Bridging the Physics of Building with the Physiology of Health Care

GREENING HEALTHCARE FACILITIES

ROUNDTABLE

This report was authored by Andreas Phelps, Michael Horman, Marcia Barr, Justin Brower, David Riley, Jorge Vanegas, and Annie Pearce. It was prepared in connection with the research project "High Performance Healthcare Facility Design and Construction" being undertaken jointly by University of Pittsburgh Cancer Institute and Penn State University for the Mascaro Sustainability Initiative. More information can be found at www.leanandgreen.org and www.engr.pitt.edu/msi/.

Lean and Green Research Initiative, 104 Engr. Unit A, Penn State University, University Park, PA 16802

EXECUTIVE SUMMARY

On October 26-28, 2005, in Pittsburgh, PA, key members of the building industry, green design community, healthcare industry, academic institutions, and government agencies gathered in a targeted dialogue to consider the feasibility of forming a consortium to improve how healthcare facilities are planned, designed, constructed, and maintained. The roundtable formally documented:

- The principal **drivers and expectations** of the participants in the roundtable regarding the event;
- The **instinctual, emotional, and intellectual reactions** of the participants in the roundtable to the greening of healthcare facilities; and,
- The **strengths, opportunities, and challenges** posed by the greening of healthcare that were identified by the participants in the roundtable.

Three areas of consensus emerged clearly from the discussion: (a) All participants supported the formation of a consortium focused on the greening of healthcare facilities; (b) All believed the mix of expertise will make this consortium unique; and (c) All believed that the development of a shared research agenda among the building industry, healthcare providers, and academia is vital.

The proposed greening healthcare consortium envisions: (1) Providing a network for sharing existing research and findings related to greening of healthcare facilities; (2) Facilitating collaboration between healthcare projects, current research, and hospital performance data; and (3) Providing an informed basis for healthcare design and construction decision-making. Based on input from the roundtable discussions, eight research thrusts were identified that the proposed consortium would be ideally positioned to address based on the competencies and positions of the members. These eight research thrusts are:

1. **Relationship between facilities and clinical outcome:** Research the dynamic relationship between the delivery (planning, design, and construction) of a facility and two types of outcomes: facility outcomes in terms of operations and maintenance, and clinical outcomes pertaining to patients and quality of healthcare. The consortium should conduct fundamental research to understand this relationship, and establish causal and correlative links between facility attributes and health outcomes. This will lead to basic knowledge on the interactions between clinical outcomes, facility performance, and operational effectiveness, and enable superior facility delivery practices to be developed.
2. **Cost-value relationships regarding green building:** Establish relationships between cost and value, and direct/indirect/externality costs and how they relate to green facilities.
3. **Basis for decision making:** Determine how green decisions are made throughout the facility delivery process, esp., those that seem to have no formal and explicit basis, and how decisions can be made in order to maximize their outcomes.
4. **Data repository:** Compile the growing body of embedded data, knowledge, and experience within organizations in the green industry. The consortium can become the repository for this information in a way that makes it useful for others. It should be responsible for the assembly, storage, and use of this data, and establish feedback loops for future data acquisition and analysis.
5. **Active and passive research methods:** There is a set of both active and passive activities that can be undertaken to perform research in healthcare facilities. Passive activities involve collecting data from existing facilities through measures of current performance. The active activities involve using healthcare facilities as experimental testbeds for new facility means, methods, and approaches.
6. **Interdependencies:** Investigate the correlations, conflicts, synergies, and tradeoffs between and among environmental, facility, and health goals, objectives and outcomes. Position the consortium to identify, exploit, and balance these to achieve desired outcomes.
7. **Waste:** Develop methods to minimize waste during the facility lifecycle pertaining to the facility and associated delivery processes as well as product waste associated with the operation of the facility.
8. **Implementation of research:** Going beyond basic research to understand and reinforce the good implementation of research results in actual practice to promote green building in healthcare facilities.

The active inter-industry discourse promoted by this consortium between the healthcare industry, building industry, and academic institutions allows for a unique dynamic to be harnessed between the "physiology" of healthcare and the "physics" of healthcare facilities. This will enable the delivery of healthcare projects and the quality of healthcare to be continuously improved and enhanced. The operational framework for the proposed consortium would rely on projects from the building and healthcare industries serving as

case studies for gathering information and incorporating the developments of research at academic institutions.

There are other consortia currently focusing on related efforts such as those listed below. Importantly, **there is currently no organization** that is focused on integrating the information from the other consortia and providing an avenue for continuous collaboration between the building industry, healthcare, and academia. Our consortium acknowledged the need to recognize and coordinate with these efforts as it moves forward.

- The **Green Guide for Healthcare** has set up a guide that provides quantifiable metrics for the sustainable design of healthcare facilities. The guide integrates enhanced environmental and health principles and practices into the planning, design, construction, operations, and maintenance of the facilities.

- The **Pebble Project** is a collaborative effort between the Center for Health Design and selected healthcare providers designed to gather evidence-based design information regarding the effects of the built environment on patients.

- The **Design-Build Institute of America** is an organization that integrates the design and construction processes of buildings, and recently hosted four regional conferences across the country focused on improving the design and delivery of healthcare facilities in terms of cost, schedule, and quality.

The perpetual need to expand and update healthcare facilities makes the design and construction of high performance healthcare facilities a vital priority in the U.S. building industry. High performance green buildings have the potential to improve the health and productivity of patients and healthcare providers. However, the extent of this potential is ambiguous, and the business case for green healthcare facilities remains unclear. Moving forward, the mission of this consortium is to advance our understanding of the relationship between building performance, and healthcare quality and health worker productivity. The research driven by this mission is expected yield insight about improving the quality of healthcare facilities, thereby enhancing care standards, and helping to restrain rising healthcare costs.

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1. OVERVIEW

On October 26-28, 2005, key members of the building industry, green design community, healthcare industry, academic institutions, and government agencies gathered in Pittsburgh, PA, to engage in meaningful and focused roundtable discussion. The purpose of this meeting was to determine the feasibility of developing a consortium to pursue research on improving how healthcare facilities are planned, designed, constructed, and maintained. This section provides a brief overview of the background, context, goals, objectives, and execution plan for the Greening Healthcare Facilities Roundtable.

Background on the Greening of Healthcare Facilities

Rising healthcare costs, and the perpetual need to expand and update facilities make the design and construction of high performance healthcare facilities a vital priority in the U.S. building industry. High performance green buildings have the potential to improve both the **health and productivity of patients and healthcare providers**, however the extent of this potential is ambiguous, and the business case for green healthcare facilities remains unclear.

A research consortium of key industry, academic, and government players was formed to focus research on improving how healthcare facilities are planned, designed, constructed, and maintained. This consortium defined the critical research priorities for high performance healthcare facilities, and metrics to evaluate the impact of green development strategies on healthcare facility performance. These important outcomes will position the consortium to pursue major grants from the National Institute of Health, the National Science Foundation, the health insurance community, and other private, state, and federal agencies.

Context of the Greening Healthcare Facilities Roundtable

The ultimate goal of this roundtable was to develop a consortium of key industry, academic, and government players that, together, will pursue focused research on improving how healthcare facilities are planned, designed, constructed, and maintained. To this end, this roundtable had the following four objectives:

1. **Benchmark against completed and current research initiatives** – Document what we already know about green buildings (health effects, costs) and identify who is currently pursuing research in high performance healthcare facilities.
2. **Examine the vision for this consortium** – Identify what is unique about the consortium; establish the strategic, tactical, and operational objectives for the consortium.
3. **Develop a** preliminary, shared, and coordinated **research agenda**.
4. **Explore** and identify **funding avenues** for carrying out the research agenda.

Drivers for the Greening Healthcare Facilities Roundtable

Although members of both the healthcare and building industries have been active in developing standards for better healthcare facilities, very little has been done to understand the correlation between the physics of buildings and the physiology of healthcare. The main driver of this roundtable discussion is to bring together influential people from these two industries and academia to assess the feasibility of establishing a consortium focused on investigating the multidisciplinary benefits of greening healthcare facilities. The roundtable discussion was organized with the help of **Marcia Barr** from the **University of Pittsburgh Cancer Institute**, **Gail Vittori** from the **Center for Maximum Potential Building Systems**, **Dr. Jorge Vanegas** of **Texas A&M University**, **Dr. Annie Pearce** of **Virginia Tech**, **Dr. David Riley** and **Dr. Michael Horman** from **Penn State University**. The responsibilities for the planning and execution of the roundtable discussion were as follows:

- **Dr. Jorge Vanegas** was responsible for serving as the formal roundtable discussion host and facilitator.
- **Dr. Annie Pearce** was responsible for collecting and disseminating the information from the roundtable.
- **Dr. Michael Horman**, **Marcia Barr**, and **Dr. David Riley** were responsible for planning the event and composing the final report.

Importance of the Greening Healthcare Facilities Roundtable

Healthcare facilities are among the most challenging types of buildings to plan, design, construct, and operate. These facilities typically support sensitive and costly activities such as patient treatment, laboratory and research testing, and food preparation.

Rising healthcare costs are a significant concern for the healthcare industry, community, and government. A key stra-

tegy to reducing the overall costs of healthcare needs to include a close examination of how healthcare facilities are delivered and perform.

The healthcare industry is one of the most significant markets today with over 120,000 buildings in the United States. Importantly, healthcare facilities are significant users of resources creating 5 million tons of solid waste annually, and using 515 trillion BTUs of energy per year, 11% of all commercial consumption. However, the most significant costs of hospitals lie in occupant salaries. While building design and construction costs account for 2% of building lifecycle costs over a 30-year period, the salaries of hospital employees account for 92% of the building lifecycle costs. If healthcare facilities can be delivered and operated with green strategies that enhance healthcare worker productivity, then significant savings can be realized in perhaps the largest cost center for these facilities.

Roundtable Discussion Format

A roundtable refers to an intensive workshop involving people working together under compressed deadlines. It is a collaborative planning or design process that taps into the knowledge, experience, skills, abilities, talents, energies, and synergy of a group of stakeholders, who have a common interest, and who wish to create and support a feasible plan that represents transformative change within the communities they represent. The roundtable discussion process combines techniques drawing on brainstorming methods to promote the free flow of ideas that builds upon suggestions from every participant.

The roundtable discussion format was selected for this event because it provides an interactive forum in which stakeholders, representing multiple perspectives on a given topic, come together to understand the complexities of the topic; to propose alternative visions to the initial baseline state of the topic; and to develop, evaluate, and select future plans and options. Roundtable discussions are especially suited to encourage discussion that goes beyond conventional thinking moving from the status quo into the realm of new possibilities. They also are an effective means to initiate collaboration among a diverse group of parties with common interests.

Goals and Objectives of the Roundtable

The initial goals and objectives of the roundtable were to:

1. **Identify, invite, and bring together a select multidisciplinary group** of 40 influential individuals, including academics, government agencies, green building experts, building industry members, and healthcare provider.
2. **Conduct an intensive roundtable discussion**, over a two and a half-day period to:
    - Collect, discuss, and record the intellectual, emotional, and instinctual reactions (i.e., reactions from the "Head, Heart, and Gut") from the academic, healthcare, and building community and synthesize them as a formal response
    - Collect, discuss, and record the strengths, opportunities, and challenges (i.e., barriers, obstacles, and inhibitors, and barrier-breakers, obstacle-removers, and enablers) associated with the greening of healthcare facilities.
    - Develop a research agenda for the collaboration between the academic community and the healthcare building industry in supporting and furthering the greening of healthcare vision, mission, and goals, and participating in the further development of specific projects within the proposed consortium.
    - Identify synergies between the academic community, healthcare providers, and building industry members, and propose a model for collaboration in research and education programs, projects, and activities.
3. **Create alignment** between the academic community, healthcare providers, and the healthcare sector of the building industry that clearly:
    - Establishes a mutual understanding of the need to understand the link between the physics of the built environment and the physiology of healthcare.
    - Identifies existing resources, tools, and knowledge within the members of the Greening Healthcare Consortium which can be leveraged synergistically, to further the vision, mission, and goals of healthcare, building, and academic communities

Roundtable Execution Plan

The execution plan for the roundtable discussion had three distinct phases:

- **Phase I** included all the pre-roundtable discussion activities, which were completed from August 30, 2005, to October 26, 2005.
- **Phase II** included all the Roundtable discussion activities, which were held over a three-day period, October 26-28, 2005, at the Doubletree Pittsburgh City Center, Pittsburgh, PA, with 41 participants from academic institutions, green

building leaders, building industry members, and healthcare providers. The complete list of participants is included in App. 1.

- **Phase III** included all the post-roundtable discussion activities, which were completed from October 29, 2005, to December 31, 2005.

An additional set of follow-up activities was added as an extension to the roundtable discussion execution plan. The specific details of each of these phases are presented next.

Phase I – Pre-Roundtable Activities

The Department of Architectural Engineering at the Pennsylvania State University was responsible for the execution of these activities, with support from the Mascaro Sustainability Initiative at the University of Pittsburgh.

- **Task 1 – Attendance at National Healthcare Construction Conferences:**

  This task focused on gathering information from four regional healthcare design and construction conferences organized by the Design Build Institute of America. The conferences were held in Berkeley, CA, New Haven, CT, Chicago, IL, and Orlando, FL. (Refer to App. 5.)

- **Task 2 – Establishment of a Website for the Roundtable discussion:**

  http://www.engr.psu.edu/pace/greenhealthcare.htm

  This task focused on establishing the official greening healthcare roundtable web site, which has been maintained and updated throughout the pre-roundtable discussion, roundtable discussion, and post-roundtable discussion activities, as a means of:

  - **Announcing** the roundtable discussion to a broad audience, and inviting interested parties to attend.
  - **Communicating** with roundtable discussion participants for all pre-roundtable discussion, roundtable discussion, and post-roundtable discussion activities.
  - **Disseminating** the roundtable discussion results to all attendees.

  This web site will be maintained for at least six months after the roundtable discussion, and after this period, all content will be preserved as an archival record of this event.

