2012

Anthony Grab

Final Proposal

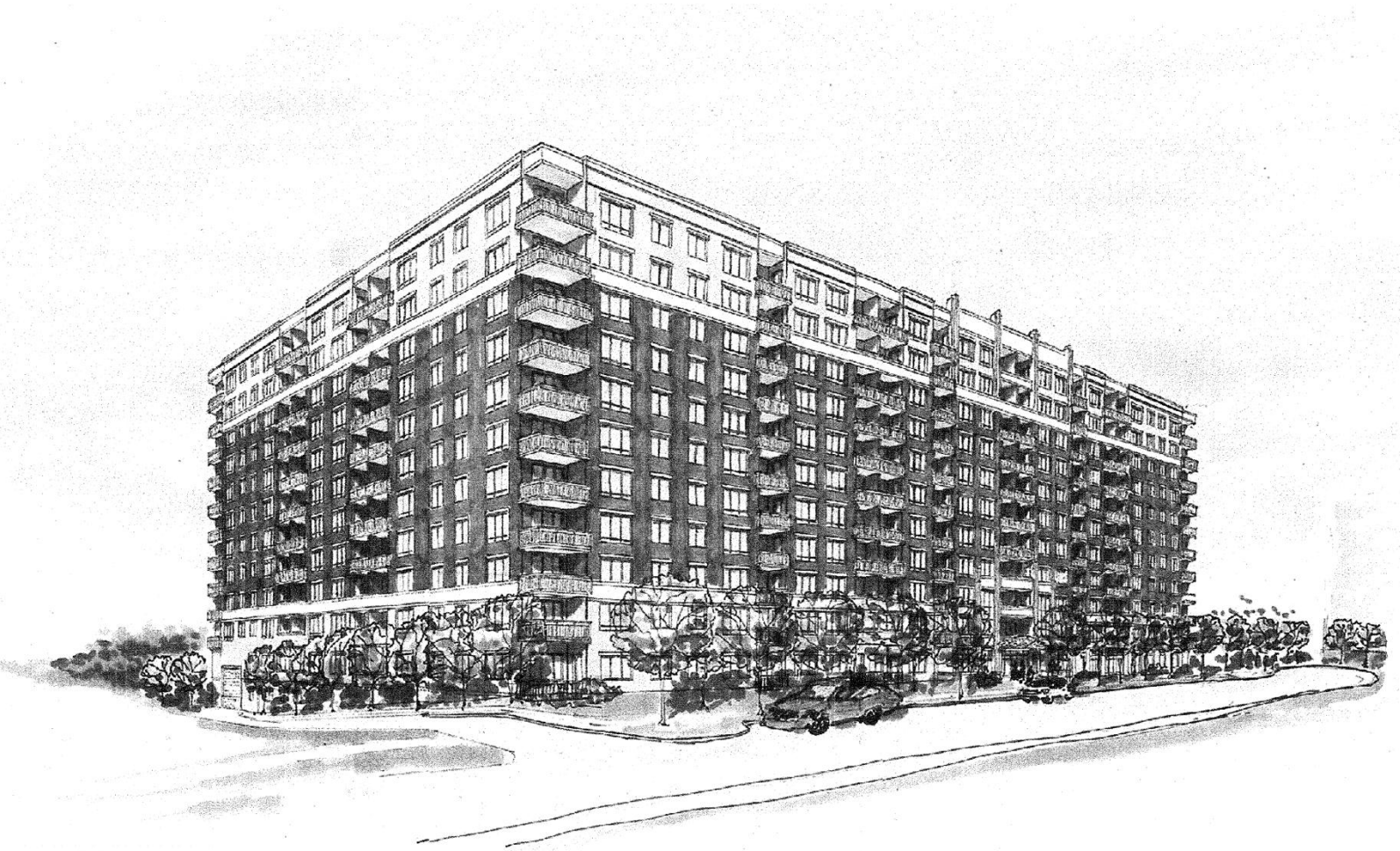


Figure 1: Sketch of Square 1400 – Courtesy of DPR

[SQUARE 1400 APARTMENTS]

Construction Management I Advisor: Raymond Sowers I Square 1400 Apartments I Fairfax, VA
12-14-2012 I Final Proposal

Executive Summary

The Thesis Final Proposal is intended to discuss the four key technical analyses that influence the execution of the Square 1400 Apartment Building located in Fairfax, VA. The building is a 327,431 SF apartment building with a neighboring three-story parking garage. Each of the analysis topics focuses on one idea that will improve the efficiency of construction. These topics include structural modification, schedule efficiency, prefabrication implantations, and energy savings systems.

