

Final Report

I PRO 311



1.0 Introduction

The overall objective of IPRO 311 was twofold: firstly, to develop several sustainability design initiatives based on the previous work developed in the spring of 2008, and secondly to investigate the interest in sustainability at IIT and the larger community to determine the best strategy for further sustainability development. The former was conducted as a collection of design projects, pursued separately by sub-groups, whereas the latter was pursued by means of a wide-reaching survey targeting sustainability issues and interests.

IPRO 311 was initially proposed at the request of the IIT Marketing and Communications Department to portray a message of the university's accomplishments in the area of sustainability and future capabilities. Furthermore, this project was driven by the interests of two IIT trustees with an interest to enhance the visibility of the IIT Main Campus from the I-94 expressway and other challenging vantage points (US Cellular Field, Sears Tower, McCormick Place, 2016 Olympics venues, etc.) Disney Imagineering was a project partner participating with the Team through brainstorming discussion assisting the Team in building the IIT Brand through the spring term.

In the spring term the focus of the IPRO was initially the development of signage that could represent sustainability and be situated at a prominent location on campus visible to the public. After several class discussions, the vision of the IPRO broadened, to develop an overall campus sustainable conceptual design, incorporating signage as one of the elements. What was inherited from this effort in the summer term were the design manual and several proposed design concepts, still lacking rigorous investigation and fleshing out. Therefore, it was decided through discussion that the purpose of IPRO 311 would be the objectives described above: development of the concepts from the previous term into actual design proposals, and a more thorough investigation into the sustainability awareness and interest climate.

Successful completion of the goals presented here will require each participant to gain useful experience and knowledge regarding teamwork, inter-professional skills and specifically sustainable concepts. The expanded interrelated objectives include:

- 1) Investigate sustainability awareness, with the focused goal of determining which projects and practices best enhance sustainability awareness, image, and interest.
- 2) Create eco-friendly, self-sustained projects that promotes general awareness of activities within the university among students, staff, faculty and the community.
- 3) Play a leadership role in supporting Mayor Daley's vision for creating a green Chicago by 2020.
- 4) Continue to develop the design manual for future IPROs to build upon.

The projects developed in this IPRO to promote these goals were investigations in the possible applications and feasibility of replacement of surfaces with permeable paving throughout campus, installation of green walls on campus buildings, installation of a solar-powered outdoor workstation, and improvement of building insulation through new materials and the development of a nuclear engineering program at IIT focused on developing waste reprocessing technologies.

2.0 Background

IIT has a rich history in innovation, problem solving and implementation by portraying itself as a center of sustainability education, research and project implementation for the Chicago metropolitan area and beyond. IIT graduates are known for their ability to accept responsible roles in the work force create technology companies and assume technology roles in established companies.

There are multiple ongoing construction projects that are greatly reducing the amount of energy consumed in the operation of the campus demonstrating IIT's move towards sustainability. A circa 1900 steam system design is being replaced with high efficiency hot water boiler systems. Lighting systems have been upgraded over the past decade which resulted in significant energy savings for general building lighting. Outdated building automation control systems are being upgraded to more responsive systems. Metering improvements have been made over the years to identify the amount and location of steam usage. With the change to the hot water boiler decentralized system, utility gas meters throughout the campus will provide a more accurate picture of the fuel needed to operate each building or mini utility plant. Although these improvements have not been individually highlighted through the initial IPRO offering, the improvements remain as opportunities for future IPROs.

A primary consideration for this IPRO, was that ideas be backed up with a continuation of improvements that make the IIT more energy efficient, materials efficient, and labor efficient, while striving towards sustainability. In addition, alterations in campus operations and the actions of students, professors and staff should create a more sustainable university environment. Finally, this IPRO considered the problem of the sustainability image of IIT as an opportunity: the design projects were developed with the purpose of taking a stronger leadership role in sustainability development and interest, and not merely with simply "greenwashing" or focusing exclusively on promoting an image of sustainability without substance.