- **Task 3 – Identification of Roundtable Participants and Logistics:**

  This task focused on:

  - **Identifying** roundtable discussion participants, from a multidisciplinary pool of experts representing many areas of the healthcare and building industry and academia. The target number of participants for the roundtable discussion was 35. Targeted disciplines to be represented at the roundtable discussion included: Healthcare Administration, Construction, Engineering, Architecture, Health Advocacy Groups, and Academic Institutions.
  - **Issuing** a formal invitation to targeted roundtable discussion participants. The announcement was disseminated within established academic, building industry, and healthcare networks. A special effort was made to ensure that most of the players involved with the design, construction, and operation of healthcare facilities were represented. The formal invitation is included in App. 2, and the Position Paper in App. 4.
  - **Securing** the roundtable discussion location and logistic support infrastructure. The roundtable discussion was held on October 26-28, 2005, at the Doubletree Pittsburgh City Center, Pittsburgh, PA.

  All logistic aspects of the roundtable discussion, including securing a meeting room, meals, and lodging for the roundtable discussion participants, were coordinated by Marcia Barr of the University of Pittsburgh Medical Center, and Michael Pulaski and Andreas Phelps of Penn State University's Department of Architectural Engineering.

- **Task 4 – Development of Pre-Roundtable Readings, Input Sheets, and Electronic Forum:**

  This task focused on designing, developing, and preparing a set of Formal Input Sheets, which the roundtable discussion participants were asked to complete prior to the roundtable discussion. Results from the completed questionnaires were posted prior to the beginning of the roundtable discussion, so they could be used within the facilitated discussions. The formal input sheets were prepared by Dr. Jorge Vanegas of Texas A & M University and are included in App. 6.

Phase II – Roundtable Discussion Activities

Dr. Jorge Vanegas and Dr. Annie Pearce were responsible for the execution of these activities, with support from the members of Pennsylvania State University and University of

Pittsburgh. Table 1 shows a schedule of the roundtable discussion activities.

The final synthesis of the research agenda resulting from the roundtable discussion is included in Section 3 following. All the supporting documentation is included in Appendices 4-13, which include the consolidated material captured prior to and during the roundtable discussion, through the formal input sheets, and through the facilitated discussions at the roundtable discussion.

Phase III – Post-Roundtable Activities

Dr. Jorge Vanegas was responsible for the execution of these activities, with support from the members of the Roundtable discussion Steering Committee, and especially, with support from Dr. Annie Pearce.

- **Task 1 – Final Processing of Roundtable Results:**

  This task focused on preparing this final report. It was disseminated broadly among all the roundtable participants and invitees that could not attend.

- **Task 2 – Posting the Final Report on the Official Roundtable Website:**

  This task focused on posting the final report on the official roundtable discussion web site as a means of ample dissemination of the roundtable discussion results, and announcing the report to the interested members of the academic, healthcare, and building industry.

- **Task 3 – Preparing Targeted Major Research Proposal:**

  This task will focus, as an extension to the roundtable discussion, on preparing a major research project.

Table 1. Summary of Roundtable Activities

Day 1: Wednesday, October 26, 2005	
6:00 - 9:00 PM	Reception and Dinner
Day 2: Thursday, October 27, 2005	
8:00 - 9:00 AM	Introductions
9:00 - 10:15	I. Reaction to baseline and vision
10:15 - 10:30	Break
10:30 - 12:00	II. Develop operational model for the consortium
12:00 - 1:00 PM	Buffet Lunch
1:00 - 2:30	III. Develop preliminary research agenda
2:30 - 2:45	Break
2:45 - 4:15	IV. Identify funding avenues
4:15 - 4:30	Re-cap
4:40 - 6:30	Break
6:30	Dinner
Day 3: Friday, October 28, 2005	
8:00 - 10:15 AM	V. Revision of Day 1
10:15 - 10:30	Break
10:30 - 12:00	VII. Path ahead and commitments
12:00 - 12:30 PM	VIII. Conclude and adjourn
1:00 - 2:30	Research Team meets to summarize results

2. THE GREENING HEALTHCARE FACILITIES ROUNDTABLE

This section contains a synopsis of the content of the greening healthcare roundtable discussion by the participants. This material can also be found on-line at: http://www.engr.psu.edu/pace/greenhealthcare.htm.

Introduction: Documenting Hats, Drivers, and Expectations

The introduction of the roundtable focused on documenting which stakeholders in the healthcare and building industry were present, what their motivation was for attending, and their expectations. In addition to the expected designers, contractors, healthcare administrators, academicians, and consultants, the attendees also represented patients, taxpayers, and concerned citizens. Through the activity of listing the "hats" that each person wore, it became clear that the topic of greener hospitals and better healthcare is an issue that affects our lives well beyond our professional careers.

The main goal for most attendees is to transform, enhance, and improve healthcare to make it the best it can be and remove whatever barriers are impeding this goal. Specifically, the roundtable discussion was focused on how to improve healthcare through green design attributes and through a more integrated delivery process. There are also issues of policy, codes, paradigms, and others that go well beyond the facility itself. The baseline and vision is to develop ways in which the physical facility is an integral part of the process of prevention, mitigation, and curing of health problems. Among the attendees, interest in collaboration was substantial and the concept that each member was a different dot to be connected to others to form a very strong and influential web was widely embraced.

Early in the roundtable it was made clear that the purpose is not to debate current green guidelines. The purpose is to determine the feasibility and relevance of establishing a consortium and collaborative that can do all these things. The goal for the attendees was to establish a shared discussion and meet others with complementary interests such as:

- Addressing real or perceived additional first costs and other challenges.
- Proving that green hospitals are more profitable.
- Identifying trends in the industry.
- Understanding what has already been done.
- Developing collaboration between disciplines.
- Gaining inspiration.
- Developing designs that include all facets of environmental health.

Reaction to Baseline and Vision

The first session focused on gathering various reactions to the baseline and vision of joining the physics of healthcare facilities with the physiology of healthcare. In order to uncover the full spectrum of reactions by the attendees, they were asked to give their reaction from their gut (instinctual), their reaction from the heart (emotional), and their reaction from their mind (intellectual). The various reactions are listed in Appendix 7.

Developing an Operational Model for the Consortium

For the proposed consortium to make the best use of the human resources available, it is important to understand the strengths, opportunities, weaknesses, and threats that exist among the roundtable participants. Once these issues are outlined, **the consortium can position itself** in order to maximize the use of its strengths, take advantage of opportunities, and address or avoid areas of weakness. Participants were asked to develop a list of perceived strengths, opportunities, weaknesses, and threats for the proposed consortium.

The two major strengths of the attendees at the roundtable are the stature of the attendees and the multi-disciplinary composition of the attendees. Most of the roundtable attendees are influential individuals within their organizations and within the industry. They have the ability to create change, adapt, and share best practices and good ideas, and have useful connections to others within the industry. The multi-disciplinary composition of the group would allow the proposed consortium to address big picture questions related to the effects of the built environment on healthcare performance in terms of operational cost, occupant productivity, and clinical outcomes. A lot of information already exists and can be processes, improved, and shared effectively within a network such as the proposed consortium. The diverse make-up of the group also allows for numerous opportunities for cross-disciplinary collaboration, collaboration with existing efforts, and unique funding opportunities.

Based on the strengths listed above, there are a number of opportunities unique to this group. With the involvement of designers, constructors, and healthcare administrators, the proposed consortium is uniquely positioned to develop partnerships to study the entire lifecycle of healthcare facilities

and use that information to continuously improve the design, construction, and operation of the healthcare facilities. The multiple viewpoints provided can help to create a more universal and stronger argument for the consortium's findings. With collaboration and shared resources between the building industry, healthcare industry, and academia, ideas and innovations can be **implemented and tested on actual projects and improved**. With the support of the diverse group that would make up the consortium, individuals may have increased credibility and leverage within the industry and expand their comfort zone to take risks that **they may not have taken by themselves**.

Many of the weaknesses outlined by the roundtable attendees pertain to how the consortium will function and be organized. Specific concerns include having the proper membership (i.e. including doctors, nurses, patients, and some "devil's advocates") but also keeping the consortium a manageable size so that it is effective. While diversity is one of the chief strengths, there is also the risk that it may lead to a lack of focus, conflicts, or possible hidden agendas. In order to maintain momentum and interest, the group will need to demonstrate some progress within a short time. Rather than setting the goal of reaching the lowest common denominator, the consortium will need make sure that their goals are ambitious, focused, and in adherance to its core values.

Without the establishment of our core values and trust between members, there are a number of threats to consider. Similar to the problems that the U.S. Green Building Council has faced, the consortium could face pressure from political or special interest groups. Without clear definition of our goals, the consortium runs the risk of other groups staking claim to similar ideas. Internally, there is always the risk of highly active members hijacking the agenda, or having the public actions of one member negatively affect other members by association. There is also the risk that the consortium may create policies that make some of the members' individual jobs more difficult.

In addition to the weaknesses and threats that the consortium may have to deal with, the attendees were also asked to outline the possible challenges and possible strategies to overcome the challenges are listed below (Table 2).

Table 2. Challenges to the Consortium and Strategies of Ovecome These Challenges

Challenge	***Overcoming Strategy***
Getting data from the industry to researchers in a timely manner	Collaborate with industry members who are forthcoming, or make them integral owners of the research
Getting the right people within organizations as well as within the building and healthcare industries to take part in the consortium	Identify key people and invite and incentivize them to participate
Disagreement of vision based on our varying interests	Negotiate to reach a consensus
Convincing healthcare institutions to improve on the status quo	Educate healthcare owners and administrators to the benefits of greener hospitals and use pilot projects to show that delivering greener healthcare facilities will not be as disruptive as feared and does improve performance
Lack of effective communication between research and practice, i.e. theory and application	Develop collaboration so that each is informed by the other and is able to deliver relevant information
Sustainable design goals tend to be broad and lack specific and direct cause/effect information.	Develop focused research goals that are directly applicable to the industry and can serve as guides for decision making
Integrated design often exposed conflicting goals, e.g., indoor air quality and energy efficiency	Develop focused research goals that address these conflicts and provide a basis for decision making
Lack of funding	Start writing proposals. With our diverse background, the consortium should be also able to pursue unlikely funding sources
Healthcare facility owners may not buy into greener facilities	Educate the owner as to the benefits of greener facilities based on existing information and results from ongoing research
Balancing the consortium with day jobs and competing priorities	Continuously connect the goals of the consortium to people's everyday work in order to maintain the momentum
Competition with other initiatives	Will have to work to become inclusive and partner as appropriate; define value added
Potential redundancy with other efforts	Careful analysis of existing efforts and strategic placement of our efforts
Intellectual Property	Identify and overcome the barriers to sharing knowledge

The 7 P Framework for Working Together

After individual and collective ideas and concerns were outlined, the attendees were asked to **work through and brainstorm** how the proposed consortium would position itself, pursue relevance, partner with other efforts and industries, persuade others, perform, and profit. These issues form the 7 P Framework developed by Dr. Vanegas (Figure 1). Some of these areas will need to be further developed as the goals and mission of the consortium become clearer.

In order to position itself, the consortium needs to clearly define its goals, mission, and research thrusts so that its unique role within the industry can be established (Figure 2). Once established, the consortium needs to get buy-in from major institutions such as National Institutes of Health, Center for Disease Control, Joint Commission on the Accreditation of Health Organizations, American Society of Heating Refrigeration and Air Conditioning Engineers, and the American Institute of Architects in order to effectively educate doctors, nurses, facility managers, the insurance industry, and politicians. Because of the focus on making the business case for greener hospitals, the consortium should focus on both healthcare providers interested in green facilities and those not currently interested.

There are a number of ways that the proposed consortium can pursue its goals. The consortium will need to present visioning sessions and benchmarking studies to healthcare facility owners and other invited people both independently and at existing forums where owners already get together to expose them to these concepts. Designers and contractors can be pursued through presentations of case studies, financial performance, and productivity at regional and national conferences. Other collaborative organizations should be pursued to align our goals so that overlap is minimized.

In terms of partnering, the consortium should look at existing cross-disciplinary groups with similar goals such as the U.S. Green Building Council and Green Guide of Health Care. Other possible industry partners include the American Institute of Architects, Association of General Contractors and the Design-Build Institute of America. In order to be most effective, the consortium needs to integrate its research with the mainstream building industry. Possible institutional partners include the Environmental Protection Agency, which currently has a demonstration project that is looking at six key areas such as patient outcomes and staff retention in Region 9, and the INSPIRE program, a Pittsburgh/PA research initiative. These, and other partnerships, can be pursued to obtain state-level funding for green building research.

Regarding how the consortium can persuade and perform, this depends on the specifics of the research efforts and the final goals and mission of the consortium. Overall, consortium members should be able to profit and benefit from their involvement in a number of ways. Interaction with other consortium members will result in **gained knowledge, greater publicity, and allow the ability of members to better sell** their services. In addition to the financial benefits, there is also the benefit of helping to transform the industry domestically and internationally. Academic institutions will have projects for students to research and everyone will benefit in terms of having better access to quality, affordable healthcare.

