Georgia Tech's Sustainable Facilities & Infrastructure Training: Lessons Learned

The concept of sustainability is gaining increased interest by decision makers as a potential solution for the myriad of global, regional, and local problems facing society in the late twentieth century. Even as developing nations struggle with issues of overpopulation, disease, and political conflict, developed countries such as the United States must balance problems such as infrastructure deterioration, pollution, and natural habitat loss with limited economic and physical resources to solve them. Sustainability offers a way of looking at problems on both large and small scales, seeking to ensure that the needs of humanity are met in the present without endangering the potential for future human needs to be met. In the context of built facilities, sustainability can be defined as a state of the facility system marked by stability, both internal to the system as well as in terms of its context, into the foreseeable future. In terms of this definition, a sustainable facility is one that meets the needs and aspirations of its stakeholders without net negative impacts to the resource bases or ecosystems on which the system depends for its ongoing existence (Figure 1).

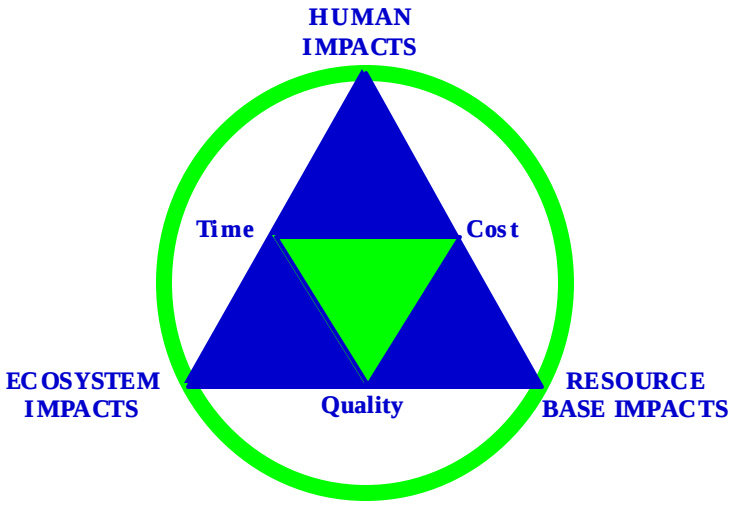

Figure 1: Parameters of Sustainable Facilities and Infrastructure (Pearce 1999)

Existing strategies for creating sustainable built facilities range from recycling construction and demolition waste, to designing for energy efficiency or healthy indoor environments, to integrating building systems for wastewater, heating, and other basic functions with existing ecosystems that perform those functions in nature. The domain of built facilities is ripe for implementing sustainability because not only are buildings vital to human existence in nearly all parts of the world, but also the built environment is one of the largest consumers of natural and manmade resources in the range of human endeavors. Built facilities also represent one of the most significant sources of negative impacts to the natural ecosystems on which we depend for life support. Traditional

construction represents a profit-based approach to constructing the built environment, with minimization of cost as the primary objective, maximizing quality and performance as secondary objectives, and minimizing negative environmental and other sustainability-related impacts as a tertiary objective. The shift to a sustainable built environment does not necessarily eliminate these primary objectives of traditional construction, but rather embeds them in a larger context of sustainability-related objectives.

To move toward sustainability, the Architecture/Engineering/Construction industry requires significant changes in the way it currently delivers facilities and civil infrastructure systems projects, and also, in the way manufacturers and vendors supply the building technologies, systems, products and materials it uses. Specifically, sustainability goals, concepts, principles, and guidelines need to be explicitly and systematically integrated in a project, at all stages of its life cycle, particularly the early funding allocation, planning and conceptual design phases. The challenges are: how can this be done? Where can one begin?

Sustainable Facilities and Infrastructure Courses

Georgia Tech's Sustainable Facilities and Infrastructure continuing education series was conceived as an alternative to the state of the art in sustainability information. Our audiences include architects, engineers, contractors, builders, developers, planners, owners, and others who are interested in the concept of sustainability as it applies to the built environment. Why might they be interested in sustainability? There is solid evidence that sustainability can save them money, reduce their liability, attract new customers, open new markets, and increase their competitiveness over the long term.

