue

Excluded:

Published before 1995 (21 of the 105)

Does not reflect primary research study or literature review (e.g. newspaper account of a research report; annotated bibliography) (22)

Excluded from Synthesis but Retained for Other Purposes:

For later reference check of synthesized results (12)

Of specialized housing types; may be relevant to a future research question or sub-question (e.g. nursing homes; trailer parks; supportive housing for special populations; mixed-income) (12)

Included for Synthesis: (38 of the 105)

Published in 1995 or later

Primary research article/report

Affordable housing characterized as either: public housing, tax-credit rental development, affordable housing, federally assisted housing, low-income housing (subsidized or non-subsidized)

Can include new developments; rehabs of existing developments

Study needs to examine at least one of the following: sales price, appraised price or other property value information of surrounding property

1.5 Reporting

These are to be web-accessed reports. Since the revised Stardust Center web site will not be available until late June or early July, an example of a one-page FAQ from EPPI is shown here, indicating the type of formatting we will use.

Figure 3: Screen Shot of FAQ (Introduction) Page from One of EPPI's RS Projects

Investment in high-performance, sustainable building design and technologies is limited by first-cost decision-making. In our collective enthusiasm to define and promote sustainability, we may be making two fundamental errors: first, broad "motherhood" definitions of sustainability, and second, arguments that green design need not cost more.

Environmental designers often argue for broad sustainability objectives without further detail, as expressed in the AIA/UIA declaration of Interdependence for a Sustainable Future "Sustainable design integrates consideration of resource and energy efficiency, healthy buildings, ecologically and socially sensitive land-use, and an aesthetic sensitivity that inspires, affirms and ennobles." However, investors and clients will need to understand the specific quality differences of sustainable design alternatives—component by component—if they are to move beyond least-first-cost decision making. Imagine selling only "mobility" with cars ranging from $10,000 to $30,000. Every 'investor' knows component by component the quality differences in the two cars, including life cycle benefits, and typically invests in the higher cost product to purchase performance qualities. Imagine selling only "computational capability" with laptops ranging from $1000 to $3000. Again, the computing industry has made quality differences in even the most hidden infrastructures in laptops evident to the customer, leading to higher quality purchases. The genius of LEED™ certification from the U.S. Green Building Council2 is that it defines sustainability in 69 more defined goals, giving the client the opportunity to qualify a greater investment of expertise or capital in their buildings.

Sustainable design is a collective process whereby the built environment achieves new levels of ecological balance in new and retrofit construction, towards the long term viability and humanization of architecture. Focusing on environmental context, sustainable design merges the natural, minimum resource conditioning solutions of the past (daylight, solar heat and natural ventilation) with the innovative technologies of the present, into an integrated "intelligent" system that supports individual control with expert negotiation for resource consciousness. Sustainable design rediscovers the social, environmental and technical values of pedestrian, mixed-use communities, fully using existing infrastructures, including "main streets" and small town planning principles, and recapturing indoor-outdoor relationships. Sustainable design avoids the further thinning out of land use, and the dislocated placement of buildings and functions caused by single use zoning. Sustainable design introduces benign, non-polluting materials and assemblies with lower embodied and operating energy requirements, and higher durability and recyclability. Finally, sustainable design offers architecture of long term value through 'forgiving' and modifiable building systems, achieved through life-cycle instead of least-cost investments, and through timeless delight and craftsmanship.

I co-direct the Center for Virtual Architecture where we do research in three different areas. Learning environment, responsive architecture, and situated technology. My involvement is mostly in the area of learning environment. I'll be talking about the projects that I've done in that area.

I received the AIA award as I was finalizing a project entitled *A Comprehensive Approach to Learning Structures by Using Advanced Media.* The project goal was to harness the capability of state-of-the-art digital tools such as dynamic modeling, animation, and graphic media to help students in understanding the fundamental principles and practical aspects of structural technology and design.

The first project was to demonstrate that advanced digital media could be utilized to develop learning environments that not only better meets the need, but improves the understanding and mastery of the subject. The second objective was to develop and implement an evaluation procedure that measured the changes in the student performance in application of structural concepts during the design process. The project outcome relied heavily on visualization techniques to convey structural concepts.