3.0 Purpose

There is an apparent lack of recognition of IIT's dedication to sustainability both by the student and faculty bodies and the wider communities, both academic and local; this is what this IPRO was created to address. Put simply, the intent of the IPRO was to develop several sustainable initiatives for the IIT campus, as well as to explore and develop a strategy for future sustainability development.

4.0 Research Methodology

Initially, the focus of the IPRO was the development of sustainable signage that could represent the 'Green' efforts undertaken by the university. After several class discussions, the vision of the IPRO broadened to develop an overall campus sustainable conceptual design, incorporating signage as one of the elements. The following subject matter explains in task orientated sequential terms how the team conducted the research activities of the project.

- A. In the initial phase of the project itself, the team split up into sub-groups which were each responsible for developing and implementing one sustainable idea for the campus. The four sub-groups formed were outdoor solar workstation, permeable paving, green walls, and heating/energy.
- B. Each sub-group focused on its conceptual design and the development of a site plan, in the form of a digital model, to demonstrate the overall green plan for the campus. This was achieved by studying the campus through photographs & video and identifying possible sustainable locations relevant to the project. Signage was included as a design element wherever possible.
- C. In order to develop the conceptual models, the sub-groups researched various green elements and sustainable concepts. Through the brainstorming sessions with manufacturers and industry vendors, each sub-group began chalking out a rough estimate of production costs and materials.
- D. During this stage of development, the whole team was also brainstorming towards identifying the overarching goal of the IPRO. Several suggestions such as a 'campus-wide GREEN competition' or a 'sustainability academy' or an 'eco-friendly seminar series', etc. were discussed. To effectively recognize the popularity of each of the above ideas on campus, the team developed a survey. The results from the survey would clarify the intent of this IPRO and positively guide the forthcoming fall semester team.
- E. In the last stages of the IPRO, the groups expanded the concepts to detailed designs which were put into a presentable master plan to rally support for campus development. The

digital model was enhanced to incorporate a three dimensional animation/video through the campus identifying all aspects of the master plan and illustrating the importance of this development.

- F. The sub-groups carefully documented the research and posted it to iGroups so that the information is readily available to all members of the present and future team.
- G. IPRO deliverables were each headed by an individual team member and as needed, he/she summoned help from other IPRO team members for the timely submission of the IPRO deliverables. All who are responsible for parts then uploaded their parts to iGroups.
- H. At the end of the semester, the sub-groups collectively came together to represent all aspects of the sustainable designs around campus in a unified manner. The team produced a mock model for the final outdoor solar workstation design and graphic renderings facilitating the permeable pavement, green wall and heating/insulation designs.

5.0 Assignments

In order to accomplish the objectives of the project for the current semester, the team was divided into four groups. Each group consisted of members from different majors that facilitated and enhanced the diversity of the team and the project.

The groups were as follows:

- **Solar Workstation**

This group developed a working model for an outdoor solar-powered workstation to showcase IIT's commitment to the environment. The designed workstation provides round-the-clock power to a maximum of 4 laptops. It is designed to be cost efficient while allowing enough room for modification to meet specific program requirements.

Members: Abraham Contreras, Neils De Vita, Mohammad Ishaq, Richard King, Adam Stultz

- **Permeable Paving**

This group developed IIT's sustainability image and improved the water management issues on campus. The main areas of research included types of paving and the specific locations they could be incorporated. The use of permeable pavement allows for storm water to penetrate the hard surfaces, rather than creating run-off which facilitates filtration of the water and eliminates the contamination through layers of gravel and soil, thereby recharging the local water table and limiting erosion and damage

from standing water.

Members: Phil Korol, Ashley Ono, Ji Ae Park

- **Green Walls**

This group investigated the benefits of green walls and the feasibility of their installation on IIT's campus. This was achieved by researching the numerous vendors for green wall technologies and by exploring the IIT campus through videos and pictures. The team then designed green walls for identified locations on campus and estimated the primary budget for their installation.

Members: Prairna Gupta, Yunseok Song

- **Heating and Energy**

This group investigated the potential benefits and feasibility of using advanced insulation in IIT buildings. Most of the buildings at IIT are very poorly insulated. In particular, the brick buildings possess only an inch of insulation that could be replaced with a material named aero gel.