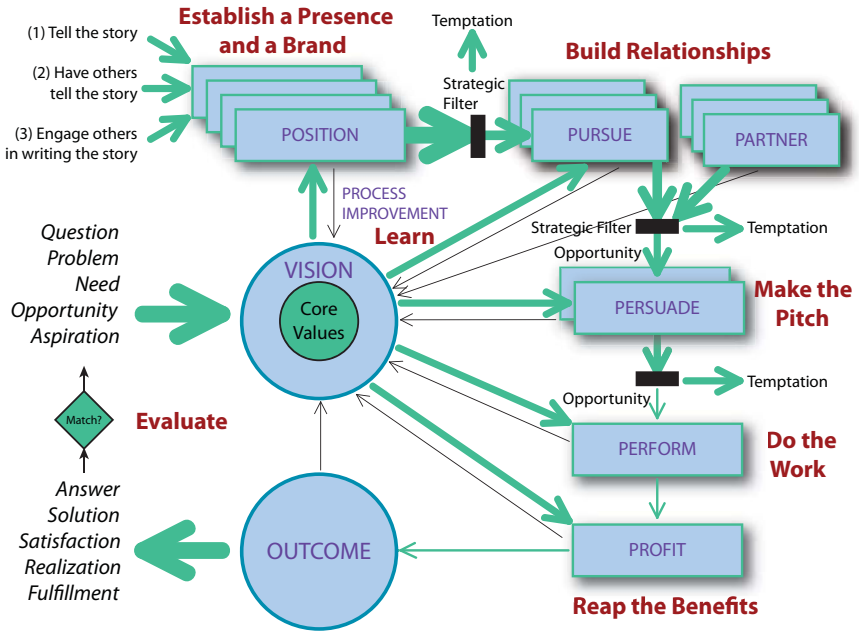

Fig. 1. The 7 P Framework for Working Together (Source: Vanegas)

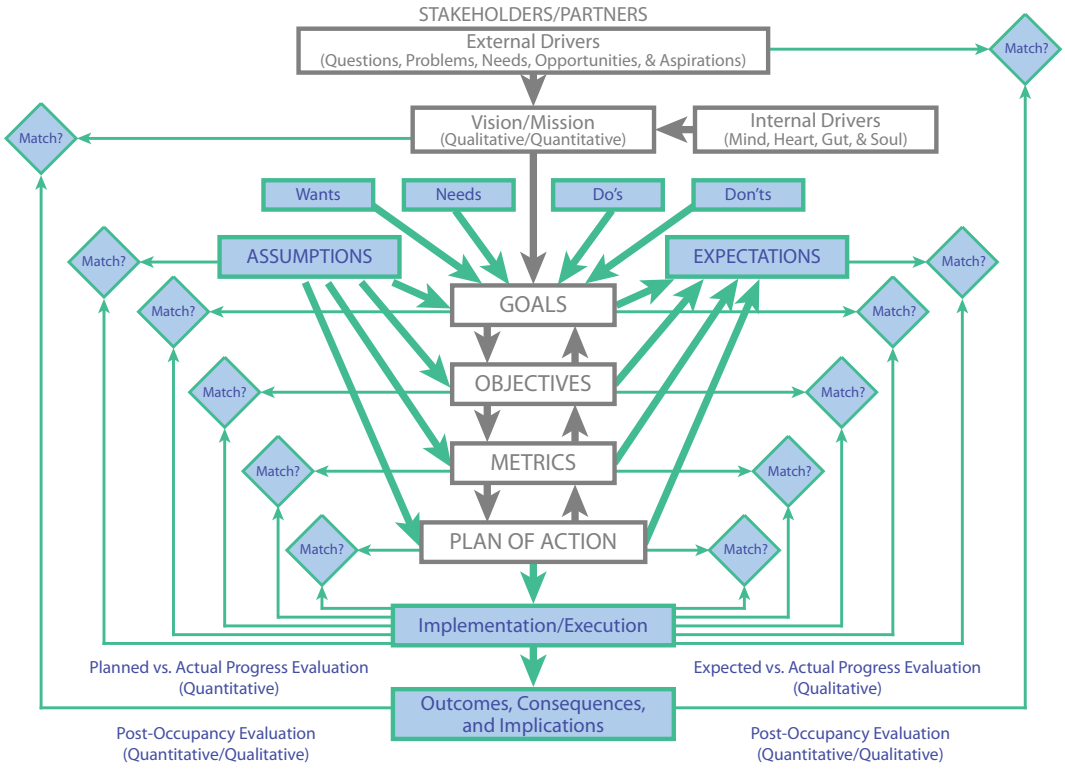

Fig. 2. Organizational Outline for Establishing a Consortium (Source: Vanegas)

3. DEVELOPING A PRELIMINARY RESEARCH AGENDA

Brainstorming a Research Agenda

The attendees were asked to brainstorm possible research agendas for the consortium to address. This included developing lists of questions to answer, problems to solve, and opportunities to realize. The issues listed below were suggested for the research agenda because they address ways in which the healthcare industry can provide better and more affordable healthcare. The list of issues can be broken down into four major groups: those related to cost, decision-making, clinical and operational benefits resulting from design and construction, and knowledge acquisition. Some of the cost related issues are listed below:

- Establishing a common database for healthcare design and construction based on existing projects that examines savings in various phases of the building's life cycle (i.e. design, construction, and operations)
- Determine if green facilities actually cost more initially and over the long-term with or without considering any costs associated with improved occupant productivity and health
- Create cost-benefit relationships for various design and construction issues

In terms of the decisions-making process, the attendees proposed the development of a comprehensive definition for green healthcare facilities. Based on that definition, an understanding of the real or perceived obstacles to delivering greener healthcare facilities should be established. By looking at previous projects or those currently underway, the consortium could research the decisions that need to be made by various players and how those decisions either support or compromise green goals. Other design and construction related questions include:

- Are there certain project delivery methods that are best suited for green healthcare facilities?
- What are the economic and health-related tradeoffs associated with different mechanical systems?
- What are the possible conflicts between indoor air quality and energy efficiency?
- Does increased use of outdoor air result in better indoor air quality in urban environments?
- How can we understand the mechanisms and relationships between various design features and their performance outcomes?
- What effects do reduction of hazardous waste materials and clean energy procurement have on the operation of the facility in terms of health outcomes and profitability?
- Will patients choose green facilities over non-green?
- Will the insurance industry offer incentives for certain green healthcare facility features?

The biggest questions relate to the potential benefits of green healthcare facilities and how to measure them. The potential benefits listed below include those related to the physical building, staff, and patients:

- Life-cycle facility cost reduction based on operations and maintenance
- Increased staff productivity
- Improved staff retention rate
- Reduced stress levels for patients and staff based on colors, textures, spaces, and lighting
- Decreased length of patient stay
- Decreased patient medication requirements
- Decreased nosocomial infection rates
- Decreased patient morbidity
- Fewer patient and staff falls
- Decreased worker days lost

The last group of questions was related to the collection and transfer of knowledge. Specifically, they were related to the ways that the consortium would generate and disseminate their findings in a valid and acceptable way. There were a number of major problems that the attendees outlined for the proposed consortium to attempt to solve. These included:

- How can projects maintain their green goals in the face of value engineering, scope changes, and escalating material costs?
- How can maintenance nightmares be eliminated by design innovations?

- How can relevant information be provided to decision-making teams to avoid "paralysis of analysis"?
- How can owners and the public be educated on the benefits of green healthcare facilities?
- How can reducing healthcare operations costs make healthcare more affordable?

By addressing the questions and problems referenced above, there are many opportunities that the consortium and members of the consortium could benefit from. There is the possibility of transforming existing business models for healthcare and creating a best practices guide illustrated with lessons learned from previous projects. The consortium could be involved with the establishment of standards for green materials, the development of new materials, and the evaluation of the performance of existing materials. In additions, universities can offer new academic degree programs and continuing educations courses.

Critical Issues for the Consortium to Address

The most essential issue for the consortium to address is creating an effective link between research and practice to investigate a number of critical issues. These issues include understanding the real benefits that green design features have on healthcare facilities in order to develop cost-benefit data so that designers and owners have a better, more informed basis for decision-making. The current requirement for decisions regarding sustainability to prove themselves through the business case is something that is required of very few other decisions. In addition, studies have shown that the extra cost of sustainability on a project falls well within the normal variance of healthcare project costs.

Another key issue for the consortium to address is how the design and construction of a healthcare facility affects operations and maintenance, including the health and productivity of the building occupants. Specifically, the consortium will need to examine decisions regarding the delivery of healthcare projects and clinical outcomes affected by the indoor environments (e.g., nosocomial infections). The consortium can use both active and passive research; passive research includes collecting data from existing projects and operations, whereas active research entails using facilities as testbeds for new facility means, methods, and approaches. In highly specialized projects such as healthcare projects, decisions affect other systems and outcomes. These interrelations sometimes result in conflict where one system is improved at the expense of another. Alternatively, they can result in synergies where multiple systems are simultaneously improved based on one decision. Another issue to address is process waste (i.e. activities throughout the design, construction, and operation of the facility that add no value and create waste in the form of added cost, added time, and decreased quality). The data gathered from case study projects and research can then be developed into healthcare design and construction guides.

Based on these issues, the eight main research thrusts listed below were outlined by the roundtable attendees:

- **Relationship between Facilities and Clinical Outcomes:** Research the dynamic relationship between the delivery of a facility and two types of outcomes: facility outcomes in terms of operations and maintenance, and clinical outcomes pertaining to patients and healthcare staff productivity. The consortium should conduct basic research to characterize this relationship and establish causal and correlative links between facility attributes and health outcomes. The outcome will be the basic knowledge on how to improve each (clinical outcomes, facility performance, and operational effectiveness) and the interactions among them.
- **Cost-Value Relationships:** Establish relationships between cost and value, and between direct, indirect, and externality costs and how they relate with respect to greening healthcare facilities.
- **Basis for Decision Making:** Map decisions made throughout the facility delivery process. Sometimes these decisions do not seem to have a formal and explicit basis. There is a need to determine how these decisions are made and how they would be undertaken with respect to green building in order to improve the success of the project.
- **Data Repository:** Compile and organize the data, knowledge, and experience of the consortium members that already exists. The consortium can become the repository for this information in a way that makes it useful for others. The consortium should be responsible for the assembly, storage, and use of this data, and establish feedback loops for future data acquisition and analysis.
- **Active and Passive Research:** Perform both active and passive activities regarding the greenin of healthcare facilities, where passive activities involve collecting data from existing facilities, and the active activities involve using healthcare facilities as testbeds for new facility means, methods, and approaches.
- **Waste:** Address process waste in the design, construction, and operation of healthcare facilities. Process wastewaste creates additional costs and uses additional time without adding any value.

- **Implementation of Research:** Go beyond basic research to understand and reinforce the implementation of research results into actual practice that promotes green building in healthcare facilities.

- **Interactions:** Understand correlations, conflicts, synergies, and tradeoffs between and among environmental, facility, and health goals, objectives, and outcomes.

Model for Collaboration

Of the research thrusts listed, the cost-value relationship is the overarching issue. Clinical outcomes, facility outcomes, and facility delivery are subsets of cost-value. Of those three subsets, clinical outcomes are the most critical and should drive the whole agenda. The essential principle is that healthcare facilities exist to provide good clinical outcomes and the failure of this to drive design and construction decisions is a major problem. Figure 3 (shown below) is theconceptual outline for the mission of the proposed consortium.

There are four main areas of research: 1) the relationship between environmental goals and facility goals; 2) the relationship between environmental goals and health goals; 3) the relationship between facility goals and health goals; and 4) the overall relationship between all three goals. Each relationship needs to analyzed in terms of correlations, conflicts, interdependencies, and synergies and then applied toward developing guidelines for decision-making, reduction of product and process waste, and cost value information.

The model for collaboration involves two complementary modes. The first involves collecting data from passive research of existing projects provided by building and healthcare industry partners to inform research within participating academic institutions. The second involves a more active process that incorporates the products of academic research into new healthcare facility projects to study the effects and use that analysis to continuously improve the products.

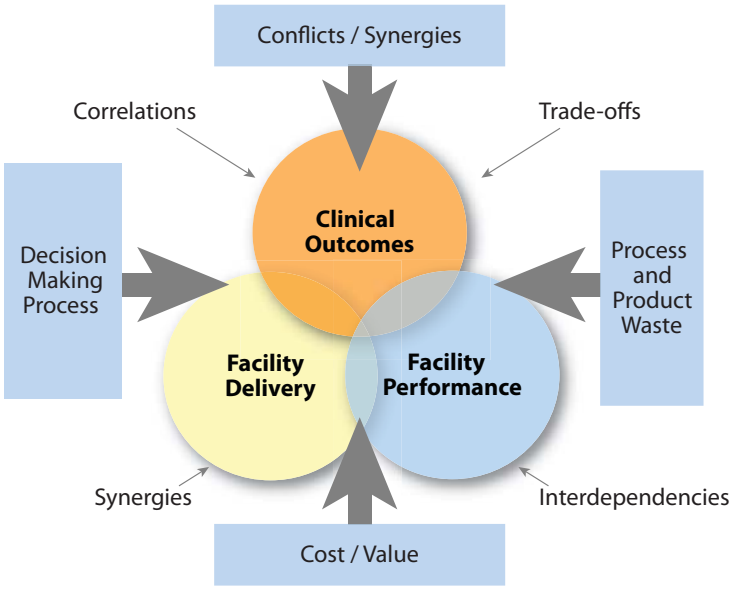

Fig. 3. Conceptual Outline of Research

Fig. 4. Roundtable Members Discussing Key Elements of the Consortium Formation at the Opening Morning Session

4. NEXT STEPS

Next Steps for the Consortium

The attendees agreed that a greening healthcare facilities consortium should be formed. At the conclusion of the roundtable, the attendees outlined the next steps for the consortium. Commitments from the participants included the following: 1) offering ongoing or recently completed projects as case studies for collecting data on current design, delivery and performance; 2) sharing access to existing efforts and bodies of knowledge; 3) providing graduate students to conduct research on improving the design and delivery of healthcare facilities; and 4) providing new projects to serve as testbeds to implement the findings of research.

Through this report and publications in strategic literary sources, the consortium will begin to establish its presence and brand in the marketplace. The next phase will be to bring the members together to formally collaborate on the research and implementation projects outlined in section 3. This will be pursued on two levels. The first level will identify agencies interested in funding further research aimed at greening healthcare facilities. Likely agencies will include: the National Institutes of Health, the Institute of Medicine of the National Academies, Environmental Protection Agency, and CDC.

The second level will use the resources immediately available to the consortium. Currently, the Penn State Hershey Medical Center (PSHMC) has several capital projects underway and is offering these as case studies projects. The PSHMC Cancer Center and Children's Hospital are in the beginning stages of design and have the potential to benefit greatly from the multi-disciplinary collective experiences of the consortium. Children's Hospital of Pittsburgh's new facility will be complete by 2008. This new research and hospital facility along with the greening of existing facilities throughout the University of Pittsburgh Medical Center (UPMC) Health System will provide numerous case study projects. The timeliness of all of these projects will provide an opportunity for the consortium to implement and test their ideas. These projects will be used as prototypes for how the consortium will interact on similar projects in the future.