While many conferences, workshops, and publications are now available that deal with built environment sustainability, few if any of these resources provide a whole systems perspective. Those that do consider whole systems generally fail to provide sufficient detail to permit practitioners to apply the concepts to their specific context. Further, those people who seek a single resource spanning the range of sustainability issues from concept to technical details will find that no such resources currently exist. Georgia Tech's Sustainable Facilities and Infrastructure continuing education curriculum was designed to meet the needs of built environment stakeholders who are seeking to make their facilities more sustainable. This series of courses is designed to fill these gaps with two significant sources of knowledge: 1) Georgia Tech's research-based knowledge of sustainability theory, integrated problem solving, and systems analysis; and 2) the lessons and knowledge-based expertise of professional practitioners. We've designed a set of seven courses that will teach course participants how to:

- Understand what sustainability means.
- Understand how sustainability might benefit their enterprises.
- Measure the sustainability of current and future projects.
- Understand the economic costs and benefits of this new approach.
- Work with diverse teams to make sustainability happen.
- Use state-of-the-art tools and resources for analysis, design, and problem solving.
- Prioritize potential strategies for improving project sustainability.
- Apply specific strategies to their projects.

Participants who pursue a certificate are required to take the first three courses in the series (*SFI 100: Primer, SFI 200: Assessment Tools and Techniques, and SFI 300: Economics of Sustainable Facilities and Infrastructure*). These courses are designed to provide a common basis of understanding of the concept of sustainability and the general analysis tools and methods useful to all built environment decision makers seeking to increase sustainability. SFI 100 serves as an overview course, and is appropriate for participants interested in taking only one course on built environment sustainability. Following the three required courses, participants will take one of four discipline-specific courses that correspond to different phases of the project life cycle: design (SFI 410), construction (SFI 420), real estate development (SFI 430), and facility management, operations, and maintenance (SFI 440).

Although the entire certificate series has not yet been offered, condensed versions of several courses have been taught under contract for Federal agencies. The following section describes lessons learned from these courses.

Lessons Learned From Federal Agency Training

Nine contract courses have been provided to several federal agencies. During these courses, the following types of data were collected during facilitated exercises:

- The meaning of built environment sustainability.
- Reactions to, benefits of, and risks of implementing sustainability.
- Likely barriers and barrier breakers.
- Ease of LEED™ (U.S. Green Building Council's Leadership in Energy and Environmental Design) point implementation.
- Barriers to, benefits of, and next steps for implementing top-ranking LEED™ points.
- Recommended action items, benefits, required resources, and target dates.
- Personal commitment input sheets, including benefits, required resources, and target dates.

Reactions to Sustainability

After the two-day course, participants were asked to give their individual reactions to sustainability. Not surprisingly, after hearing about a variety of strategies for improving built facilities, most of the responses were overwhelmingly positive. Participants, for the most part, believe that implementing sustainable strategies in their facilities is a good idea. There is concern by some participants about gaining the support of upper management and about the difficulties that may be associated with implementing a new way of conducting the facility design and delivery process. The following list summarizes commonly stated reactions to sustainability.

- Sustainability is a great idea.
- We will probably see significant impacts by implementing sustainable design and construction strategies.

- We need to begin implementation and this will require changes in the way we do business.
- Implementation won't be easy.
- We need upper management support.
- This will probably require additional funding.

Following are some quotes from participants that express their views:

"We need to take stewardship of resources into consideration of what we do. If consistently used [it] should be easier and cheaper than the way we do them now…Need more guidance and funds…"

"Mostly just good design, much of which we should already be doing."

"Fantastic - support of concept and principle. Concern over costs (initial, up front). Difficult to change organizational and A/E mindset towards sustainability."

"A good idea but should include upper management first…The program is great if all players are on the same sheet of music."

"I think all of these ideas are excellent, but I doubt that they can be put into effect anytime soon, due to the overall mentality of the persons working."

"Good idea, but budgetary constraints may make it impractical."

There were also, of course, some participants (a minority) that were not convinced by the end of the training that sustainability is something important for them to consider. Here are some representative quotes from this group:

"This is a social problem – hard to implement given economics now."
"Driven by politics and directives more than practical and economic factors."
"Is this like TQM?"
"Nice thought – not practical."