Additionally, on some buildings (Galvin, Crown, the HUB), I-beams are exposed both indoors and outdoors, allowing directly thermal conduction; this could be improved with the use of thermal coatings.

Another avenue explored was the development of a nuclear engineering program at IIT, including the re-installation of the nuclear reactor on IIT campus. This would allow the university to investigate new research in recycling and reconditioning nuclear waste.

Members: Elliot Barlow, Michael Chamales, Anne Nadler

In addition to the above assignments, the project team selected a team leader (Elliot Barlow) responsible for the timely submission of deliverables and coordination of disparate groups. The leader was not the guide of the project, however, merely the member whose duty was to keep things "on track" per the goals established by group consensus.

Name	Role	Major	Skills
Elliot Barlow	Researcher/Team Leader	Aerospace Engineering	Researching; Organizing
Michael Chamales	Researcher/Leader-Meeting Minutes	Material Science	Researching; Technical Solving
Anne Nadler	Researcher/Leader-New technology	Mechanical Engineering	Researching; Technology exploration
Abraham Contreras	Researcher/Leader-Modeling	Architecture	AutoCAD, Photoshop, Illustrator, Sketch-Up, Modeling, Computer Drawing, Research
Neils De Vita	Researcher/Leader-Brochure	Architecture	AutoCAD, Photoshop, Illustrator, Sketch-Up, Modeling, Computer Drawing, Research
Mohammad Ishaq	Researcher/Leader-Poster	Psychology	Researching; Technology exploration
Adam Stultz	Researcher/Leader-Project Plan	Biomedical Engineering	Researching; Organizing
Richard King	Researcher/Leader-Final Presentation	Computer Engineering	Researching; Technical Solving; Organizing.
Prairna Gupta	Researcher/Leader-IIT sustainability survey	Architecture	AutoCAD, Photoshop, Illustrator, Sketch-Up, Modeling, Computer Drawing, Research
Yunseok Song	Researcher/Leader-Green Wall Technology	Electrical Engineering	Researching; Technical Solving; Organizing.
Ashley Ono	Researcher/Leader-Permeable Paving	Architecture	AutoCAD, Photoshop, Illustrator, Sketch-Up, Modeling, Computer Drawing, Research
Ji Ae Park	Researcher/Leader-Mid Term presentation	Architecture	AutoCAD, Photoshop, Illustrator, Sketch-Up, Modeling, Computer Drawing, Research
Phil Korol	Researcher/Leader-Campus Digital Info.	Architecture	AutoCAD, Photoshop, Illustrator, Sketch-Up, Modeling, Computer Drawing, Research
Rae Mindock	Sustainability Consultant	Business	Sustainable technology applications

6.0 Obstacles

The primary obstacle for the IPRO was the conceptualization the overall idea and visualizing it into the form of a site plan. It was defining the scope of the IPRO and developing the conceptual model for the project. The team had to understand the work of the previous semester and take it a step further. Instead of starting with a fresh slate, the team had to build upon a foundation which had already been established. The previous semester had compiled many different ideas but not detailed out any one. Hence, the challenge was to finalize the concepts of last semester that would be continued and also come up with new ideas that would add to the IPRO goal. Successive team meetings and interaction helped the team come to a cohesive approach.

Another challenge faced by the team was defining the long term goal for this IPRO. Though it was similar to the above, the team advanced on it in a different way. The main question was: "What should the forthcoming semesters be working on in this IPRO?" Several group

discussions were held in search of an answer. However, at the end, a rational solution was implemented; the team drafted out a survey to ask other members of the IIT community what they wanted to see in terms of sustainability on campus. The survey was quite successful, and helped the team determine which of its ideas were worth pursuing and which not.

An additional challenge encountered by the team was inter-group communication. Each sub-group was responsible for the completion of individual tasks which were interrelated to the other groups. Consequently, the need for effective communication between the groups was identified almost immediately. However, judicious use of iGroups and weekly meetings designed specifically to update the progress of each group were proven to be effective counter-measures to the communication problem.