Fig. 5. Roundtable Facilitator, Jorge Vanegas, Collecting Input From Roundtable Members

APPENDIX 1. ROUNDTABLE ATTENDEES

Carolyn Akers, Penn State Hershey Medical Center

Richard Aradine, Penn State Office of Physical Plant

Marcia Barr, University of Pittsburgh Cancer Institute

Eric Beckman, Mascaro Sustainability Initiative, University of Pittsburgh, Department of Engineering

Patrick Branch, Astorino

Justin Brower, University of Pittsburgh, Health Policy & Mgmt

Sho-Ping Chin, Payette

Pete Dahl, Penn State University, Department of Architectural Engineering

Ellen Dorsey, The Heinz Endowments

Edward Dudek, UPMC Presbyterian Shadyside

James Faust, HSC Builders and Construction Managers

Jim Freihaut, Penn State University, Department of Architectural Engineering

Douglas Gardner, Windber Medical Center

Yun Gu, Carnegie Mellon University, College of Architecture

Robin Guenther, Guenther 5 Architects

Michael Hinchcliffe, Payette

Michael Horman, Penn State University, Department of Architectural Engineering

Gena Kovalcik, University of Pittsburgh, Mascaro Sustainability Initiative

Chris Leyenberger, Centerline Associates

Sandy Lusk, Eighty-20 Re:Sources

Jennifer Macks, Barton Malow Construction

Michael McLaughlin, Southland Industries

Jim Moler, Turner Construction

Megan Moser, Green Building Alliance

Teresa Mendez Quigley, Health Care Without Harm

Kim Needy, University of Pittsburgh, Department of Industrial Engineering

Jeffrey Nicholas, Gilbane Construction

Annie Pearce, Virginia Tech

Deborah Pereira, Gilbane Construction

Andreas Phelps, Penn State University, Department of Architectural Engineering

Robert Ries, University of Pittsburgh, Department for Civil Engineering

David Riley, Penn State University, Department of Architectural Engineering

Greg Roberts, WHR Architects

Stefanie Spinelli, Array

Jelena Srebric, Penn State University, Department of Architectural Engineering

Alan Traugott, CJL Engineering

Jorge Vanegas, Texas A&M University

Gail Vittori, Center for Maximum Potential Building Systems

Abe Vogel, Penn State University, Department of Architectural Engineering

Fig. 6. Roundtable Members Intent on Discussing an Important Element of the Consortium

APPENDIX 2. ROUNDTABLE INVITATION LETTER

PENNSTATE

1855

Partnership for Achieving Construction Excellence
Greening Healthcare Facilities
104 Engineering Unit A
University Park, PA 16802

Phone / Fax 814-865-3369
www.engr.psu.edu/pace

9/07/2005

Greetings,

I would like to personally invite you to a special planning meeting with approximately 25 of the leading experts in the design and construction industry from Oct 26-28, 2005 in Pittsburgh, Pennsylvania. Some preliminary information about this event is provided below and in the attached invitation. We hope that you will consider attending.

As part of an ongoing research program at Penn State in the area of sustainable design and construction, we are committed to improving the delivery of Green Healthcare Facilities. Our goal for this event is to develop a research agenda and roadmap to enable the healthcare industry to design, build and operate greener and healthier facilities to provide better care for their patients. We are collaborating with top firms and minds in the field, including Gail Vittori of the Center for Maximum Potential Building Systems and Professor Jorge Vanegas from The Georgia Institute of Technology, who will be facilitating the event.

We would be honored if you would consider attending this important meeting, and contributing your expertise to this conversation.

Attached please find some initial details about this event. The event will be held at the Doubletree Hotel, Pittsburgh City Center in Pittsburgh, PA from Oct 26-28, 2005.

If you have questions about this event, please do not hesitate to email me at: mjhorman@engr.psu.edu.

Penn State graduate student Andreas Phelps will be helping to make the final arrangements: afp112@psu.edu.

More information will be posted soon at http://www.engr.psu.edu/pace/greenhealthcare.htm. At this location, you will be able to register for this event. Registration should be completed no later than Oct 12, 2005.

Best regards,

Michael Horman, PhD
Lean and Green Research Initiative

Fig. 7. Making Progress on the Intricate Healthcare Issues Being Confronted at the Roundtable

APPENDIX 3. ROUNDTABLE AGENDA

Day 1: Wednesday, October 26, 2005	
6:00 - 9:00 PM	Reception and Dinner
Day 2: Thursday, October 27, 2005	
8:00 - 9:00 AM	Introductions
9:00 - 10:15	I. Reaction to baseline and vision
10:15 - 10:30	Break
10:30 - 12:00	II. Develop operational model for the consortium
12:00 - 1:00 PM	Buffet Lunch
1:00 - 2:30	III. Develop preliminary research agenda
2:30 - 2:45	Break
2:45 - 4:15	IV. Identify funding avenues
4:15 - 4:30	Re-cap
4:40 - 6:30	Break
6:30	Dinner
Day 3: Friday, October 28, 2005	
8:00 - 10:15 AM	V. Revision of Day 1
10:15 - 10:30	Break
10:30 - 12:00	VII. Path ahead and commitments
12:00 - 12:30 PM	VIII. Conclude and adjourn
1:00 - 2:30	Research Team meets to summarize results

Fig. 8. Roundtable Facilitator, Jorge Vanegas, Illustrating a Point

APPENDIX 4. POSITION PAPER

Greening Healthcare Facilities

--Connecting the "Physics" of Buildings with the "Physiology" of Healthcare through High Performance Healthcare Facilities

Roundtable Position Paper

Purpose

Rising healthcare costs, and the perpetual need to expand and update facilities make the design and construction of high performance healthcare facilities a vital priority in the U.S. building industry. High performance green buildings have the potential to improve the health and productivity of patients and healthcare providers, however the extent of this potential is ambiguous, and the business case for green healthcare facilities remains unclear.

A research consortium of key industry, academic, and government players is being formed to focus research on improving how healthcare facilities are planned, designed, constructed, and maintained. This consortium will define the critical research priorities for high performance healthcare facilities, and metrics to evaluate the impact of green development strategies on healthcare facility performance. These important outcomes will position the consortium to pursue major grants from the National Institute of Health, the National Science Foundation, the Health Insurance Community, and other private, state, and federal agencies.

Objectives

The goal of this roundtable is to develop a consortium of key industry, academic, and government players that, together, will pursue focused research on improving how healthcare facilities are planned, designed, constructed, and maintained.

To this end, this roundtable has the following four objectives:

1. Benchmark against completed and current research initiatives – document what we already know about green buildings (health effects, costs) and identify who is currently pursuing research in high performance healthcare facilities.

2. Examine the vision for this consortium – Identify what is unique about the consortium; establish the strategic, tactical, and operational objectives for the consortium.

3. Develop a preliminary, shared, and coordinated research agenda.

4. Explore and identify funding avenues for carrying out the research agenda.

State of the Art

Many independent efforts within the building sciences, healthcare design, and healthcare delivery disciplines are investigating issues related to healthcare facilities. The following efforts are some of the multidisciplinary groups that are focused on creating a transformational change within the healthcare facility industry:

- The Pebble Project is collaborative effort between the Center for Health Design and selected healthcare providers designed to gather evidence-based design information regarding the effects of the built environment on patients.

- The Fable Hospital is a fictitious 300-bed hospital based on a composite of newly built or renovated hospitals that have incorporated evidence-based design. The model

provides an opportunity to compare the benefits and related costs of various technologies and innovations through simulated construction and operation of the project.

- The Green Guide for Health Care is the first guide that provides quantifiable metrics for the sustainable design of healthcare facilities. The guide integrates enhanced environmental and health principles and practices into the planning, design, construction, operations, and maintenance of the facilities.

- The Design-Build Institute of America has recently hosted four regional conferences across the country focused on improving the design and delivery of healthcare facilities.

- The Commission for Architecture and the Built Environment focuses on the effects that good design has on not only the functional performance of a building (productivity of staff, maintenance and energy costs), but the wider social value.

Importance of This Consortium

Healthcare facilities are among the most challenging types of buildings to plan, design, construct, and operate. These facilities typically support sensitive and costly activities such as patient treatment, laboratory and research testing, and food preparation.

Rising healthcare costs are a significant concern for the healthcare industry, community and government. A key strategy to reducing the overall costs of healthcare needs to include a close examination of how healthcare facilities are planned, designed, constructed, and maintained.

The healthcare industry is one of the most significant markets today with over 120,000 buildings in the United States. Importantly, healthcare facilities are significant users of resources creating 5 million tons of solid waste annually, and using 515 trillion BTUs of energy per year, 11% of all commercial consumption. However, the most significant costs of hospitals lie in occupant salaries. While building design and construction costs account for 2% of building lifecycle costs over a 30-year period, the salaries of hospital employees account for 92% of the building life cycle costs.

If healthcare facilities can be planned, designed, constructed, and operated with green strategies that enhance healthcare worker productivity, then significant savings can be realized in perhaps the largest cost center for these facilities.

Expected Outcomes

This consortium will yield the following outcomes:

1. Review of the state-of-the-art research and practices in greening healthcare facilities.

2. Operational model for the consortium.

3. Preliminary research agenda

4. Identified funding streams for research in greening healthcare facilities.

5. Identified pilot projects for greening healthcare design and delivery.

APPENDIX 5. DBIA-PENN STATE HEALTHCARE INDUSTRY STUDY

During September and October of 2005, DBIA held four regional conferences on the delivery of healthcare facilities. These conferences were held in:

- Berkeley, CA
- New Haven, CT
- Chicago, IL
- Orlando, FL

In conjunction with DBIA, Penn State collected survey data from conference attendees. Respondents were categorized as either designers (e.g., architects and engineers), contractors (e.g., general, specialty, and sub contractors), and providers (e.g., owners and facility managers). Half of those that fell into the "other" category described themselves as design-builders with the others consisting of a manufacturer's representative, insurance broker, technical recruiter, and healthcare consultant.

Respondents were also asked to select: 1.) The benefit of green healthcare facilities that is the most important to them; 2.) The two research questions regarding facility performance and green healthcare facilities that are most important to them; 3.) The two research questions regarding building occupant performance and green healthcare facilities; and 4.) The two greatest barriers to the design and construction of green healthcare facilities. The survey results demonstrate that lower operating costs and improved clinical outcomes are the two main reasons for pursuing green healthcare facilities. These are expected results, however the survey also showed that perceived higher costs of design and construction, current delivery and contracting practices, and facility complexity are the biggest barriers to greening healthcare facilities. Despite overall general alignment of view, there are significant differences in how designers, contractors, and healthcare providers view the benefits, needed research, and barriers related to green healthcare facility design and construction. The full summary of the survey data follows.

The Design-Build Institute of America (DBIA) is a membership organization founded in 1993 to advocate and advance single source project delivery within the design and construction community. The design-build method of project delivery embraces architecture/ engineering and construction services under a single contract, thereby re-integrating the roles of designer and constructor. DBIA members include practitioners from all project phases, plus public- and private-sector project owners (www.dbia.org).

Table 3. Role of Respondents

Role	*Number*
Designer	21
Contractor	37
Owner/Provider	13
Other	14
Total	85

Table 4. Most Valuable Benefits of Green Healthcare Facilities

Benefit	*Percent*
Reduced use of water and energy due to efficient design	34
Improved indoor air quality	25
Increased use of daylight	19
Reduced use of materials with high content of volatile organic compounds	13
Reduced use of toxic cleaning products and pesticides/herbicides	4
Reduced worker injuries and worker days lost	5

Table 5. Most Valuable Benefits of Green Healthcare Facilities, by Role

Benefit	*Role*			
	Designer	Contractor	Provider	Other
	(% of Respondents)*			
Reduced use of water and energy due to efficient design	26	39	22	42
Improved indoor air quality	29	20	29	32
Increased use of daylight	26	20	21	5
Reduced use of materials with high VOC content	14	14	14	11
Reduced use of toxic cleaning products and pesticides/herbicides	5	2	0	5
Reduced worker injuries and worker days lost	0	5	14	5

(* E.g., 26% of designers felt reduced water and energy was the most valuable benefit of green healthcare facilities.)

Table 6. Top Two Important Research Questions Concerning Healthcare Facility Operation

Do Green Healthcare Facilities Help to:	*Percent*
Reduce energy cost	30
Improve patient recovery rate	31
Reduce average patient stay	7
Reduce infection rate	23
Lower worker injuries and days lost	7
Other	2

Table 7. Top Two Important Research Questions Concerning Healthcare Facility Operation, by Role

Do Green Healthcare Facilities Help to:	*Role*			
	Designer	Contractor	Provider	Other
	(% of Respondents)*			
Reduce energy cost	60	59	42	77
Improve patient recovery rate	60	70	58	46
Reduce average patient stay	19	19	8	0
Reduce infection rate	47	41	67	46
Lower worker injuries and days lost	9	11	25	16
Other	5	0	0	15

(* E.g., 60% of designers felt reduced energy was one of their top two important research questions.)

Table 8. Top Two Important Research Questions Concerning Healthcare Quality

Do Green Healthcare Facilities Help to:	*Percent*
Attract top quality healthcare workers	30
Reduce healthcare worker turnover	23
Improve healthcare worker productivity	42
Other	5

Table 9. Top Two Important Research Questions Concerning Healthcare Quality, by Role

Do Green Healthcare Facilities Help to:	*Role*			
	Designer	Contractor	Provider	Other
	(% of Respondents)*			
Attract top quality healthcare workers	39	66	57	72
Reduce healthcare worker turnover	58	42	38	48
Improve healthcare worker productivity	77	87	95	72
Other	26	5	10	8

(* E.g., 29% of designers felt attracting top quality healthcare workers was one of their top two important research questions.)

Table 10. Two Greatest Barriers to the Delivery of Green Healthcare Facilities

Barrier	*Percent*
Complexity of facilities – it is challenging to make them green	18
Higher design and construction costs	35
Codes and regulations governing design and operation	10
Current project delivery and contracting practices	14
Ignorance regarding alternative technologies and materials	20
Other	3

Table 11. Two Greatest Barriers to the Delivery of Green Healthcare Facilities, by Role

Benefit	*Role*			
	Designer	Contractor	Provider	Other
	(% of Respondents)*			
Complexity of facilities – it is challenging to make them green	57	30	25	30
Higher design and construction costs	52	71	83	81
Codes and regulations governing design and operation	29	25	0	15
Current project delivery and contracting practices	14	33	33	22
Ignorance regarding alternative technologies and materials	38	36	50	52
Other	10	5	9	0

(* E.g., 57% of designers felt facility complexity was one of their top two greatest barriers.)

