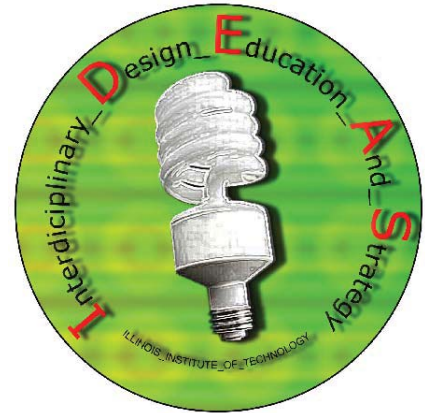




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# IPRO 337

Zero Energy Lab  
and  
Designing the IPRO Team Collaboratory Space

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## 1. Team Information

### 1.1 Team Members

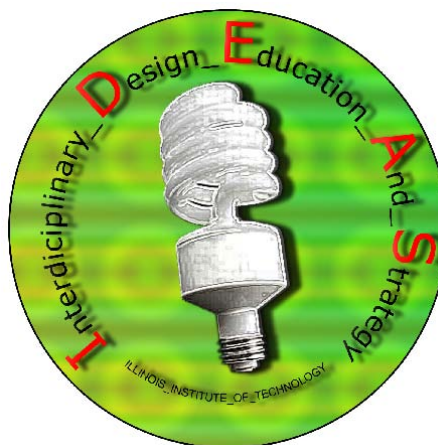
Name	Major/Year	Skills/Strengths	Sub-Group
Abraham Akutagawa	5 <sup>th</sup> year Architecture	AutoCAD 2010, 3D Studio MAX, Sketch-up, Revit, physical model construction	Programming
David Babnigg	4 <sup>th</sup> year Architecture	Office, AutoCAD 2010, 3D Studio MAX, physical model construction	Machinery Hall
Jim Braband	Advisor		Programming
Mark Chiu	5 <sup>th</sup> year Architecture	AutoCAD, Adobe, Office	Machinery Hall
Ray DeBoth	Advisor		IPRO
Benton Dosky	3 <sup>rd</sup> year Arch. Eng.	Office, AutoCAD	CTA
Nancy Hamill	Advisor		Machinery/ CTA
Kai Hansen	5 <sup>th</sup> year Architecture	Model making, graphic artist, experience as a tool/ die maker	Programming
Konrad Kawa	4 <sup>th</sup> year CPE	AutoCAD, SolidWorks, pSPICE, (8) Comp. Languages, hand drafting and physical model construction	Machinery Hall
Teddy Mensah	4 <sup>th</sup> year Architecture	Practical, easy to work with, good at following directions	Programming
Lillian Park	4 <sup>th</sup> year Architecture	Office, AutoCAD, Adobe, Revit, Sketch up, site surveys, detail-oriented	Programming
Brian Parkes	4 <sup>th</sup> year Aerospace Eng.	MATLAB, Office	CTA
Jay Patel	4 <sup>th</sup> year ECE	Office, Java, quick learner, research, working hands-on	Machinery Hall
Jonathan Reinecke	5 <sup>th</sup> year Architecture	Well disciplined, animated, hard working, good work ethic, AutoCAD, Sketch UP, Adobe	Machinery Hall
Clayton Shive	4 <sup>th</sup> year Aerospace Eng.	Quick learner, good under pressure, mathematics software, ROTC, Army Reserve	CTA
Limia Shunia	Advisor		Programming
Evan Vice	4 <sup>th</sup> year Business	Basic finance, project management, market research skills	CTA
Theresa Zappala	5 <sup>th</sup> year Architecture	AutoCAD 2010, 3D Studio MAX, Adobe, Office,	Programming

## 1.2 Team identity

### 1.2.1 Zero Energy Lab Logo



### 1.2.2 IPRO Collaboratory Space



## 2. Team Purpose and Objectives

### 2.1 Purpose

The goal of this IPRO is to continue the research and application of previous research into 'Zero Energy' techniques, while simultaneously evaluating an old CTA building on the IIT campus for its feasibility both as a collaboratory IPRO space and as a 'Zero Energy' building.