7.0 Results

Solar Workstation:

The Solar Workstation team identified two possible installation sites and a finalized design with room still remaining for any necessary modification. Additionally, the team developed an itemized budget based on real pricing and design material needs as well as identifying potential funding sources in the form of public grants.

Permeable Paving:

Green Walls:

The Green Wall Technologies team carried forward the conceptual ideas from the previous IPRO semester and took them a step further with specific research and design strategies. Different locations that could be prospective sites for Green Wall installations were identified after studying the IIT campus plan. The team designed appropriate green walls along with incorporating the IIT marketing strategies. The final designs were based on the measurements of each green wall site which guided the selection of the type of green walls. Finally, the team calculated the area for the installations as well as the specific modules that would be installed. A primary budget scheme was developed for the installation of green walls on campus to visualize the expected funds required to fulfill this project. The team's goal to build an eco-friendly, self-sustained project that promotes general awareness of sustainability in the university was finally achieved. At the end of the semester, a comprehensive research booklet, a set of drawings of the IIT master plan and graphic representations of the green wall designs were uploaded on iGroups for the future IPRO team.

Heating and Energy:

The Heating and Energy team conducted thermal surveys of the E1 building, recording the temperature variation and determining the amount of heat transfer through the walls during the course of a normal summer day. Additionally, thermal comparison tests were conducted

using aerogel insulation in comparison to standard fiberglass, with results strongly favoring the performance of the aerogel. A similar test was conducted using a scale model of the exposed I-beams in Galvin library to compare standard black paint (currently in use at the library) with an improved thermal coating, with results very strongly favoring the thermal coating.

Additionally, research was conducted into nuclear waste reprocessing and recycling, with the interest of potentially starting a nuclear engineering department at IIT focused on these issues.

Survey:

The final result of this IPRO was a survey, conducted online and launched through (though not hosted by) the popular social networking site facebook.com. The questions asked were directed towards determining the levels of sustainability awareness and interest and rating the possible courses of action, including a design competition, the establishment of a “sustainability academy” to fund students to promote sustainability, and a seminar series. The results of this survey, which will remain ongoing into the fall semester, are passed down to the future terms of IPRO 311 in order to inform the sustainability development strategy. Some of the outcomes are additionally discussed in the recommendations section, below.

8.0 Recommendations

One of the primary efforts of this term was the investigation and determination of the future strategy for this IPRO, as researched through the online survey. This survey, which can be found at <http://FreeOnlineSurveys.com/rendersurvey.asp?sid=9wlpujokc42e1jg463059>, indicate strongly that the most effective way to generate interest in sustainability is by means of a design competition; such a competition could easily be based on any of the four projects conducted by the IPRO subgroups this term. This point is reinforced by the fact that there was no clear preference amongst the 53 respondents (as of the writing of this report) for any one of the four design projects in particular.

As a result, it is recommended that future sessions of IPRO 311 investigate and secure funding for such a design project; the overwhelming majority of respondents indicated that the best prize for such a competition would be the actual realization of the design. This is particularly fitting, given that a clear majority also favored faster rather than slower action to improve sustainability at IIT; there is no better or clearer way to engage the student body and the community in sustainability than to allow them to determine its course immediately in this fashion.

9.0 References

In the interests of brevity, the full list of references is included in the attached bibliography.

10.0 Acknowledgements

1. Nancy Hamill, IPRO Professor: Provided numerous contacts and information about past and current IIT sustainability and design plans.
2. Rae Mindock, IPRO Consultant: Provided consultation on sustainability applications
3. IPRO 312- Permeable Paving: Provided research and design concepts for permeable paving to be placed on sidewalks on campus.
4. IPRO 307- Wind Turbine: Provided research in design of wind turbines to collect energy and supply campus with the energy collected.
5. IIT Library: discussed Solar Powered Workstations around campus and outside the library.
6. George Nassos, IIT Professor: provided advice and resources for Solar Powered Workstations, natural energy collection and other ways to improved sustainability on campus.
7. Society of Automotive Engineers, IIT Chapter: Provided facilities and tools for metalworking and cutting, used to make the mock-up of the Galvin library I-beams.