Analysis 1: Change in Cast-In-Place Structure

The current structure for the Square 1400 Apartment Building is a six-inch cast-in-place structure with post-tension reinforcing. This cast-in-place structure has a large impact on construction cost, schedule, and manpower. The design of a new structural system, wood or Infinity, would result in a substantial direct and indirect cost savings with possible impact on the overall project schedule.

Analysis 2: SIPS (Short Interval Production Scheduling) + BIM (Building Information Modeling)

The project utilizes traditional scheduling techniques and minimal BIM was implemented. The use of the Short Interval Production Schedule (SIPS) method helps to break construction activities into detailed repeatable activities. This differs from the conventional way of project scheduling as it usually breaks projects into smaller operations instead of larger tasks resulting in a higher level of detail for individual tasks, which increases productivity and quality control.

Analysis 3: Increase Production Through Precast Brick Panels

Traditional Fraco Scaffolding System was used on all sides of the building to assist with the placing of exterior brick. This tied up the exterior of the building, which made it difficult for different trades to perform work on the building envelope and get materials into the building. This slowed down the production of a number of trades. The use of prefabricated brick veneer panels will substantially increase productivity, decrease site congestion, and improve trade coordination while achieving a similar building aesthetic.

Analysis 4: Critical Industry Issue: Operations and Maintenance + BIM

Today's buildings are becoming more complex and difficult to operate as there is a high demand for information rich models that will assist with the upkeep of the different building systems. In some cases, a more complex building means more energy costs. In the apartment setting, it can be challenging to monitor the energy use between each apartment unit. With the installation of an energy-savings dashboard, the hope is that the competitive nature of the residents, along with other incentives, will greatly reduce the building's overall energy intake.

Table of Contents

Project Background

Figure 2- HITT Logo – Courtesy of HITT Contracting

About two years ago, co-presidents of HITT Contracting, Brett Hitt and Jim Millar, sat down to discuss the construction of the first apartment building that would be constructed and owned by the family's brand, Rushmark LLC. The project location chosen was home to the previous HITT Headquarters. After selling the first HITT Headquarters property, the new owner quickly built very successful apartments. When Brett first heard of this, he decided to not sell the property; instead, he would build on it.

The total project cost for the new apartment building is about $50 million and is currently being constructed in Merrifield, VA. Within walking distance from the Dunn Loring Metro, the project is scheduled for completion in September of 2013. The new development includes a 12-story, 368,000 square foot apartment complex with 327 units and a 137,000 square foot parking garage. Residents will be able to choose from 95 two-bedroom units or 232 one-bedroom units. Each floor plan will consist of 43 apartment units with dens. Residents will have the option to share a number of different amenities within the complex including a pool, yoga studio, fitness center, community room and 3,000 square feet of commercial space.

The apartment structure is comprised of a cast-in-place frame with a brick façade exterior. The nearby parking structure utilizes a precast structure with a precast exterior skin to match the neighboring apartment building. Site work includes the demolition of the existing former HITT Contracting Headquarters.

Figure 2 – Square 1400 – Courtesy of HIITT Contracting

The project was designed to achieve a LEED Certified Rating of Silver for new construction. The design-build team led by HITT Contracting Inc. includes SBE Associates as the Project Architect, Wyble and Associates as the MEP Designer, Dewberry as the Civil Engineer, Gates Hudson and Associates as Property Manager, and developer Rushmark Properties LLC.

Technical Analysis Descriptions

Analysis 1: Change in Cast-In-Place Structure

Problem Identification/Background Research

The current structure for the Square 1400 Apartment Building is a six-inch cast-in-place structure with post-tension reinforcing. At twelve stories, the building is 105 feet tall with about 8.5 feet per floor-to-ceiling height. Cast-in-place concrete is the preferred structure in Washington, D.C. because it allows the end user to maximize the number of floors within local height restrictions. However, since Square 1400 is located in Fairfax, VA, it does not fall within the height restricted area and has a potential for an alternative system. The current cast-in-place structure required has a large impact on construction cost, schedule, and manpower.