### 2.2 Objectives

#### 2.2.1 Machinery Hall

- Make the fourth floor of Machinery Hall a workable, useable space
- Create a system of LED lighting fixtures for the space
- Participate in an energy training program

### **2.2.2 CTA Building**

- Evaluate the CTA building's energy consumption
- Research technologies to implement in the space
- Investigate application of Zero Energy Lab techniques in space

### **2.2.3 Programming**

- Re-evaluate existing program proposal for collaboratory IPRO space
- Provide a new study on IPRO program's spacial needs and requirements
- Create a program and preliminary study for a new IPRO space

## **3. Background**

The listed sponsor for IPRO 337 is DOE/EPA Labs 21 in collaboration with KSA Lighting samples Lithonia Meccho Shade, whereas there is no current sponsor for IPRO 301. IPRO 301 and 337 were initially independent IPROs, but they have been combined into a joint effort because of how their goals can complement each other.

Over the past seven semesters IPRO 337 has researched various methods of supplying and conserving energy in an efficient manner. The results of this research have been tested in and applied to the Zero Energy Lab on the fourth floor of Machinery Hall. The goal of IPRO 337 has been to make the Zero Energy Lab self sufficient from an energy standpoint and to set an example of effective energy saving applications. Technologies that have been researched include a mobile battery bank, solar thermal, photovoltaics, wind turbines, and a climate control system that utilizes mechanical operable windows.

The IPRO program has had offices before in both the E-1 and Herman Union Buildings. The HUB would have been an ideal location, but it is not dedicated solely to the IPRO program so other activities in the building conflicted with IPRO needs. Now the IPRO program is based in 3424 with the Stuart School of Business. However, this site has few classrooms and conference rooms that are available. This leads into the goal of IPRO 301, which is to create a facility designated solely for the IPRO program. The facility is to be a convenient location for IPRO groups to work together as well as effectively showcase the IPRO program. Over this past summer case studies were conducted to analyze different interdisciplinary programs at Northwestern and Purdue University as well as here at IIT. The studies looked into the educational philosophy, business model, information technology, and facility of each program. To follow up this research a proposal was made that outlined possible plans for a future IPRO facility. Proposed were plans for either the construction of a new building or the use of either Machinery Hall or the A2 CTA building.

The previous efforts of both IPROs will be pursued, but now that IPRO 301 and 337 have been merged we can apply the Zero Energy concepts studied at Machinery Hall to the new IPRO space. The CTA building on the North corner of campus is currently being considered as a

possible candidate for the new space, so its existing conditions will be evaluated and new technologies may be applied to the building. To continue the research done by the previous IPRO 301 team, information will be gathered to find out what resources could benefit the future of the IPRO program and be included in the IPRO facility. The fourth floor of machinery hall will continue to be improved, but as a new initiative for the Zero Energy Lab, methods of training the public in energy conserving techniques will be pursued as well.

The primary ethical issues to consider during this IPRO particularly involve the development and implementation of new technologies. All team members must ensure that toxins or any other malicious substances from these technologies are not released into the environment. When implementing these technologies, the team must also ensure that all local and state building codes are satisfied. This especially pertains to the CTA building, since this is the first time that an IPRO team has functioned in this space.

#### **4. Team Values Statement**

The IPRO Team will utilize various ethical values to maintain a good working environment as a result increasing productivity and quality of work. Team members are expected to attend every scheduled meeting at the requested time; if for some reason team members cannot attend a meeting they must inform the rest of the team prior to the meeting. Team members are required to be in contact with the other members of the team through email, phone, iGroups, or in person, to promote communication. Once a team member has been assigned a task they are required to complete that task by the due date. The work will also be distributed in an equal manner to ensure all members input the same amount of work and time. If problems arise they will be handled by the subgroup and if further problems occur it will be brought to all of the subgroup leaders collectively. If problems can't be handled by the team then it will be taken to the IPRO instructors. To increase communication between subgroups there are subgroup leaders that will work together to ensure a unified team approach. This includes holding weekly joint meeting on Tuesdays to increase awareness of each subgroup's tasks.