The project evaluation showed promising rewarding results, which were published in the AIA 2005 report and university research. Although the project had a certain level of interactivity, by the time of its completion six years later the technology had advanced to allow much more. And there were a few nagging questions that kept me thinking. How comprehensive was this project in reality if it only looked at the structural issues of the building design? How responsible was the project if it didn't look at the larger issues of sustainability when buildings are responsible for 40 percent of energy consumption in United States. And then, would the students use this tool if they were not, if they were not obliged to or that, it was not a part of their coursework?

In trying to answer some of these issues, the AIA Award provided me a chance to take the project to much larger scale. Using the AIA fund I was able to put together a small prototype software that dealt with systems integration architectural design leading to a funded project entitled Building Literacy. Actually then the rest of the title is The Integration of Building Technology and Design in Architectural Education.

Like the previous project, this project was funded by US Department of Education, the Fund for Impairment of Post-Secondary Education. The premise of the project is that the sustainability in design is closely related to the integration of building systems in which various design and construction elements work together to allow synergetic benefits to be realized. Therefore, improving the building performance beyond the impact of each individual system. The project aspires to teach that structural and environmental systems such as lighting, electrical, plumbing, heating, cooling, ventilation, and construction systems are interrelated and are integral part of progressive practice of architecture. By doing this, the project aims to address the problem with the traditional architecture curriculum, which is based on a schism between design and technology education.

This structure is inherently in conflict with the principle of integration. We understand that large-scale reform of architecture curricula is a complex, ongoing, and difficult debate. By attempting to develop learning environments that can simulate the practice of integrated design, we could impart students with an understanding of how integration can happen.

Therefore, the specific objectives of the project are to teach the concept of integration and integrated design by first immersing students in a virtual environment that imitates the complexity of the real-world collaboration, decision making, and material choices in design. And second, creating compelling and rewarding reasons for student's engagement and the learning process.

The project mode of delivery is a simulation game that is based on engaging the students in a scenario driven design project that makes the case for sustainable development. These scenarios will take on a variety of ecologic and economical issues such as squandering natural resources, fuel costs, decline in water, air and soil quality, volume of waste and climate change.

The premise of the game revolves around the user, playing the role of an architect is very similar to the real-world experience and challenges facing architects today. Each scenario will lay a case for meeting a budget; completion deadline; and balancing the demanding requirements of site, context, building systems, selections and construction types, energy and climate control, and lighting systems.

Each scenario takes the students through a series of choices, advanced tours of building design, to press forward the systems integration and sustainability agendas. The game engine will provide a mechanism for rewarding the selection of compatible systems and penalize when selective systems do not integrate efficiently or inherently or are incompatible.

The selected choices will be stored in a library of two, within the gain structure ready for the design stage. In the design stage the students can work with the selected two and will have the series of available formal possibilities to organize the massing of the project. The project is scheduled for completion in January 2010.

In closing I would like to say that both of these are not single-person projects. There is a large group of people who are collaborating to make this happen. Especially the second project. There are 15 faculty and various professionals for helping me to develop this.

I am Mike Martin. I'm actually a faculty member at the University of California at Berkeley and one of three recipients of the 2005 Latrobe Award. I will talk a little bit about the Latrobe research piece in just a moment. But before I do that, I wanted to say that I established something at Berkeley called the Design Practice Group. It's actually a group of graduate students and two other faculty members who are really focused on the issues of trying to make a kind of a connection between the Academy and practice in a research kind of format. And we're really interested in this from the standpoint of design as the kind of spine around which this is actually developed and as soon as you do that, you know—I already had two people here in this room ask me a question about the concept of whether design is really something that has research connected to it.

And obviously my answer is yes, but I think this is one of the major questions that we have to somehow grapple with. And it seems to me there are kind of two paradigms that we operate within, in most schools of architecture today and with most faculty when we think about design. I will frame this pretty simply; with the seven minutes I have I can't really talk about it in any great depth.

Design is research. Okay, the other major paradigm is design as research. And they're quite different. I think it comes back to something that Matt talked about, and it has to do with the issue of how you frame the questions. And then this is also, I think, related to another kind of set of the way in which we look at knowledge production in relationship to the kind of larger context that we're a part of. Basically, I think in the academic community and in the professional community as well when we think of knowledge production we think of it basically from kind of an experiential base and from our kind of predecessors of the kind of apprentice master model where you learn about your profession through experience.