Proposed Solution

In order to reduce costs, schedule duration, and manpower, it would be beneficial to investigate other building structure systems such as Infinity Structures or possible a hybrid of both Infinity Structures and cast-in-place concrete. The proposed building structure would allow for the original layout to remain relatively the same. The life of the structures would be compared to allow the owner to determine whether it fits within their needs.

Research Methods

To complete this research, an in-depth design and analysis of the Infinity Structure System must be performed. Techniques learned in AE 475, AE 308 may be utilized.

Solution Methods

- Gather information of the current structure system (dimensions, layout, code requirements)
- Design Infinity System
- Structural Analysis
- Cost and Schedule Impacts
- Life Expectancy of Infinity System vs. Cast-In-Place
- Summarize Results

Resources

- Dr. Hanagan, Dr. Boothby (Penn State structural professors)
- Raymond Sowers (Infinity System Expert)
- Infinity Subcontractors

Anticipated Results

The design of a new structural system is anticipated to result in a substantial direct and indirect cost savings with possible impact on the overall project schedule. For this analysis, only the direct cost savings will be estimated. Due to the flexibility of the infinity system, the building floor layout will remain relatively the same.

Analysis 2: Short Interval Production Scheduling (SIPS) + Building Information Modeling (BIM)

Problem Identification/Background Research

The project team for HITT Contracting is currently using traditional scheduling techniques and minimal BIM methods were implemented. The use of the SIPS method helps to break construction activities into detailed repetitive activities. This actually differs from the conventional way of project scheduling as it usually breaks projects into smaller operations instead of larger tasks.

Proposed Solution

With the consistent layout of the Square 1400 Apartment Building, it would be beneficial to use SIPS on one of the wings. The schedule would then be repeated throughout the entire construction of the building. The creation of a BIM model will allow the project team, owner, and subcontractors to see a much higher level of detail of individual tasks and their relationship to the overall construction of the building.

Research Methods

- Generate BIM Model
- Identify specific critical tasks and determine the durations
- Identify controls (crane speeds and capacity)
- Generate a detailed schedule for one wing
- Link schedule and BIM Model (4D Model)
- Compare traditional schedule with the SIPS schedule
- Summarize results

Resources

- Square 1400 Project Team
- Dr. Messner (BIM Expert for Penn State)
- Andrew Thoma (HITT's BIM Coordinator)
- Dr. Dubler (SIPS consulting)

Anticipated Results

The used of SIPS scheduling with the integration of BIM will have an anticipated result of reducing the schedule for the construction of the apartment building and possibly the overall schedule. The BIM model will provide a higher level of detail for individual tasks, thus increasing productivity as well as quality control. The linked BIM and SIPS schedule will allow the owner to better understand as to how their building is to be constructed.

Analysis 3: Increase Production Through Precast Brick Panels

Problem Identification/Background Research

A traditional Fraco Scaffolding System was to be used on all sides of the building to assist with the placing of the exterior brick. The plan was to have the masons start on one corner of the building and work their way up and around in a clockwise manner. This would streamline the production of the masons. However, with the exterior occupied by the mason's Fraco lift, it was unnecessary for the other trades to perform work on the building envelope and get materials into the building. This slowed down the production of a number of trades.

Proposed Solution

The proposed solution considers using precast brick panels for the exterior of the building. An analysis will need to be performed to determine whether it would feasible to install the exterior windows in the precast panels. This would allow for an increase in productivity to meet an earlier dry-in deadline.

Research Methods

- Research different types of brick panels
- Determine how they attach to the structure
- Determine the best way to set the panels
- Re-sequence schedule for the installation of the panels
- Compare traditional brick laying methods with brick panel (schedule, cost saving, and manpower)
- Summarize results

Resources

- Square 1400 Project Team
- Penn State AE Faculty
- Brick Panel Subcontractor

Anticipated Results

Through extensive design and research, the anticipated result is to significantly increase productivity, decrease site congestion, and improve trade coordination while achieving a similar building aesthetic. The potential increase in cost may be compensated by the fast installation of the brick veneer, which would result in an earlier move-in data for the tenants.