#### **5. Work Breakdown Structure**

##### **5.1 Sub-group Tasks, Methodology, and Goals**

###### **5.1.1 Machinery Hall Sub-Group**

This subgroup will pick up where previous semesters of the Zero Energy Lab IPRO left off, by working towards the goal of making the fourth floor of Machinery Hall into an example of Zero Energy living. Ideally, the space would be able to function off the amount of energy it can produce, through the use of different methods. The ultimate goal for the semester is to get the space ready for students to work in. To this extent,

projects started in the past few semesters will be completed, including working to complete the ceiling lighting plan, removing the unnecessary secondary sprinkler system, and cleaning and tuck-pointing the original Machinery Hall brick structure. The IPRO would also like to recruit the help of past IPRO members and interested members of the community for help in these areas. The sub-group will study and design a new LED lighting system for the space, and install a new battery bank. This sub-group also intends to participate in an energy training program, to educate students and faculty in performing their own energy analysis, ideally using software like eQuest, on their own spaces. This sub-group will also research new technologies that could be implemented in the Zero Energy Lab.

### **5.1.2 CTA Sub-Group**

The ultimate goal for the CTA sub-group is to determine whether the space will be useable in creating an IPRO collaboratory space and whether Zero Energy Lab techniques can be implemented in this space. This sub-group will work in conjunction with the Zero Energy Lab to perform an energy analysis of the building. An assessment of the building's existing energy consumption and air infiltration, in addition to the use of energy analysis software such as eQuest will help this group assess whether or not Zero Energy Lab techniques would benefit this space. Some other technologies this group will research for this building include super-insulation, radiant energy, and geothermal energy. A report on what kinds of alterations might be necessary or desirable will also be done.