APPENDIX 6. SAMPLE FORMAL INPUT SHEET

Greening Healthcare Facilities Roundtable

Date: October 27 & 28, 2005
Location: Doubletree Hotel Pittsburgh City Center, Pittsburgh, PA

INPUT SHEET No. 1 (Introductions)

Documenting Hats, Drivers, and Expectations

What "Hats" are you wearing today?

Please list all the different "hats" that you are wearing today for this roundtable. In other words, what roles will you play, what perspectives will you have, and/or what points of view will you represent, toward the development of a consortium for the greening of healthcare facilities?

What "Drivers" brought you here today?

Please list all the different "drivers" that brought you here today for this roundtable. In other words, what prompted you to attend this roundtable?

Fig. 9. Soliciting Input from the Roundtable Particpants on the Consortium

APPENDIX 7. DRIVERS AND EXPECTATIONS

What "Hats" Are You Wearing Today?

- Planner
- Student – hope to get a good thesis project out of this, make some good contacts and case studies
- Engineer
- Researcher
- LEED Accredited Professional
- Enviro funder
- Leader in greening of health care at UPMC
- Representing and exploring how to further Heinz legacy and interest in green building
- Member of national enviro health movement
- Owner/facilities department of health care facilities
- Co-Director, Center for Maximum Potential Building Systems in Austin, TX
- Co-Coordinator, Green Guide for Health Care
- Chair, LEED Application Guide for Health Care
- Collaborator, Healthy Building Network/Health Care Without Harm
- Practitioner of green design/development policy
- Contractor, engineer, and design-build team leader
- Believer in the process
- Doubter of successful implementation without support for newbies
- Represent view of clients who are not yet ready to leap
- Independent observer
- Proponent of sustainable facilities
- Architect, Payette Associates
- Penn State Hershey Medical Center – Cancer Institute
- Architect – design and product selection
- Construction manager
- Regulatory services executive
- Sustainable initiatives leader for the company
- Health care core support
- Mechanical engineer involved in healthcare design for 25 years
- Operating officer for an A/E design firm responsible for health and welfare of our firm
- Academic
- Research – building performance/healthcare
- Architect
- Practicing architect/firm owner
- Green Guide author
- Pebble Project participant
- AIA Guidelines member
- Environmental health advocate
- ASHE "materials"
- LEED AP
- Construction practitioner
- Facilitator of leading builder of US healthcare facilities
- Engineer
- Advocate for sustainable building practices in healthcare
- How to quantify the benefits of greening healthcare
- Mechanical and plumbing system design engineer
- Mechanical and plumbing contractor/cost control
- Healthcare design oversight

- Construction budgeting and cost control
- Operational evaluation for cost efficiency
- Financial/operations control
- Operations manager
- Healthcare leader
- Learner
- Owner
- Program manager and process engineer
- Streamline integrated design to minimize problems for sustainable design
- Offer pilot/case study for research of a world class institute and children's hospital
- Host for research
- UPCI – Center for Environmental Oncology
- Environmental Asset Monitoring and Control
- Hospital representative for greening UPMC
- Cancer and other disease prevention as it relates to the environment (greening hospitals, homes, environment in general)
- Engineer
- Direction of division at Center for Environmental Oncology
- Educator
- Gather data to make the case that greening saves dollars and lives
- Role of participant to gain awareness of multiple areas of concern and responsibilities, and how they all fit together
- Hats are many!
- Passion for learning new ways to think of environmental concerns
- Resource for interiors and research
- Family member – concern for future generations
- Green building advocate
- Efficiency vs. effectiveness
- Engineering undergraduate
- Graduate student in School of Public Health at Pitt
- Researcher for Pitt Cancer Institute Center for Environmental Oncology working on developing a strategic initiative
- Owner
- Hospital administrator
- Board member
- Construction manager
- Operation of plant/maintenance
- Designer
- Researcher of the design and delivery processes of green buildings, especially healthcare facilities
- Teach in construction management
- Convenor
- Researcher in design process management
- Facilitator of consortium
- Green building/architectural engineer
- Teacher
- Health care without Harm – a campaign on greening healthcare
- Liaison and organizer working with hospitals in Philly and Pittsburgh
- Women's Health and Environmental Network – environmental stewardship
- Environmental health advocate
- Voice of hospital facilities
- Academic research center
- Construction document specification writer and architect

- Green building educator and advocate
- Architectural firm principal
- GGHC Steering Committee member
- LEED Application Guide for Healthcare member
- Promoter of green building and sustainability goals and education
- Strategic planner and communications
- Making research market relevant
- Patient
- Academic
- Researcher in indoor air quality and sustainability
- National Director of Healthcare for Gilbane
- Construction manager working at Hershey Medical Center looking for application to projects
- IAQ researcher
- Educator
- Potential patient
- Taxpayer and insurance premium payer
- Concerned citizen about good health care
- Academician
- Researcher
- Industrial engineer
- Interested in productivity impacts
- Interested in health and safety impacts, especially patient outcomes
- Operations control
- Scheduling and logistics
- Value and cost impacts
- Information gatherer
- Principal of CJL Engineering with a 50% healthcare practice
- Founding member of USGBC
- GGHC Steering Committee
- Green Building Alliance board member and chair of the R&D Committee
- Like schools, hospitals – the right place to be green
- Chair the University of Pittsburgh Medical Center Building Systems committee, setting material and equipment standards for construction and renovation projects
- Director of Engineering and Maintenance for UPMC Oakland
- Manage University of Pittsburgh Research Facilities in Oakland
- Sit on the UPMC Greening Committee
- Editorial Board of Maintenance Solutions Magazine

What "Drivers" Brought You Here Today?

- Interest in hearing all parts of the spectrum to figure out how to optimize the entire process
- Learn
- I take pride in operating my departments proactively and strive to maintain a very high level of accountability on all fronts. This is a very interesting and vital component in that environment.
- To learn more about the state of healthcare greening
- Identify and discuss trends in greening of healthcare facilities
- Continue to be on the cutting/leading edge
- Collaboration and synergy focused on how to make green healthcare happen
- Networking and future business
- Partners in Pitt, CMU, and Penn State
- Research collaborations/partnerships
- Research directions

- See a concrete path to collaborate on health care facility projects
- Healthcare as a strategic sector for sustainability
- Implementation steps
- Education of skeptics
- Common pushback is "How much?"
- Why do Executives care?
- Economic impacts on region
- Critical research areas
- Inspire connections
- To understand industry needs for future research
- Establish collaborations
- Transform health care
- Healthcare facilities are a key issue for green construction
- Change could have major economic impact
- Learn – what are the hot buttons?
- Network
- Exchange thoughts and ideas
- Collaboration
- Transform the healthcare industry
- To learn what the potential research and possible interactions of players can be
- Awareness of needs to reduce healthcare costs and improve health performance through green facilities
- Issues need my skills in scientific research
- Dots are out there, but not connected
- The notion that research in this area can make a real impact on health, healthcare, as well as other building sectors
- To figure out how to get a huge research contract to investigate this issue properly
- Design/cost of operations
- Clean environment
- Reduction in environmental waste
- Productivity of staff
- Improve health care
- Fairly new to the field – important to learn where we are and where we are going/want to go
- Share experience – lessons learned, cost effective greening tactics
- Co-PI who wants to not have to sell greening – it should sell itself!
- Expanded knowledge from various viewpoints of participants and their areas of concern
- Cut to the chase
- Network with expertise
- Case studies of best practices
- Better/cost effective green delivery
- Transform healthcare
- Collaboration
- Opportunity to meet and learn about the issues and concerns of owners and other representatives at the table
- Improve the delivery and use of healthcare with synergy
- Expectations, commitment, and a study
- Learn how to apply green to building design
- Gain experience from others on how to apply within codes
- Improve efficiency
- Transform healthcare
- Collaboration
- Transformation of health care design – improve "hospitals"
- Curiosity/intrigue

- Opportunity to do more
- Learn
- Validate your own work
- Turner as the leading edge of healthcare construction
- Learn and better understand
- Keep our firm on the cutting edge
- Opportunity to do more
- Validate
- Feel like I contributed to a worthy effort
- Improving the built environment for healthcare facilities
- Research into building performance/occupant performance in green buildings
- Push the research envelope – better buildings
- Sustainable design for a current project that will set the process for the owner and future projects
- Change the skeptic
- General contractor involvement in several Hershey Medical Center construction projects
- General interest in greening healthcare facilities
- Information – increase my company's value added services
- Proactive in green
- A desire to do what I do better, in a more responsible and sustainable way – help our clients make good decisions
- Desire to really learn how to make this work in my Detroit marketplace and at my company
- To bring perspective of obstacles to implementation in renovation
- Gain perspective on industry's position on green – what steps are they actually taking?
- Enhanced opportunities for collaboration
- Coordinate/collaborate research and fundraising
- Current work in greening of health
- Beginning of Master Plan expansion over next 10 years with multiple new buildings to be built. We are going to have buildings be LEED certified and are interested in this program as it seems to more adequately apply to healthcare facilities.

What Expectations Do You Have For This Roundtable?

- Everyone excited in generating a successful consortium
- Joining theory with practice
- Clearly defined outcome
- Real data collection identified
- Pilot projects identified to monitor and enhance
- Roadmap of prioritized next steps
- Identify who is missing
- A better understanding of how HMC may apply this program to the construction and operations of our new buildings
- Action plan for resource/knowledge sharing to overcome obstacles of implementation
- Acknowledgement of obstacles to implementation
- Identify a direction
- Gather information, tools, and contacts to advance my efforts
- Find out what my peers are doing – some benchmarking information
- Reality in healthcare design and costs
- Project costs – initial vs. life cycle
- Realism of budget vs. building
- Owner/facilities want green and follow through
- Alignment of sustainable goals with healthcare provider goals
- Business case made

- Identify challenges and tools for overcoming them
- Practical implementation techniques
- Meet partners similarly interested in advancing sustainability initiatives
- Start to peck away at some of the myths of first cost premiums
- Establish collaboration with clear and specific targets and goals identified and an action plan for moving forward
- Inspiration/vision
- Local action and game plan
- Constructive contribution to the discussion
- Clear way forward
- Focus the debate on issues of concern to the executives
- Expand network
- Tangible project with measurable results – identify a pilot project that can implement the ideas generated today and prove tangible results for the team to build on
- Expand network with industry professionals
- What can be done to apply green to research and inpatient facilities?
- Economically improve design and construction to improve operations efficiency and lower costs
- New approaches to apply and new knowledge
- Network with industry expertise – who to go to to find what
- "Big ideas" for breakthrough performance in green delivery
- Best practice ideas to improve green delivery performance that can be applied to Hershey Medical Center
- Driven by healthcare executives
- I NEED DATA!!
- Develop case studies and data on first costs, metrics, and attributes of data
- Walk away with a specific agenda on what are the next steps, not just networking
- Feel this was indeed a valuable session to encourage all participants that we can collectively make a difference
- Application in real world
- Best practices
- Disease prevention activity
- Collaboration for information sources to support our efforts
- Want to develop standard – need to show why we need a new standard
- As a group, we can design a functional building as to operating cost and environmental health. Improve health care services and customer delivery.
- Data on profitability of green design
- What we need to do with this association
- I'm starting to realize that facilities are an integral part of the healing process. They're not treated as such now. Green can help to achieve this.
- For attendees to feel it was worthwhile
- To have exciting new ideas and contacts to work with
- Find a way to come to agreement on next steps that lead to a defined goal or deliverables that build momentum
- Make greening an integral part of healthcare, not just operations but the entire mindset
- Get all talking together from administration to support to facilities and link them to the community needs
- Make greening profitable, sustainable, and common sense
- Identify how university faculty and students can impact this issue
- More positive direction for transforming greening of healthcare
- Identify support for advancing research and knowledge
- Agenda of "next steps"

- Identify areas of activity and actions; clarify roles and actions
- Big picture
- Coherent strategy to pursue vision so high priority needs get addressed
- Learn about main problems (obstacles) for greening healthcare facilities
- Ability to apply key points to many projects
- Specific path to collaboration identified
- Action, not just talk – a plan with next steps
- New collaborations/networking
- Identify/capture trends in constructing green facilities
- Action plan – path forward – pilot project
- Resource sharing
- Direction
- Prioritize future steps
- Identify people, firms, resources not here
- Inspiration leading to shared vision
- Best practices/lessons learned
- Data on greening efforts and costs thereof
- Game plan, next steps forward
- Political strategy to understand what needs to be done to green the healthcare industry
- Very different expectations from owners to obtain data, costs, benefits, why do green

Fig. 10. Roundtable Facilitator, Jorge Vanegas, Helping the Consortium to Make Sense of Its Progress

APPENDIX 8. REACTIONS TO THE CONSORTIUM IDEA

Reactions From the "Gut"

- This group needs to focus first on the actual motives of the various parties involved (and they are not necessarily in this room) in the healthcare facilities delivery community.
- There are several other competing groups that have done some considerable work.
- Broad, somewhat unfocused purpose.
- Objectives are ambitious and need to be clarified.
- Importance OK.
- Provides a good reason to draw people with shared interests to come together.
- Starting point of the conversation.
- Needs the details to be filled in, e.g., the reason for the consortium.
- Moment is right for convening consortium – enough momentum has built and need for exchange of information. However, more players without real collaboration or without clear leadership and goals could at minimum lose opportunity or even damage it.
- Energy conservation, IAQ, infection control concerns, LEED-EB.
- How long will it take to transition from individual thoughts to actual practice, and will this time keep up with current advances?
- Can bottom line be achieved?
- How to collect and disseminate data.
- Pessimistic – changes will be made in the area of greening healthcare facilities only if there is a large, compelling, and obvious benefit/savings.
- Most healthcare administrators won't simply do it because it's the right thing to do.
- Very different expectations from owners: data, cost, benefits – political!
- Reticence on the part of owners toward collaboration; skepticism.
- Big task – missing many major partners, e.g., AIA, ASHE, more major owners, Kaiser Permanente.
- Challenge of implementing change within operational procedures of an institution as that change applies to greening of buildings.
- Green is good, but it's not immediately profitable so it's dead.
- Initial reaction is that the focus is on the mechanics of improving facilities. A real barrier is lobbying funding providers and users to understand the value.
- Sounds good, but will the resources be there for the proper support so that this is not just another published guide without people and resources to share the real life experiences to implementation?
- Generates more questions than answers. How do we make a change without experiencing other negative impacts? How can we generalize the delivery process?
- The proposed consortium should later on be more topic-focused and not so much broad-based.
- Boondoggle – a lot of talk with little opportunity to actualize.
- Gold mine – a wealth of resources to draw upon.
- Inspiration – peer network to build upon for moving forward.
- The process seems to work. I would like to see something physical that would show me that the process has worked in the past and will work in the future.
- Economics.
- Initial enthusiasm will be overcome by other commitments and will degenerate into apathy.
- Where is the glue that holds it all together?
- Good purpose, achievable objective – focus on 92% (salaries) vs. 2% (design and construction).
- Great! I've been looking for partners who have similar goals, interests, and motivations.