Benefits of Sustainability

The participants were also asked to list potential benefits of implementing sustainability in their facilities. The following benefits were identified:

- Reduce waste and conserve natural resources (e.g., water, energy, materials).
- Protect the environment for present and future generations.
- Save money.
- Improve public relations.
- Have happier, healthier employees.
- Build better facilities.

Risks of Sustainability

Participants were asked to identify risks that they would expect to encounter when implementing sustainability in design and construction within their organizations. Examples of successes with implementing sustainable facility strategies were included in the training, as well as discussions about how integration of these strategies early in the design phase often results in buildings that do not cost more up front. Higher cost was still the most commonly stated risk. The following list captures the majority of the risks participants perceive to be associated with sustainable facilities.

- High costs.
- Lawsuits.
- Increased time required.
- Not measuring up to expectations/losing credibility.
- Opposition to change by others.
- Performance and durability or possible failure of unfamiliar products and technologies.

Barriers & Barrier Breakers

Several key themes emerged throughout the training courses as potential barriers to implementing sustainability. Proactively addressing these barriers will be important to enhance the probability of success. Commonly cited barriers and recommended barrier breakers are described below.

Perceived Economic Impacts: Participants have concerns that sustainable projects will cost more, if for no other reason than more research and management will be required in from the early part of the learning curve and/or sustainable materials, contractors, and A-E's are difficult to find. This barrier is countered by anticipated life cycle cost saving resulting from sustainability.

An approach to overcoming this barrier is to begin with low- or no-cost sustainability solutions in order to establish a history of project economic success. Such solutions could include reuse of existing structures, use of cost-neutral solution such as waterless urinals or changes in paint colors, or elimination of irrigation systems via the use of native plantings. In other cases, projects with rapid payback (e.g., within a single budget cycle) can provide the basis for demonstrating economic success with sustainable projects. Participants also suggested that life cycle cost analysis be required to support all project decisions. Documentation of the economic impacts of project sustainability is paramount. Additional training that includes more case studies with economic data can also help to ameliorate perceptions that sustainable projects cost more, as well as provide the economic tools and data to support calculation of true economic costs and benefits to support project decision-making.

Individual and/or Organization Resistance to Change: This is always a factor, particularly when some individuals have a stake in the status quo or when not everyone believes there is a need for change.

One approach to minimizing resistance to change is to explicitly articulate the costs and benefits that can result from the change, thereby providing better information as a basis for a more sound reaction to the possibility of change. More information and a clear articulation of the vision behind the change can increase the alignment of the team behind the change. Identification, education, and top management support of key players is critical to generating the momentum necessary for change. Also critical is the provision of necessary resources, tools, policies, and procedures to ensure that everyone has the same understanding of what the change entails and how to implement it. Finally, choosing battles wisely to ensure short-term victories is important to avoid demoralizing even the most ardent champion of change. Felt that having clear leadership and commitment from the top would dramatically reduce resistance to change. Even those who might remain personally opposed to change would be required to implement sustainability with sufficient encouragement from the higher-ups.

Lack of Necessary Knowledge: As with any new concept, some participants feel a need for more education and training before implementation, to reduce the potential for failure, mistakes, or other embarrassment. Many participants are also concerned that without awareness of sustainability goals on the part of all project stakeholders (e.g., from top management down to the trenches), project team members may inadvertently or intentionally work against each other.

While the introductory training for stakeholders has provided a point of departure fro establishing a common knowledge base and vision for capital project sustainability, it is likely that additional training will be needed to provide the tools and techniques for actually implementing sustainability techniques on real projects. Additional information in the form of case studies, field trips, and other examples can also help to bridge the gap between idea and implementation, as well as overcome misperceptions about likelihood of success, economics, or stakeholder buy-in. Alternatives for providing necessary knowledge include establishment of a resource center for personnel (e.g., reference materials, products samples, case studies), follow-on training for specific project strategies, refresher training on a periodic basis, or development of customized, detailed procedures and guidelines for sustainable projects. Finally, nothing works better than actual experience, which may be obtained by trial of new strategies or by adding experienced personnel to project teams.