### **5.1.3 Programming Sub-Group**

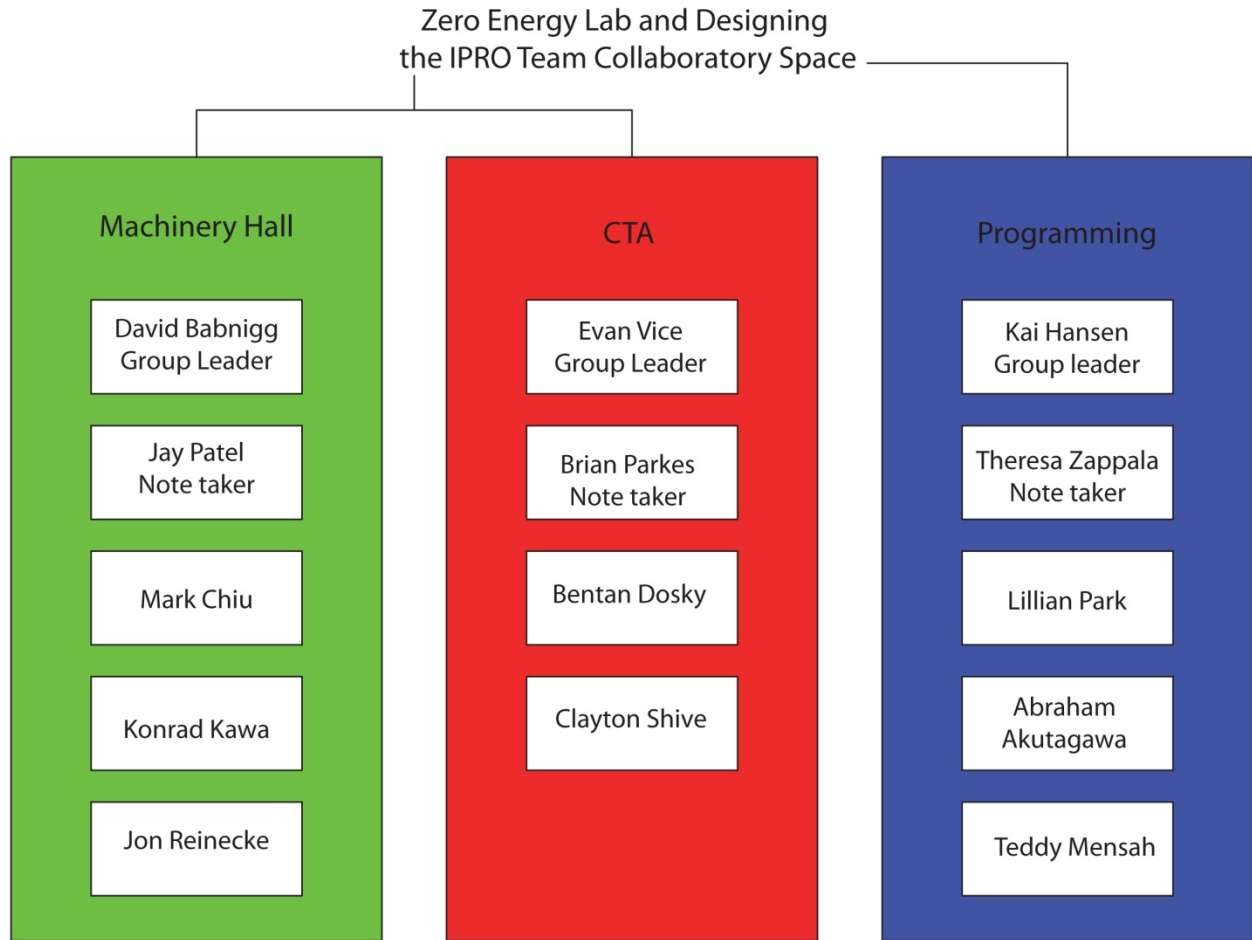
This sub-group will be reevaluating the work from the Summer IPRO 301, the creation of a collaboratory IPRO space. A review will be done of the previous IPROs research and conclusions, in addition to new research. A precedence study of similar projects, an analysis of the IPRO program's history and projected future growth, and interviews with students and faculty will help this sub-group to create a detailed and realistic program for the IPRO space. The group will then investigate the possibility of using the CTA building to house the IPRO program. If necessary, they will also investigate the use of the upper two floors of Machinery Hall for such a program as well.

### **5.1.4 Sub-Group Methodology**

The IPRO is being divided into three sub-groups, each with a sub-group leader and note-taker. There will be no one group leader, because the sub-group projects differ enough in their goals that they can function independently of each other. To keep each sub-group accountable for their work, a note-taker will record what goes on in each group and the subgroups will convene once a week to give each other reports. For these

whole-IPRO meetings, a minute-taker will keep minutes for the IPRO. Deliverables for IPRO will also be discussed at these meetings.