- Big undertaking – how do we get it done where the rubber hits the road?
- Everyone is busy – who do we make the consortium important and valuable enough to maintain momentum and achieve involvement?
- Change is hard – political barriers.
- It is important to gather people for all fields to see greening problems from difference of view.
- From health and productivity points of view, to improve the positive strategies.
- This is very important because the hospitals should be better places than what they are now.
- Excellent field for implementation of green technologies.
- Coordination and leadership is key to realizing the tremendous potential.
- Need to balance research and application.
- It will take the right team with a win-win attitude to make this happen.
- Can be done with team members that are willing to change and willing to trust.
- Doesn't cost more.
- Essential interaction for implementation into operative healthcare arena.
- Long term effectiveness – cost/indoor air quality.
- A "must do".
- Align health industry, regulatory, and A/E/C.
- Balance academic with practical implementation – keep feet on the ground.
- Noble objectives.
- Real bite-sized projects for early success to sustain effort.
- Build momentum.
- My gut tells me this is much harder to accomplish in the real world than it is in collaborative session of people who have desires and passions for environmental initiatives. The economics will always be the driver. Put a dollar amount to the value of the benefits of health and productivity.
- Can't end here – must continue.
- Not everybody can do everything.
- Balancing act between challenge and opportunities presented.
- Building recognition of what's been done with what can be done.
- Competition and collaboration among various players.
- Everything is possible!
- Most people are interested, but may not have as much time to dedicate to the consortium as they would like.
- Some people may be disappointed if they don't.
- Outline a framework for how this will work.
- First cost argument for green hospitals needs to be made through design and construction efficiency.
- We are close to a tipping point that could contribute to significant change in the industry. There is a good case to be made if we can find the right words and make the case to tap the motivations of owners – industry will follow.
- Need to prove profitability. Need to prove it will increase life of individuals and facility and lower liability of owner.
- Changing attitudes and behaviors of educated people is extremely difficult and may take longer than I am willing to wait.
- Difficult to get diverse organizations to work together, even with the best of intentions.
- Once we go back to our individual real worlds, how much follow through will there be?
- Major opportunity for state investment if we all come together.
- Need #1 person and/or organization to lead.
- Excited about potential.

Reactions From the "Heart"

- This is a worthy idea for the benefit of all society –

potential!

- Promise for an improved world, and better understanding of all needs.
- Overwhelmed – where do you start?
- Skeptical – can this really work outside this room?
- Cautiously optimistic.
- Save life and environmental conditions.
- I hope that greening the environment will be soon and the value of it will be seen.
- Nature is separate from healing is separate from spirituality in traditional hospitals.
- What will be the cost if we don't do it?
- Hope that the collaboration of these entities energizes and motivates.
- Long term motivation and inspiration.
- Interconnectedness of humans with nature – putting us more in touch with our environment is healing in and of itself. If you take a fish out of water, it dies. If you take people out of their natural environment, we may also die a little.
- Excitement – the benefits of green healthcare facilities could provide the last chance and best incentive to fix many of the things that are broken in our industry. Fix them and you may be able to afford better facilities.
- Save lives.
- Must do, can't wait, impatient.
- Frustration of the way economics and pure $ dominates decision making, as opposed to overall well-being.
- Excitement of being a small part of a larger ideal vision.
- Hope.
- Can you afford not to do it?
- Fear of change – nature not separated from healing!
- Compassion: health care facilities need to address individual needs, requirements, and feelings of those people who co-exist in these facilities and maintain human dignity to all concerned.
- It's the right thing to do.
- Energized to work with like-minded team members.
- Save lives and protect the environment.
- What is the cost to not do it?
- Prevention as an equal mission for the hospital.
- It is the right thing to do.
- It is a needed improvement.
- It is a new paradigm needing to be developed.
- Improve the environment.
- I hate going to hospitals because they are ugly, smelly places which is counter-intuitive.
- Exciting and full of promise – pregnant.
- Human compassion – opportunity to heal.
- Overwhelmed.
- Awe – encouraged.
- It's difficult to change peoples' habits.
- Engineers do work mostly based on experience. New strategies are not acceptable easily.
- Affirmed and confident in my effort to advocate for green healthcare.
- It's difficult to bring together people from this variety of perspectives (logistically and intellectually).
- Hopeful that this can really make a difference – this can help create a better healing environment.
- Relieved that others are interested.
- Counterintuitive challenge to our American ego that relates highly technical to desired/better?
- It seems like the right thing to do, but it's really difficult, thankless work.
- Optimistic! I think that the patients' overall wellbeing is taken into account for other people besides the medical

profession.

- It starts with one…we have 40 people going in different directions with one goal!
- Work together as a cooperative to better facilities, healthcare, and job satisfaction.
- It makes sense, it's logical, it should be a natural outcome that it will be a greater challenge to achieve.
- I want to make this work because my family members who are in and out of hospitals deserve better, more comfortable, healthier facilities.
- This is harder to do than what I and our teams currently know how to do our job – not enough hours in the day to do already what I need and want to do.
- Perception that healthcare is only bottom line.
- Make it happen! It's the right thing to do for all parties involved – patients, staff, etc.
- Emotion takes me to my kids. The future of our people and environment – save lives.
- Angry – Leadership is needed! All the data is not yet in, but owners need to stand up and make an investment and commitment to get the data to generate the proof of concept.
- Take the bet, err on the side that green hospitals may result in improved healthcare, patient and staff performance, prevention, and bottom line. It's the responsibility of healthcare providers to provide better healthcare – a new standard of care.
- Makes sense that green building would improve patient care and operations.
- The environment created within the building affects the outcome of the care provided.
- Improves patient satisfaction in the care provided.
- Competitive industry.
- Concern – greening health care must be done. It is the right thing to do. Health care costs are out of control. More people in the US cannot afford health care. Greening can help reduce costs and make health care more affordable for all.
- Needs to be done, for the betterment of me, us, all, environment, cost.
- Personal commitment to manage areas of our responsibility to a high level of accountability.
- We're resigned to the belief that this comes with a higher financial investment. We can change that.
- Urgent – we have a no choice but to figure out answers. People are dying connected to environmental contaminants and environmental systems keep declining. If we do this right, it must connect to environmental health agenda. We can transform the paradigm of health care.
- Motivation and frustration – who is not sitting at the table?
- Health care can expand its mission from detection and treatment of disease to also include – with equal weight – prevention of disease and service to community and society that has been lost as we know. A model of healing that looks to nature as a significant contribution.
- Something we need to do – it needs to be done.
- Start of the shared conversation.
- This is hard, but it needs to be done. This is transformation.
- Frustration.
- Responsibility.
- Wow – great! One of the better green building areas. Natural application and great opportunity!

Reactions From the "Mind"

- We must develop the tools to educate/convince board members and administrators of the value/necessity of sustaining health care.
- Difficult, time sink, don't do it.
- I believe it is crucial to develop this link between health care and better built environment and an understanding of the link in terms that can be widely accepted in the medical community.
- Needs to be done.
- There is so much to do that we need to work together. Roundtable is the vehicle to organize us.

- Must reconcile "gut" reaction with reaction from the "heart".
- How to deal with adding complexity of green to hospital administrators?
- Good strategy is everything, even if you have a solid foundation.
- To produce results, an effective process must be created determining appropriate stakeholders, supported by good data, producing a sense of efficacy. Data and vision without strategy won't work.
- Define goal, describe sub-categories, prioritize, research, pilot, rollout, buy in, do, feedback.
- Develop a focused vision.
- Educate administrators on the value.
- Join the facility to the treatment – results – value.
- Solve a specific/local problem, then expand solution to global.
- It's all a point of being an organization committed to the community and having establish a high level and process of accountability.
- I manage based on the principles that Kevin Kerns outlined in "Managing for Accountability". Dr. Kerns speaks of developing an open environment in business, making accountability common and instinctual.
- We can do this. The timing is right. Not only is this the right thing to do "morally", it is the economically right thing to do.
- Big task – missing partners – AIA, ASHE, Doctors…
- Leaders – Kaiser Permanente – opportunity to raise the bar.
- Consortium can be a conduit for data, education, and owners.
- Hospitals are very complex. How to raise the priority of green?
- If we can join the emotional patient satisfaction between environment and science of treatment, it will impact the operational bottom line.
- Consortium is a good idea conceptually. Uncertain of plan; that's why I'm here.
- The time has come for something like this – to take all the documents, evidence, facts, etc., and translate it into doable, implementable processes with the proper support and resources to make it a reality.
- The information is out there. We just have to ask the right questions and involve the right people.
- If a consortium is to be successful, it must involve the appropriate body of people and present information and activities to engage them effectively, while increasing accessibility to information, membership, and education.
- No! Greening of healthcare facilities is in the design phase. We have the program established, but we're trying to put all the pieces of the program together to see a final product! We're working on objectives, financing, rising costs of healthcare, construction, and materials.
- We've got the materials and program – let's put these pieces together and create a strong foundation to build on. We're just starting to gain momentum and to keep this momentum going we need to create the ongoing process, we need to keep gathering information, and sharing the knowledge.
- Yes – this is definitely the future for healthcare. Sooner or later it will be mainstream.
- Do my customers want to invest in facilities that will forever ban them from achieving what will become the norm?
- That the shift of behavior, attitude, practice, etc., in facilities is akin to acceptance of eastern medical and holistic and natural healing practices. It's difficult because it goes against what America has adopted as the perfect healthcare environment.
- Need a shared vision of what defines a green healthcare facility and embrace the political challenge.
- Not easy to bring owner and investors to commit to it.
- Solid research in this area is urgently needed.
- The pieces are there, the will is there, the passion is there – it's doable. Have to tap into mission-driven obligation of healthcare.
- Need data, facts, research to support our belief.
- Need leaders.

- Define vision.
- Need tools to educate constituencies to set direction.
- Sell vision (future).
- Yes, but don't have all participants identified and involved, buying in to make green work.
- Balance cost of green objectives with other demands.
- Yes – long term productivity, improved health of patients and staff
- Clear a path through the forest to meet the objectives so administrators can see and understand.
- Logically, anchoring a solid foundation is very achievable; just not easy (requires focus and dedication). Being smart and exploring products and processes in a new way – rethink the old thought process. Awareness campaign is vital.
- As an engineer, it makes sense in theory, but need to prove the theory.
- Not only is it logical and practical to do, but essential. Hospitals should not be in the business of harming peoples' health.
- Not only does health care have a responsibility and obligation, they have to do it to remain competitive and sustainable.
- Hospitals pride themselves in being the stewards of the community's health. We can partner with hospitals to buy into this.
- Green design and sustainable design makes sense for everyone (especially for healthcare).
- The people who make these decisions need to understand this.
- The other problem is that there are so many different entities that are trying to maximize the benefit to themselves that they lose sight of the greater good.
- There is little ambiguity of what to do.
- Does not cost more – metrics are there to demonstrate the facts.
- The question is how and what is the fastest way to overcome the re-learning challenges that exist. Yes – setting up measurements.
- When I breathe smoke and diesel exhaust and VOCs, I feel badly. Know it is hurting my health. Know that greening the environment is equivalent to value of getting miners out of mines, and must be done. Must link health to environment through education.
- Develop focused vision.
- Pessimistic that meaningful change will take place. Concerned that a focused vision is not identified.
- It makes absolute sense – the positive outcomes can be clearly outlined.

APPENDIX 9. STRENGTHS, OPPORTUNITIES AND CHALLENGES

What Are the Unique Strengths Created by the Proposed Consortium?

- Multidisciplinary / Diverse perspectives
- Share of information and expertise
- Collect more and better information
- Provide an individual sense of efficacy – see results elsewhere
- Opportunity to create new skills in members
- Belief in big picture greening
- Leaders of our organizations
- Network of influence through our professional contacts
- We have data already available
- Political connections
- Resource of combined knowledge
- Proven success at other institutions
- Firms that allow for translation
- Mimic by other participants – lessons learned
- Competitors are united under a common goal
- The group can take risks instead of the individuals
- Access to ideas and solutions to make their facilities and work more sustainable and effective
- Diversity allows us to understanding the "other" sides of issues
- Combined effort allows us to more forward on all levels of healthcare
- Ability to evaluate and measure a myriad of issues
- Bring individual perspectives and expertise to bear on a critical issue
- Nobility of the objective
- Coordinated effort
- Enhance and build upon current initiatives
- Provide many answers to a single questions
- Relevant evidence and case studies already exist
- Produce "tools" to affect change
- Have the scale to pursue larger fundraising
- National knowledge base to regional implementation
- Complete collective knowledge to make informed decisions
- Be more that just the sum of the parts
- The mission to join green and healthcare is ripe
- Synergy of unique but complimentary groups
- Benefits are multifaceted: economic, environmental, health, and safety
- Creative cross-discipline/industry think tank
- Proliferation of best practices and good ideas
- Outreach capabilities are magnified
- Credibility

What Are the Unique Opportunities Created by the Proposed Consortium?