And the knowledge that's connected with it is really tacit. That it's not formal in the sense that, that we might think of. The other way we might look at this is what has been mentioned a couple times already, this notion of evidence-based or very explicit kind of knowledge that we somehow look at this as testable and verifiable that it uses much of the kind of scientific method that has been already talked about.

Now, the two projects that I'll speak about specifically in relationship to the research is the 2005 Latrobe Fellowship which was actually a project to develop a research model for design through collaboration and a trans-disciplinary, in a trans-disciplinary context. It's about creating evidence for evidence-based design. And it was really based on the assumption that if you brought together the kind of three partners that had ownership to a specific kind of framing of a research question that that would enhance the possibility of reaching outcomes that would be meaningful to all of the constituencies.

The three constituents were an architecture firm, Gordon Chong Partners in San Francisco; Kaiser Permanente one of the largest healthcare delivery systems in the United States; and the University of California at Berkeley. And this was obviously done to try to integrate an understanding of these three voices and how you bring this different language from these three voices into a research kind of setting.

The project itself is ongoing. We're officially finished with the project in July. I hate to tell you this, but it's not going to be finished in July. We knew that going in. We're going to have results obviously from the Latrobe by July but we knew it was an ongoing project. There are kind of three pieces to the Latrobe Project.
The first is a natural experiment, the natural, what we call the Natural Experiment and it's really looking at room attributes in healthcare settings in relationship to patient outcomes and it's really done because of Kaiser's capacity. We have access to more than 350,000 patient records in 30 different hospitals around specific room attributes that we'll look at.

And I'm not going to go into the detail, but the analysis here has to do with looking at kind of outcomes, specifically those related to length of stay around light and sound as attributes in patient care. And also then looking at this across a variety of diversity of populations. If you look at the population of the Kaiser Permanente healthcare, they have to have 47 different languages to address the patient care within their hospital system.

The second piece of this project is an intervention where we're actually doing an intervention to a space and looking at the psychological response to certain kinds of changes in relationship to light and sound in a space and actually taking EKG and other kinds of cortical measurements and so forth to look at this to and again both of these, both of these pieces are intended to be for the purpose of producing evidence.

And then the third piece of the project is basically the model itself, of trying to come forward and says this is a model through which research can be done in a collaborative setting between a research community, a client, and also then the profession itself. The second project that I'll talk about has to do with something that I've been working on for several years called Building Stories.

It came out of the case study work earlier with AIA but it's research project I entitled Building Stories Knowledge Production in the Wild and, again, it's one of these collaborative projects between the profession and the academic community that is trying to actually look at active cases in relationship to projects that are going on in offices and this came about because one way of looking at research is to look for new knowledge.

Okay? And there's a process that leads you to new knowledge. My hypothesis was that there's already a lot of knowledge that actually exists in the profession. And that we ought to have a mechanism for actually capturing that knowledge as opposed to just letting it evaporate project by project and so the process of Building Stories was connected to that. We now have about 30, what I call stories. They're not comprehensive cases.

It's really based on the knowledge, on the process of narratives or storytelling. It actually integrates into a team structure students, recent graduates from architecture schools, and seasoned professionals on active projects. And it's actually a Web-based kind of format so that one can keep adding stories to this. Where we are in relationship to the research, we're actually now in the process and getting very close to having a search engine to be able to go into these case studies, each of these stories find a kind of the connection between the stories.

And so you can begin to use key-word structures to look at kind of pieces of the actual stories that are there and begin to have that as an informant or evidence to bring to evidence-based design. And in conclusion, I just want to mention four things. First, I think one of the big challenges for this group is that we need to find ways to integrate this evidence into practice.

We have a tradition of research but most of it never gets to practice. We really need to focus on the notion of the collaborative model that integrates the kind of academic community, the profession and the client and others who have vested interest in what we do. There's a major issue in relationship to the streams of funding and then I think we really need leadership commitment about, from the profession, from the academy, and from the kind of others who have a kind of interest in this.

Because I actually think we're really in our infancy and after Matt's presentation I'm absolutely convinced we're in our infancy in relationship to the academic community and I think that is actually even true in the profession in relationship to having research as a major kind for piece of our agenda. So, thank you.