## 5.2 Sub-group Members and Roles



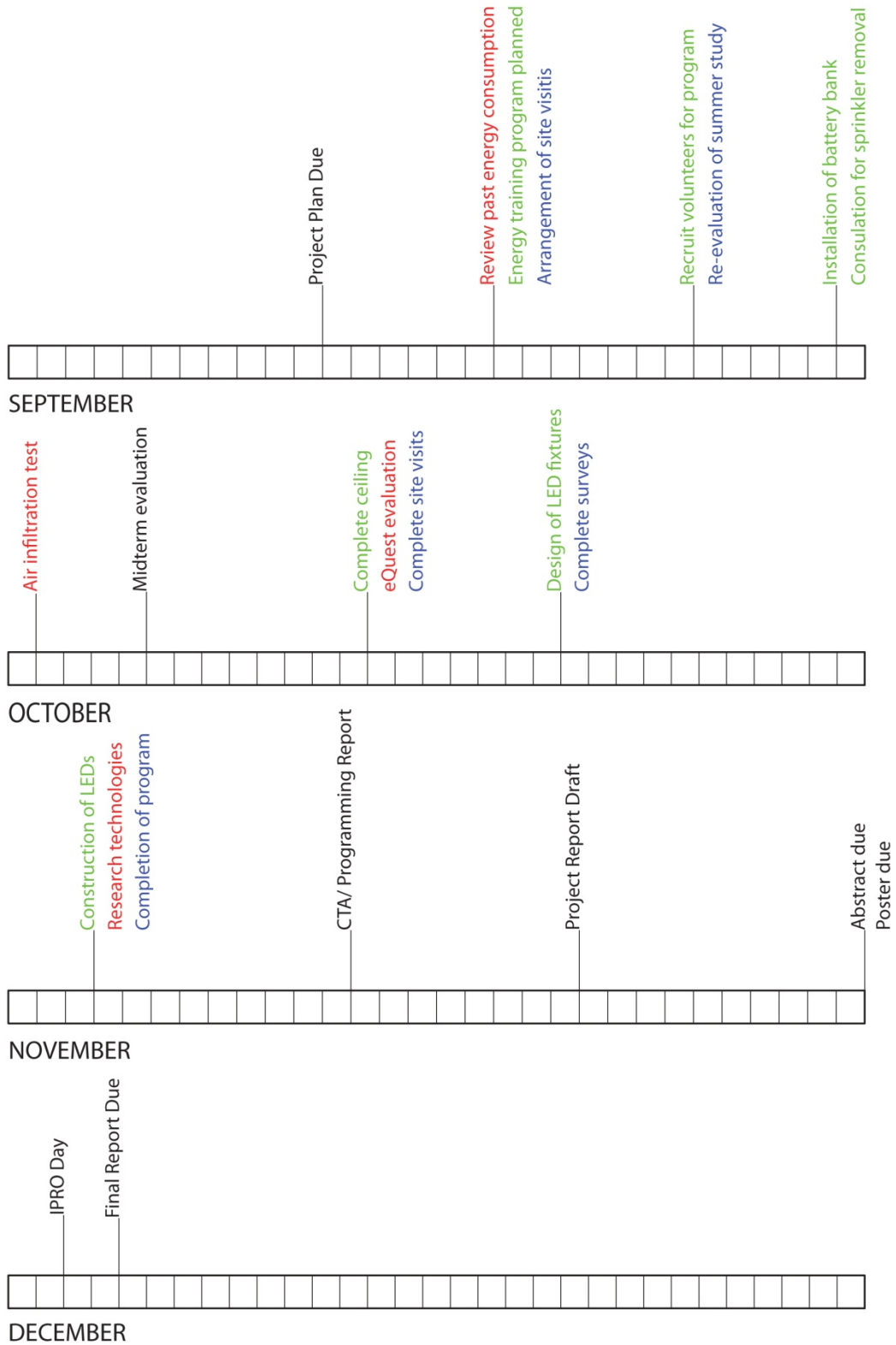
IPRO Minute-taker: Jay Patel

## 5.3. Benchmark Schedule

**5.3.1 Hours Worked** As an IPRO, we expect each other to spend as much time outside of designated working times as during. With an estimate of about four hours work each outside of class, by the end of the remaining twelve weeks, the IPRO should have a combined total of 672 external hours.