Lack of Management Buy-In: Some participants are not yet confident that their forays into sustainable capital projects will be backed fully by management support, particularly if traditional metrics of project success (e.g., budget, completion time) do not prove to be favorable. This barrier can be addressed by emphasizing policy trends at a federal level that are increasingly requiring sustainability concerns to be considered in capital projects receive training on sustainability, and that proactive measure are taken to align personnel behind a common, well-articulated, operational goal of sustainability. Other approaches

include establishing a sustainability functional unit or working group of permanent staff. Ultimately, the only way to address this concern is to establish the organizational infrastructure that can sustain itself without management buy-in in the long term.

Risk of Failure: Participants emphasized the possibility of unintended consequences resulting from implementing sustainability, ranging from products that do not perform as intended, to reduced safety and performance; wanting to wait until new technologies are demonstrated elsewhere is a common barrier to innovation. An additional element of this factor is participants' concern that products they may specify or wish to use may not be available.

This risk can be addressed in two primary ways. First, more information (e.g., raw data, case studies, analysis tools) can lead to better decisions with a lower risk of failure. However, obtaining and processing that information will require an expenditure of additional resources. A second strategy is to mange the penalties associated with failure, particularly when such failure stems from an attempt to be innovative while seeking to achieve sustainability objectives. Establishing a knowledgeable core team that can provide guidance and review of decisions will help to minimize the risk of failure from innovation.

Unclear Payoff/Lack of Incentives or Rewards: While many participants acknowledged the potential benefits of implementing sustainability in projects, they perceive such implementation to be an additional burden on them individually, without any specific incentives or rewarded for going the extra mile, as well as the real possibility of backlash if implementation does not go as planned.

Some participants feel no motivation to incorporate sustainability into their project practices if there is neither reward for doing so, nor penalty for not doing so. Additional motivation will likely be necessary. This can be formal (as in programs to officially recognize and reward project team member who take sustainability risks), informal (as in management "pats-on-the-back"), or inverse (as in formal policies that absolve penalties for failure). The power of simple reinforcements can have a significant impact on the overall attitude of project teams.

Top Ranking LEED Points

In the second day of training, we use the LEED™ Rating System as a framework to help participants identify how they'd like to start implementing what they've learned. LEED™ is a self-assessment tool developed by the U.S. Green Building Council for new and existing commercial and industrial facilities. Points can be earned in five categories (sustainable sites, energy, water, materials and resources, and indoor environmental quality). By earning specified numbers of points, a building can apply to become a certified green building at one of four levels (certified, silver, gold, or platinum). For more information about LEED™, visit www.usgbc.org. We recognize that some participants were required to attend the training courses and that many are not eager to implement sustainable design and construction activities prior to attending the course.

Therefore, they are asked to focus not on what won't work or can't be done in their facilities, but rather what **can** be done. To assist with this, following a two-hour overview of the LEED™ rating system, trainees were asked to use a pair-share exercise to identify the top three specific LEED points they believe would be the most easy to implement in the kinds of projects with which they are typically involved. Table 1 lists the specific points that were rated the highest among combined participants from 9 courses and the percentage of the total number of "votes" that the point received relative to all votes within each category.

Table 1: Top Ranking LEED Points

Top Ranking LEED™ Points	**Percent of Total Votes in the Category (%)**
Site	
Site selection	17
Light Pollution	12
Stormwater management	12
Reduced site disturbance	12
Water	
20% Water use reduction	30
50% Landscaping water use reduction	30
Energy	
Optimize energy performance 20%/10%	21
Eliminate CFCs and halons	19
Additional commissioning	17
Measurement and verification	17
Materials	
Building reuse, 75% existing shell	20
Local/regional materials	17
Construction waste management 50%	15
IEQ	
Low-emitting paints	16
Ventilation effectiveness	15
CO2 monitoring	9

The results presented here confirm that federal agency personnel are, for the most part, in favor of incorporating sustainability into their construction projects. However, there are barriers that may make implementation difficult to achieve on a large scale in the near future. Participants were able to identify potential barrier breakers and also make personal commitments to do something towards reaching that goal. Additional research is needed to evaluate whether or not the participants have followed through on their commitments and to identify the real barriers they have faced when trying to achieve sustainability goals.

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