- Education of owners
- Hershey Childrens' Hospital as a willing pilot project
- Collaboration with I.N.S.P.I.R.E.
- Windber lessons and data
- UPMC Childrens' Hospital in progress
- Build trust at the roundtable meeting
- Big Funding Dollars
- Unique Funders

- Improve healthcare partnerships
- Improve government and alliance cooperation
- Market Strength
- Mutual Endorsment
- Funneling of Contacts
- Influence policy makers, code officials, standards, funders, insurers, shareholders, board members, communities, and consumers
- Develop evidence-based research projects
- Show strength in numbers
- Raise awareness of a global issue that affects every individual in some way
- Getting out of a thought pattern of greed
- Balance several points of view
- Sloan funding
- National attention – lead by example
- Test solutions with supportive groups and take risks
- Improve safe materials
- Enable students to participate in real projects and interact with practitioners, owners, architects, and advocates
- Community leadership
- Optimization of the whole rather that the individual parts
- Build perception and reality
- Collaboration of research with practice
- Address practical problems in the application of green strategies
- Market transformation
- Leverage resources
- Collaboration on education
- Access to research for industry
- Credibility – retains integrity
- Implementation (broad)
- Expedite informed decision making
- Create a clearing house of ideas, research, and baseline/benchmarking data to provide decision makers
- Compile lessons learned and best practices
- Have side bar sessions to discuss specific issues or topics
- Develop a balanced perspective
- Create momentum
- Ability to divide and conquer but also provide checks and balances

What Are the Weaknesses That the Proposed Consortium May Have?

- Diversity of perception
- Too many personalities
- Too many priorities
- Lack or over abundance of leaders
- Redundancy with other efforts
- Labeled as having a hidden agenda
- Manipulation of data
- Keeping the group a manageable size
- Not all the right players are represented (e.g. nurses, doctors, patients, etc)
- Preaching to the choir – need some devil's advocates
- "We all drank the Kool-Aid"
- Lack of focus, specific targets
- Timeliness of action (i.e. a large beast takes longer to tame)
- Limited ability to change direction/inertia/momentum
- Short term need versus long term vision

- No established framework for collaboration.
- Diversity may lead to diffusion
- No demonstrable success
- Financial uncertainty
- Politics may create conflicts
- Guilt by association
- Time Frame
- Our day jobs
- No ownership by one entity
- Loss of independence
- Passing the buck to other in the consortium
- Geographical isolation
- Focusing on the lowest common denominator/low hanging fruit

What Are the Threats That the Proposed Consortium May Face?

- Becoming too exclusive
- Loss of enthusiasm
- Negative media coverage
- Perception of hidden cost
- No value added
- Fear
- Lack of trust
- Setting the bar too high
- Non-transparent process, roles, and contributions
- Different kind of views
- Whose ox is being gored?
- Becoming a target for criticism from business-as-usual entities
- Inertia
- Other related initiatives
- Resistance to change
- Losing our individual identity
- Equity in time, effort, support, and rewards
- Influence of unsustainable industries
- Conflict of interest between collaboration and the competitive edge
- Perception as a "tree hugger"
- Lack of definition regarding sustainability
- Vocal or active members may highjack the agenda
- Time
- Money
- Lack of buy-in from other stakeholders (e.g. medical equipment vendors)
- Lack of focus, effectiveness, and interest
- Other hospitals not pursuing green
- Bottom dollar costs
- Losing sight of the patients' best interest for the sake of the hospitals' best interest
- Being focused on LEED
- Political issues (e.g. government, regulatory, lobbying)

Fig. 11. Consortium Member, Chris Leyenberger, Describing His Project Delivery Map to the Roundtable

APPENDIX 10. CRITIQUE

What Are the Key Inhibitors That Could Slow Down the Development and Implementation of the Proposed Consortium? Suggest an Enabler.

Duplication of effort	-	Refocus and revise
Hospital board buy-in	-	Good presentation from leaders with evidence
Time	-	Financial support and partnerships
Inertia	-	Owner commitment/leadership, education, R&D, pilot projects
Apathy	-	Motivation
Resource/Knowledge Availability	-	Identification of people ownership
Not getting sufficient attendance due to scheduling	-	Schedule way in advance
Lack of interest	-	Focus on specific solutions to continue engagement
Achieving the same goal	-	Define the goal
Members need to focus on their own daily lives	-	Evenly share the load so that the return is greater than the investment
Establish a working framework	-	Look at models of other consortia
Enhancing Collaboration	-	Clear framework for member interaction
Poor leadership	-	Transparent organization in terms of its achievements and award systems
Too much information	-	Information at the right time
Lack of focus	-	Clear, crisp vision
Effective communication between research and practice	-	Clear framework for collaboration
Getting the wrong people involved	-	Clear mission and goals
Competing priorities of members	-	Communication systems
Differing levels of commitment and buy-in	-	Industry outreach
Fear of change	-	Education
Lack of funding	-	Write proposals (non-traditional sources)
Disagreement of vision	-	Negotiate agreement/develop consensus
Existing perceptions	-	Education, awareness
Not including the right players/ too many players from the same team	-	Develop contacts and assess who need to be here (including the community)
Membership drops due to other pressing commitments	-	Each member or group represented has a backup
Lack of design standards, consistent with individual goals	-	Establishing an outcome or measured outcome – based protocol
Not meeting/exchanging/or growing on a regular basis	-	Develop commitment, schedule, and structure
Waiting for data from research partners	-	Partner w/ researchers that are forthcoming with data

What Are the Key Obstacles That Could Make Difficult the Development and Implementation of the Proposed Consortium? Suggest an Obstacle-Remover.

Long-term nature of projects	-	Seek to use completes work and transferable concepts
Relating cause and effect	-	Chose projects carefully
Funding	-	Membership, grants, corporate funding
Business case/data/evidence	-	Research and Info Documentation
Conflicts of interest	-	Code of ethics
Industry/political opposition	-	Local owner commitment, publicity
Lack of focus	-	Escalation to a higher priority
Not being able to implement goals and agenda	-	Form sub-committees to implement goals
Schedule and timing conflicts	-	Remote participation or broad-based media accessibility
Owner/board buy-in	-	Owner education
Members needing to maintain a competitive advantage	-	Benefit to each member must outweigh what you give up/share
Funding not available	-	Advocate for funding in this area

Industry conflicting interests	-	Clear mission and vision and effective leadership
Wrong motivation or lack of motivation	-	Mutual understanding of clear goals
Owner interest in change/willingness to do things differently	-	Prove to them why it is in their best interest to change
Added cost and time	-	Experience, recorded history, evidence
Communication	-	Clear terminology
First cost vs. life-cycle cost	-	
Association with other "failed", "self interest" and groups and "greenwashing"	-	Be prepared with statistical "facts" that bring convincing arguments and create awareness
Participation costs become prohibitive	-	Attendees get some cost reimbursement
Segmentation of the industry	-	Formation of interdisciplinary teams
Existing linear process for design, build, operate, and maintain	-	Need to allow for feedback loops
Loss of interest	-	Check-ins, regular meetings
Loss of focus/change as needs evolve	-	Implement good feedback and checkpoints
Presently, there is no recognized public champion for the effort	-	Measured results should establish interest

What Are the Key Barriers That Could Prevent the Development and Implementation of the Proposed Consortium? Suggest a Barrier Breaker.

Absence of projects or policies	-	Broader based opportunity research
Lack of measurable achievement in a small time frame	-	
Funding	-	
Politics, codes and regulations	-	Include these people in the consortium
Legal barriers to participation of members	-	Look at working consortia
Bottom dollar budget	-	Develop new budget structures
Status quo	-	Defining a reward for change

APPENDIX 11. RESEARCH AGENDA DEVELOPMENT

What Can the Proposed Consortium Do to Position?

- Share within our system and affiliate hospitals operations
- Share with out community groups
- JCAHO - Joint Commission on the Accreditation of Healthcare Organizations
- DOH – Department of Health
- Federal, State, and Local Governments
- Code Organizations
- Building Groups - AGC
- Educate Design Groups – AIA
- Communicate the positive effects to Owner Groups – hospital boards and executives
- Equipment Suppliers
- Research Organizations
- Funding Sources – NSF, NIH, endowments, Sloan
- Building Trades
- Insurance Organizations
- Manufacturers, vendors
- End Users (e.g., doctors, nurses, patients, unions, AARP, VA, other societies)
- Venture Capitalists/ investors
- National Healthcare Networks – Trinity, Ascension, non-profits, profits
- Health Departments at the state level
- Build demonstration cases
- Media/Journalists
- Philanthropic organizations
- Through non-green journals and associations
- Hershey Medical Center upcoming projects
- Consumer reports
- Communities
- Presidents of Universities
- PA Congressman Murtha
- Build trust with each other – blind trust among partners
- Learn from other green efforts
- Focus on the right type of owners

What Can the Proposed Consortium Do to Pursue?

- AIA – work to include efforts into AIA standards for healthcare facilities
- JCAHO – work to make these issues a part of accreditation
- Congressional leaders – visits and lobbying with data
- NIH– National Institutes of Health
- Target Owners w/ conference sessions and data
- Lobbying – Harrisburg and Washington D.C.
- Word of Mouth
- Senior leadership of national healthcare networks
- Website of best practices and product recommendations for design professionals to access
- Code officials – IBC, BOCA, UBC, SBC
- Publish research in JAMA (Journal of the American Research Association)
- Present data at insurance industry conferences/periodicals/peer-reviewed publications
- Propagate green awareness
- Lean Construction
- Integrate into activities in healthcare (conferences, peri-

odicals, etc.)

- One-on-one meetings
- Consumer groups
- Generate a "need to know" and "what is it" resources/fact sheets
- Feed friendly media stories
- Develop case study projects of exemplary high-performance healthcare
- TV and Radio

What Can the Proposed Consortium Do to Partner?

- AIA w/ requests for proposal
- NIH – National Institutes of Health
- Conferences
- Training Sessions
- JCAHO – Joint Commission on the Accreditation of Healthcare Organizations
- ASHE – American Society of Healthcare Engineers
- EPA – Environmental Protection Agency
- AIA – American Institute of Architects
- ASHRAE – American Society of Heating, Refrigeration, and Air-Conditioning Engineers
- AMA – American Medical Association
- AHA – American Hospital Association
- Doctors
- CDC – Center for Disease Control
- FDA – Food and Drug Administration
- INSPIRE – Research Agenda of the Green Building Alliance in Pennsylvania
- USGBC – U.S. Green Building Council
- ASID – American Society for Interior Designers
- EPA Region 9 (CA) Building Healthy Hospitals Project has similar research and publication goals
- H2E – Hospitals for a Healthy Environment
- The 7 Group (in Pennsylvania)
- Greenbuild – present and collect information
- Partner with organizations to create and pass legislation to support healthcare greening efforts

What Can the Proposed Consortium Do to Persuade?

- Encourage innovation instead of fear of change
- NCEMBT – National Center for Energy Management and Building Technologies
- Owners of healthcare facilities on healing benefits
- Insurance industry on healthcare cost reduction, reduced mediation costs
- HMOs
- Corporations
- Foundations
- Federal Government
- EPA, DOE, VA, NIH, CDC
- Department of Defense
- Use our depth/diversity of experience/expertise
- Improved quality at the same cost
- Patient advocacy groups
- Design professionals
- Manufacturers
- Medical professionals

What Can the Proposed Consortium Do to Perform?

- Research Institutions – faculty, graduate students, post docs

- National Labs
- Universities partnering with case study projects
- Set up board and review committees
- Volunteers
- Retirees
- Funded Staff
- Baseline administrative staff
- Strategic, Tactical, operational
- Donate time and resources from larger supportive companies and corporations

What Can the Proposed Consortium Do to Profit?

- Sell our services – individual or company
- Educate others and ourselves
- Reduced staff turnover
- Health benefits
- Overall quality of care
- Improved image
- More integrated design
- Licensing
- Consulting

What Are the Questions That the Proposed Consortium Will Attempt to Answer?

- Does wind energy cost less than natural gas or coal generated power when health effects are taken into account?
- Can improving the efficiency and quality of the design/construction process save cost that can then be used for further improving the quality of the final building?
- How different it the project delivery process on green projects to non-green projects?
- How does greening healthcare (re)shape project delivery?
- How can you prove that green healthcare facilities cost no more than non-green?
- What is a green hospital? What matters?
- What are the externalities that affect performance?
- What sources of waste in traditional mechanical and envelope design and construction processes both diminish building quality and create health risks to patients?
- How does a green building reduce infections during and after surgery?
- How does a green building reduce stress levels as to color, texture, space, and light?
- How can we accurately demonstrate improvements to environments inside hospitals?
- What are some of the direct measurable health benefits that show green facilities should be built?
- Is there an authorized mainstream report of results verifying the information presented by the consortium?
- How can integrated sustainable design provide a high-performance building within budget and schedule?
- CFO – what is in it for me (long-term productivity, health, etc)?
- Does it really cost more? Can you afford not to do it? Why?
- How do we get the best use of our resources (people, capital, materials, etc.)?
- What codes need to change to meet green objectives?
- How can we produce products that meet green less expensively?
- Will the greening of hospital facilities help patients heal more quickly?
- Will doctor/nurse turnover rates decrease as a result of green facilities?
- Built environment effect of staff productivity
- Acoustic environment effect on patient outcome
- Daylighting impact on medication dosage

- How much does X affect Y? (X=light, air, views, acoustics and Y=recovery rates, infections, worker turnover, length of stay, medication needed)
- What are the process modifications that will most effectively reduce the key waste streams? What are the design features that will support these process modifications?
- What industries could support the improvements of greening healthcare because it is in their interest (e.g. energy reduction, insurance)?
- What is the impact of medical equipment to project cost and schedule?
- What are the economic and health tradeoffs associated with the use of different mechanical systems such as 100% outdoor air, recirculated systems, variable air volume, and constant volume systems in support of a green hospital?
- How do we really convince the investor and owners to accept green technology and willing to spend money for them?
- Does sustainable healthcare building cost more?
- What are green building benefits? How can we quantify them?
- Can health and productivity benefits influence insurance costs?
- What is the ecological footprint of a hospital?
- What are the operational and maintenance requirements of green hospitals?
- Do green building features affect patient outcomes?
- In the life-cycle of a healthcare facility, where are the negative health and/or environmental impacts occurring?
- What is the difference in intitial and life-cycle costs for green facilities?
- How can we educate professionals to dispel the myths of green and sustainable design?
- Can sustainable design satisfy infection control?
- Do sustainable buildings heal patients faster?
- Are sustainable buildings better for the built environment?
- How can design professionals gain access to supporting data to assist decision makers in their choices?
- How do we balance effective systems to install, efficient to maintain, and environmentally responsible for occupants?
- How do we design sustainably to keep up with changing technologies in such a fast-paced industry?
- How is this able to be implemented at the hospital level?
- Will green buildings help the hospital in terms of profitability or staff productivity?
- What resources are needed to make a successful implementation?
- What are the synergies and conflicts between green initiatives and healthcare business initiatives?
- How do hospitals decide which measures to pursue?
- Are reported savings in energy, health & safety, productivity, etc actually attributable to green or other related factors?
- Establish shared metrics for measuring
- Can a common database of construction costs with variables such as construction types, locations, use, applications, etc be developed from existing projects and extended for future costs?
- Should LEED standards change based on the type of healthcare being provided?