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5 **Mir M. Ali, PhD**
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2006 RFP Recipient

I'm with the University Of Illinois at Urbana-Champaign. I work in different areas of research, tall buildings is one of them. I got this award from AIA as the principal investigator and there is a co-investigator. He is a colleague of mine. We also have two research assistants working with us. Also I have a doctoral student who works in a more or less allied area for her dissertation. Her work is not exactly the topic of the research, but is in a way related.

The topic of the research was an investigative study of integration of physical systems in sustainable tall buildings. We have looked at the issue of sustainability and integration jointly, how we can apply it to tall buildings. Now tall buildings consume a lot of energy as you know. They are in a way particle cities in the sky so when we talk about cities, we cannot isolate tall buildings.

We talk about sustainability in many areas; sustainable cities, sustainable buildings, sustainable agriculture, sustainable development and so on and so forth. So I don't have to go into details of that. Basically the focus of sustainability is developing alternative strategies for energy production and conservation, as well as wise and prudent use of renewable resources, and then finding or designing environmentally friendly buildings. Of course incorporating intelligent building systems to sort of automate all these different aspects of tall buildings is included.

Now in terms of integration, of course, the components have to share space. Arrangements have to be made so that for an architect they're kind of esthetically resolved and they must work together, not compete with each other. So, what we have done basically, we focused on couple of areas.

One is development of an integration web. We got the idea from the Food Web in the food sciences, a disciple, and the food. The integration Web is basically a diagrammatic or graphical representation of all the components of a tall building. That also includes sustainability issues. And to sort of show the linkage between all these components so that we can say that this item is related to that and that item is related to that. So it's a chart. And we also found this interestingly in the, the aircraft industry. Of course, their charts are very complex. But we learned a lot from their industry as well.

Now there are many physical systems in tall buildings, just as in any other building. These basic systems are architectural systems, structure, mechanical systems, plumbing and electrical. And of course, there are many subsystems. And we can sort of compare them with our body, human body. For example, the façade is like the skin. The structure is like the skeleton. You know, the, the heart is like a pump. The blood circulatory system is basically related to plumbing, and plumbing system has a lot of pumps also. The electrical system is more like our nervous system. The way we function every system is dependent on the other and each system is important and we are basically very, very well integrated. So likewise, we looked at tall buildings as a very integrated system. So the integration wave was the first thing and the second thing was technology transfer.

We studied the aircraft industry and also the automobile industry just to see what we can learn from them because those systems are also very complex. Especially the aircraft industry and we learned a lot about the aircraft industry definitely. We also looked at few other areas like nano technology, and we are still working on that. Of course we also incorporated the intelligent building systems. Which are as you know, getting more and more popular as we are in a computer era right now. And it's getting better and better, more and more pervasive. So, in terms of intelligent buildings we look at structures, facilities, automation and control systems, services and who are the users and of course the building management system which is the BMS.

We also look at basically the maintenance and performance of tall buildings. Additionally we also looked at couple of case studies and the buildings we chose are Swiss Reinsurance Building in London, Petronas Towers in Kuala-Lumpur, Conde NastBuilding in New York and Solaire Building in New York. Now we spend more time on the Conde Nast and the Solaire Building in New York. Of course we got a lot of information as well because they are here. We found that, for example, in Conde Nast, there is 40 percent less energy required because they have the sustainability features in them and of course, many of the systems are well integrated. So we are continuing on our research and right now we are developing a matrix of different systems and components and also the components versus the functions and to what degree they participate with each other.

Sometimes the relationship is minor, sometimes it's major. Sometimes it's kind of in between. So we are looking at it a bit more closely and finally, integration is a phenomenon. It's an art. It's not really directly dependent on time. However, it's related to time because as we integrate our design we have to go through the design process and therefore there is a sort of process of integration. So we are looking at something we call critical integration process which is time dependent.

We are trying to sort of digitize it, develop some software so that it will be useful for practitioners in terms of project management like scheduling of meetings, eliminating communication delays, expediting integration process work flows, finishing projects on time, etc. And then it will meet the challenges of tall building design facing increased complexity and limited resources. So we are still continuing on that and we hope to continue longer on that.
Thank you.