### 5.3.2 Schedule of Milestones



## 6. Expected Results

- 6.1** As an IPRO we divided ourselves into 3 sub groups with the intent to design, program, research, and test a zero energy facility for the IPRO program. The programming sub group will do precedent studies on other similar zero energy facilities. They will create questionnaires and conduct interviews with the IPRO faculty and students in order to create a program for the zero energy building. The Machinery hall sub group will work towards making the 4<sup>th</sup> floor of machinery hall “off the power grid” and inhabitable for students. Conduct more research in LED lighting and finding more efficient ways of lighting the space as well as looking into new technologies that could be implemented into the zero energy lab. The CTA sub group will be conducting studies on whether or not the space would be sufficient for a zero energy lab that can be used by the IPRO program. These studies would include looking at ways to better insulate the building, looking at better operable windows for lighting and ventilation, determining the buildings current energy consumption and look at ways to reduce it through such technologies such as geothermal and radiant heating.
- 6.2** For programming we hope to look at a number of precedent’s that we can learn from and also create a series of questionnaires and interviews in order to have a better understanding of what the IPRO program as a whole would need. When our research is completed we hope to have a fully functional program that we could implement into our zero energy building that would better suit the IPRO program for future IPROs. The machinery sub group will be looking at the future use of machinery hall and the sort of applications that would prove to make the building zero energy with its research and testing completed we hope to make machinery hall a completely “off the power grid” facility that would provide the IPRO program with an optimal space for conducting future testing, research, and implementation. The CTA sub group would be looking into the possibility of a conversion of the old CTA building on campus into a zero energy building that could also accommodate all the needs of the IPRO program as well as create a training facility that would educate everyone on the concept of zero energy.
- 6.3** Whether we decide to use Machinery Hall or the old CTA building on campus we hope that the building will bring a more public awareness for sustainability in design and educate the public through zero energy training sessions that would use the building itself as a learning tool.
- 6.4** Through the programming elements we hope to discover a better understanding of the different IPROs and create a space where all can meet and work in harmony with one another. Create a place that would allow each IPRO an optimal work space where they can conduct research, testing, and even implementation. The Machinery hall and CTA sub groups would hope to discover the most energy efficient ways in converting those buildings into zero energy through research and development of sustainable products such as photo voltaic panels, LED lighting, and energy efficient methods of insulation, heating, and cooling.

**6.5** We hope to have sufficient feedback from all the IPROs so that we can better program a zero energy building that would meet all of its needs, create a building that increases public awareness of the zero energy concepts and develop a training system that educates the public of zero energy and sustainable design.

**6.6** Challenges we could encounter during the programming process would be finding a way to get sufficient feedback from the IPROS creating a questionnaire that would get us the most information from a programming standpoint. Determining the systems that we would want to incorporate into the buildings, whether it is Machinery hall or the CTA building, and whether or not those systems would damage the historical integrity of the buildings themselves.

**6.7** With our IPROs completion we hope to have a well programmed zero energy IPRO building that will meet and address the needs of the entire IPRO program in terms of classrooms, work spaces, and testing areas. The Building will be zero energy and bring about a public awareness for the zero energy concepts through a training program that will be associated with the building.

## 7. Project Budget

Category	Amount	Description
Transportation	\$150	Visiting other schools
Models	\$100	Illustration of proposals
Booklets	\$200	Publishing of research
Research Printing	\$100	For studies and meetings
Final Presentation	\$125	IPRO day presentation
Questionnaires	\$100	Interviews and mass mailings
Misc. Costs	\$50	Other unexpected costs
<b>Total</b>	<b>\$825</b>	

## 8. Designation of Roles

**8.1 Minute Taker** There will be one team member assigned to take notes when the group meets as a whole. Notes are meant to be a summary of all important decisions and changes made at each group meeting and will be posted on the iGroups website. The minute taker will be Jay Patel.

**8.2 Sub-Group Leader** Each of the three sub-groups will have a leader responsible for making sure that his or her sub-group remains on task with their objectives. The sub-group leaders will collaborate with each other to ensure the overall project goals are being met. When the group meets as a whole, the three leaders will direct the agenda of the meeting to facilitate efficient and goal-oriented time use. The sub-group leaders for the Machinery Hall, CTA, and Programming groups will be David Babnigg, Evan Vice, and Kai Hansen respectively.

**8.3 Sub-Group Minute Takers** Similar to the minute taker for the overall project, each sub-group will have its own minute taker to take notes of the sub-group's meetings. These notes will be reported to the whole group during its weekly meeting. The sub-group minute takers for the Machinery Hall, CTA, and Programming groups will be Jay Patel, Brian Parkes, and Theresa Zappala respectively.

**8.4 iGroups Moderator** The moderator will be responsible for making sure the groups iGroups page is maintained. He or she will be given the administrative ability to edit information on the page and add any files necessary for the success of the group. The moderator will be Jay Patel.