What Are the Problems That the Proposed Consortium Will Attempt to Solve?

- Can hospitals in a non-urban setting allow natural ventilation without negatively impacting infection control?
- Which design guides should be used?
- Is there an ideal design/delivery process that should be used for uniquely complex projects like healthcare facilities?
- How do we maximize the success of green projects (e.g., worker productivity, IEQ, healing environments, etc.)?
- The reality of the first cost mentality
- Reduce the learning curve – help build industry competencies

- De-bunk misconceptions
- High cost of healthcare
- Operational cost after construction
- Problems of evolving supply of materials that may or may not be safe materials
- Keep projects in budget and within the program
- Poor project delivery, team performance
- Balancing the application of green choices to meet budget, schedule, program, and operational objectives
- Technological limits to current materials, systems, and products within a building
- Sources of funding for healthcare environmental improvements
- Waste reduction and disposal
- Analysis and process modification of operations
- Low priority of green on the agenda for decision makers
- Lack of communication between owners, architects, engineers, buildings, and users of healthcare facilities
- Increased energy consumption
- Super sizing facilities
- Maintenance nightmares
- Identify misunderstandings about the relationship between green healthcare and clinical outcomes and develop correct information
- PBT material avoidance strategies
- Budget doesn't meet scope, inflation, construction costs
- Limited availability of green products and manufacturers
- Finish the LEED/sustainable "marathon" – start and complete the process.
- Unrealistic life-cycle costs
- Water conservation in a surgical environment
- Energy conservation with radiology equipment
- Recycling on jobs with too many hazardous materials
- Highly volatile materials prices driven by high energy costs
- Maintaining a budget using sustainable materials and designs
- Getting "proof of concept" data that owners need to make decisions
- Risk management, liability concerns
- Short term versus long term tradeoffs
- Not enough budget for desired scope
- Construction manager expertise being brought into project too late

What Are the Needs That the Proposed Consortium Will Attempt to Satisfy?

- Identify where in the life cycle of a building green issues would have the largest impact?
- Eliminate/reduce toxins
- Define a process of greening healthcare facilities
- Eliminate ambiguity about what works
- Connect different disciplines to help sharpen and focus research questions
- Medical waste minimization
- Basic human needs
- Awareness campaign of what really affects your everyday life
- Market transformation
- Improve project delivery team performance (optimization of resources, people, capital, and materials)
- Healthcare cost model
- Staying current with changing technologies
- Channel the consortium's research into educating future professionals
- Knowledge of sensible, costly, and available design efforts

- Sustain sustainability throughout the operation of the facility
- System designs that are sufficiently flexible to address the changing healthcare delivery system without restructuring the physical building
- Guide to help decide between competing priorities or green measures.
- Effectiveness of green measures
- Healthcare cost reduction as a result of green (affordable to all)
- Evaluation of where we are and where we want to be

What Are the Opportunities That the Proposed Consortium Will Attempt to Realize?

- Economic development: New materials, applications, jobs, expertise, services
- Lessons learned
- Continued and expanded education
- Standards for greening materials
- Establish a model for all to see of a successful business operation by measuring employee health, energy consumption, appearance, etc.
- Increasing market share for green facilities
- Certification
- Conserve existing material resources
- Develop a software package to track and disseminate operational improvements that may require collaboration from various entities
- New IT solutions for paperless environments
- Linking academics with industry and professionals
- To create functional design that promotes patient wellness and health
- Product creation
- New business collaborative groups
- Develop standard protocols for operations that have safe
- Develop standard protocols for operations that have safe and effective results
- "Green bonds" for healthcare construction (lower interest)
- Additional sustainability ideas as they apply to healthcare'
- New business model
- New uses for existing buildings and campuses
- New energy recovery systems that prevent cross contamination and reduce use
- Opportunity to fill the void and define what makes a product green
- Job training – teach housekeeping staff how to clean using green products and new methods, education for MDs and RNs on environmental health
- Publish a journal or periodical
- Capitalize on what we already know
- Identify new project management techniques for green buildings
- New college majors/programs and community programs
- Lecture series for universities and communities

What Are the Aspirations That the Proposed Consortium Will Attempt to Fulfill?

- Link sustainability into an accountability audit for hospital operations
- Be part of the developing team of a new model for healthcare service
- Transform the healthcare industry – lower costs
- Effect change in the healthcare industry
- Tie into INSPIRE program
- Improve the healthcare experience through the environment and building design
- Improve the building delivery systems to provide flexibility to design, efficiency to building operation, ideally combined with efficiency to deliver materials to the project

- To provide more efficient care in a healthier environment
- Allow sustainability to penetrate all market sectors
- Sustainable health and well being for all in a dignified manner
- Improve healthcare design through facility design, construction, operation, and maintenance
- Catalyze regional demonstration initiatives
- Design for health and wellness
- Connection to mission: "First do no harm"
- Reconnection to humanity
- Improved quality
- Transform the industry
- Reintegrate dignity
- Link health(care) to nature
- Raise the standard
- Better healthcare delivery
- Reduced patient stress
- To help people live longer healthier lives
- Cost-effective, comfortable, and calming building environments
- High performance teams deliver high performance buildings
- Address a fast growing disaster (escalation of healthcare costs)
- Make healthcare service and delivery sustainable
- Involve the community and environmental groups in charettes
- Community based healthcare that not only provides treatment but prevention (healthy food store, athletic facilities, places of repose, spas, etc)

Who Will Pay for Answers to Questions?

- Insurance industry
- NIH, NSF, CDC, EPA
- Government
- HMOs
- Kresge Foundation
- Window manufacturers
- Standards committees
- Utilities
- American Heart Association
- Highmark HMO
- CFOs – investment in green paybacks and additional value

Who Will Pay for Solutions to Problems?

- General contractors and architects – less risk
- Insurers – pay for measure that reduce their costs
- Product manufacturers – pay for markets for products
- Owners – pay for measure that reduce their cost
- Heinz Endowments
- Robert Wood Johnson Foundation

Who Will Pay for Satisfaction of Needs?

- Owners – better healthcare, lower costs
- Customers (patients) – will pay for better care, single rooms, more control of their space, better food, personal attention, etc
- Sloan
- PSU and Pitt grants
- Hospital boards and investors

Who Will Pay for the Realization of Opportunities?

- Healthcare providers
- Healthcare facility designers and contractors

Fig. 12. Making a Strong Point to the Consortium

APPENDIX 12. DEVELOPING A PLAN OF ACTION (SESSION VI)

Strategic Goals

- Pool resources and expertise to develop a powerful resource team that a high likelihood of meaningful success in critical areas of Healthcare Facility Delivery
- Decision making that is driven by better clinical outcomes
- Create a project development team that will develop a proposal to address the "NIH question" (i.e. what is the interaction between building design/construction, building performance, and clinical outcomes)?
- Show that green buildings are not more costly than non-green buildings.
- Evidence-based knowledge management
- Identify cost savings through waste minimization of process and products
- Measurable outcomes on products validity. Resolve products issues, product review, standards requirements.
- Methods for enacting the healthcare industry
- Improve clinical outcomes
- Improve clinical outcomes through the design, delivery, and operation of healthcare facilities.
- Create a healing environment through utilization of electrical/lighting systems to keep staff and patients in a productive and comfortable environment
- Refine healthcare delivery methods to provide improved performance of buildings to benefit health outcomes
- Reduce waste in processes and operations
- Demonstrate the green facilities have a positive impact on patient care/healing

Tactical Objectives

- **Objective:** Develop a meta-organization for working together
  Plan: Tap INSPIRE as a head start
  Metric: Retention of key players
- **Objective:** Study hospital facility decision making process and describe the strategic goals that underlie the process
  Plan: Select multiple projects and develop an instrument to map decisions and their underlying basis
  Metric: Rank strategic goals that inform process
  Assumptions: Decisions are based on a variety of factors not related to clinical outcomes
  Expectations: Using clinical outcomes to inform decisions will result in different decisions
- **Objective:** Develop a decision making model that uses "better clinical outcomes" as the foundation for making facility delivery decisions
  Plan: Collaborate with project teams to develop a model that uses available clinical outcome data to inform decisions
  Metric: Correlate decisions that were and were not informed by clinical outcomes
  Assumptions: Outcome based decision making will bring different information and parties to the facility delivery process
  Expectations: Outcome based decision making will produce "greener" healthcare
- **Objective:** Submit a proposal to research the "NIH question" (Strategic Goal #3)
  Plan: Gather interested and capable parties (preferably experienced in NIH proposals) to develop the proposal. This group should include hospital members, architects, and policy groups.
  Metric: Funded proposal
  Assumptions: There are interested parties willing to give the time, resources; willing to work together
  Expectations: There are interested parties willing to give the time and resources
- **Objective:** Show that green buildings are not more costly than non-green buildings.
  Plan: Partner with USGBC to study the 2000 green facilities on their website and then survey these companies over the next three years to establish outcomes
  Metric:
  Assumptions: Companies will provide information
  Expectations: Can gather information in a timely manner
- **Objective:** Compare nurse and healthcare staff retention between an existing green healthcare facility and an other similar non-green facility
  Plan: Cooperate with a LEED hospital
  Metric: Patient outcomes, staff retention rates, productivity, and operational costs
  Assumptions:

Expectations: Nursing staffs satisfaction and retention in green facilities is better than in non-green facilities

- **Objective:** Measure the cost of waste factors and products
  Plan: Look at safer, recyclable materials
  Metric:
  Assumptions:
  Expectations: Safer, recyclable materials are cheaper in a life-cycle analysis

- **Objective:** Transformational change in the healthcare industry
  Plan: Look at evidence-based design
  Metric: Patient healing rates and staff retention

- **Objective:** Influence implementation
  Plan: Presentation of vision with a plan for input, implementation, and support
  Metric:
  Assumptions: Resistance, opposition, indifference
  Expectations: Promote, hope, increased value, and support

- **Objective:** Demonstrate a cost-value relationship
  Plan: Prove the cost of building green will increase the value by improving the health of staff

- **Objective:** Evaluate the effect that different mechanical systems have on indoor air quality and clinical results for surgery and recovery
  Plan: Trend facilities in operation with different mechanical systems
  Metric: Outdoor air ratio, cleanliness, air change rate for effective removal of generated contaminants

- **Objective:** Quantify the increased value from specialty lighting (i.e. circadian rhythms) or indirect lighting on systems
  Plan: Test in a specific set of facilities
  Metric: Alertness, staff retention, patient satisfaction surveys

  Expectations: Increased alertness, improved staff retention, and higher patient satisfaction

- **Objective:** Improve designs to reduce waste in the design and delivery.

- **Objective:** Set budget level for use of green objectives
  Plan: Define options and cost/benefit of options
  Metric: Initial cost of product and operational costs

- **Objective:** Improve staff productivity, patient healing through healthy environments
  Plan: Establish specific research proposal to be tested on HMC capital program
  Metric: In operations - staff attendance, turnover rates, patient stay days, infection rates. In building – amount to landfill, local procurement of materials. In design – sufficient process.

- **Objective:** Prove that choices of HVAC, materials, etc lower patient time in hospital demonstration projects
  Plan: design new materials, products, and processed to achieve these goals

- **Objective:** Resolve HVAC conflicting objectives (IAQ vs energy efficiency)
  Plan: Negotiate objectives with other guiding panels/ consortia.

Needs

- Start-up funding

Do's

- Collaboration

Don'ts

- Isolation

APPENDIX 13. COMMITMENTS

Personal Commitments

- Contribute strategic ideas and diplomacy to help keep consortium members involved and engaged
- Advocate for participation in the study by project teams
- Help pull project team together to submit to NIH-like funding
- Work on a team that will benefit from my association with UPMC, UPCI, and Pitt.
- Be a resource for contacts and experts throughout the U.S. and identify partner hospitals in other regions
- Commit lessons learned, knowledge and experience to the betterment of healthcare facilities specifically a number of surveys/studies, information on psychology of healing through color selection and targeted audience.
- Assist in the implementation though project application, case studies, and evidence-based design (with cross-over to green building strategies).
- Whatever I can do
- Identify contacts for existing facilities to measure. Assist with refining, focusing measurement, and metrics. Provide results analysis and potential impacts to real world costs and processes.
- To share project resources to further the cause
- Participate in making the Hershey project as a pilot for implementing green healthcare
- Use Hershey Medical Center as a pilot project for research. Use students in research, LEED documentation, implementation, and measuring results of best practices. Offer HMC project delivery roadmap as a starting point to refine green process to improve efficiency and reduce waste.
- Review research outcomes for a plan to create guidelines and implement outcomes.

Institutional Commitment

- Penn State University
    - Research in areas of mechanical systems design and indoor air quality and case studies on delivery.
    - Coordinating consortium – sponsor cyber meetings
    - Contribute resources to help establish a proposal team
- Turner Construction
    - Dedicate a portion of staff time to study participation
    - Eighty-20 Resources
    - Offer in depth presentation on healthcare market segments – market research and the impact of psychology of patient care
- WHR Architects
    - Industry Support
- Windber Medical Center
    - Data on why we have the lowest infection rate
- Southland Industries
    - Data, projects, and contacts
- Barton Malow
    - Offer projects for pilot and/or testing of strategies for work currently under construction. We currently have a project registered with the GGHC.
- Hershey Medical Center
    - Utilize pending building projects as pilot programs for collection of data and information
- Mascaro Sustainability Initiative
    - Resources for partner projects – faculty/student teams
    - Joint grant development

Commitments Expected from Others

- Identify a responsive champion; contribution of expertise
- Inclusive discussion on potential funding sources
- Efforts to demonstrate research results
- Participation with project development teams

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Lean and Green
RESEARCH INITIATIVE

Penn State University
104 Engr. Unit A
University Park, PA 16802
814-863-2080

www.leanandgreen.org