Analysis 4: Critical Industry Issue: Operations and Maintenance + BIM

Problem Identification/Background Research

Today's buildings are becoming more complex and difficult to operate. With that in mind, there is a high demand for information-rich models that will assist with the upkeep of the different building systems. In numerous scenarios, a more complex building leads to an increase in energy costs. In the apartment setting, it can be challenging to monitor the energy use between each apartment unit. Furthermore, the average resident does not realize how much energy they are wasting. This can be contributed to a number of different reasons. For example, the residents might not understand how much can be saved by taking a few extra precautions or they simply do not care.

Proposed Solution

To decrease the amount of energy lost, a proposed solution would be to place a live reader board in the main lobby of the building. It would illustrate a detailed breakdown of each apartment unit and its energy uses. Energy uses that would be monitored include electric, water, and gas. This is similar to hybrid cars, as in-dash display readouts communicate how much fuel was saved.

Research Methods

- Determine how gas, water, and electric will be monitored for each unit
- Develop a model that identifies the major areas for energy saving
- Locate software for the dashboard
- Survey to see how many people would cut back based on the dashboard
- Determine the payback period for the energy saving system
- Summarize Results

Resources

- Square 1400 Project team
- BIM Coordinator (HITT Contacting)
- Dr. Messner (BIM Expert for Penn State)
- Moses Ling (Mechanical Expert)
- Dr. Riley (Sustainable Building Expert)

Anticipated Results

The anticipated result is the hope that the competitive nature of the residents, along with other incentives, will greatly reduce the building's overall energy in take.

Analysis Weight Matrix

The Analysis Weight Matrix, shown in Table 1, depicts the percentage of analysis of the four main topics of investigation. The percentages represent the amount of time and effort allocated for each topic. These may vary slightly as the analyses are performed.

Table 1 – Analysis Weight Matrix – Developed by Anthony Grab

Analysis Description	Research	Value Enginnerring	Constructabily Review	Schedule Reduction	Total
Change in Cast-In-Pace Concrete	20%	5%	5%	5%	35%
SIPS + BIM	-	-	10%	10%	20%
Exterior Glazing and Precast Brick Panels	10%	-	10%	50%	25%
O & M + BIM	10%	10%	-	-	20%
Total	40%	15%	25%	20%	100%

Spring Semester Schedule

In order to meet the deadlines and stay on task, a schedule was developed. The schedule depicts work progressions for each technical analysis throughout the spring semester. See Appendix B for the Spring Semester Schedule.

Conclusion

Through in-depth research and study, the proposed technical analysis will provide a thorough understanding of improving the efficiency of construction. It is expected that the analysis of an Infinity Structural System will have an indirect cost savings with little impact on the overall project schedule. The use of SIPS will increase the level of detail for individual tasks, thus improving productivity and quality control. Through extensive design and research, the use of prefabricated brick veneer panels will have a substantially increase productivity, decrease site congestion, and improve trade coordination while achieving a similar building aesthetic. Finally, implementation of an energy-savings dashboard will have a substantial impact of reducing the overall energy consumption of the building.

This proposal is intended to be worked on and revised as feedback is received.

Appendix A

Breadth Proposal

Breadth Topics

The following topics involve a higher level of detail in distinct technical disciplines within the architectural engineering major. Each of the following topics contributes to the previously mentioned analysis.

Structural Breadth: *Contributes to Technical analysis 1*

The current structure for the Square 1400 Apartment Building is a six-inch cast-in-place structure with post-tension reinforcing. This specified structure has a large impact on construction cost, schedule, and manpower. In order to reduce these factors, it would be beneficial to investigate other building structure systems such as Infinity Structures or possibly a hybrid of both an Infinity Structure and cast-in-place concrete.

The proposed hybrid structure would have a large impact on the overall cost of the building as Infinity Systems have been proven to greatly reduce the cost of the building over post-tension structures. The constructability of the Infinity Structure will also be evaluated as its can require a high level of detail to construct.

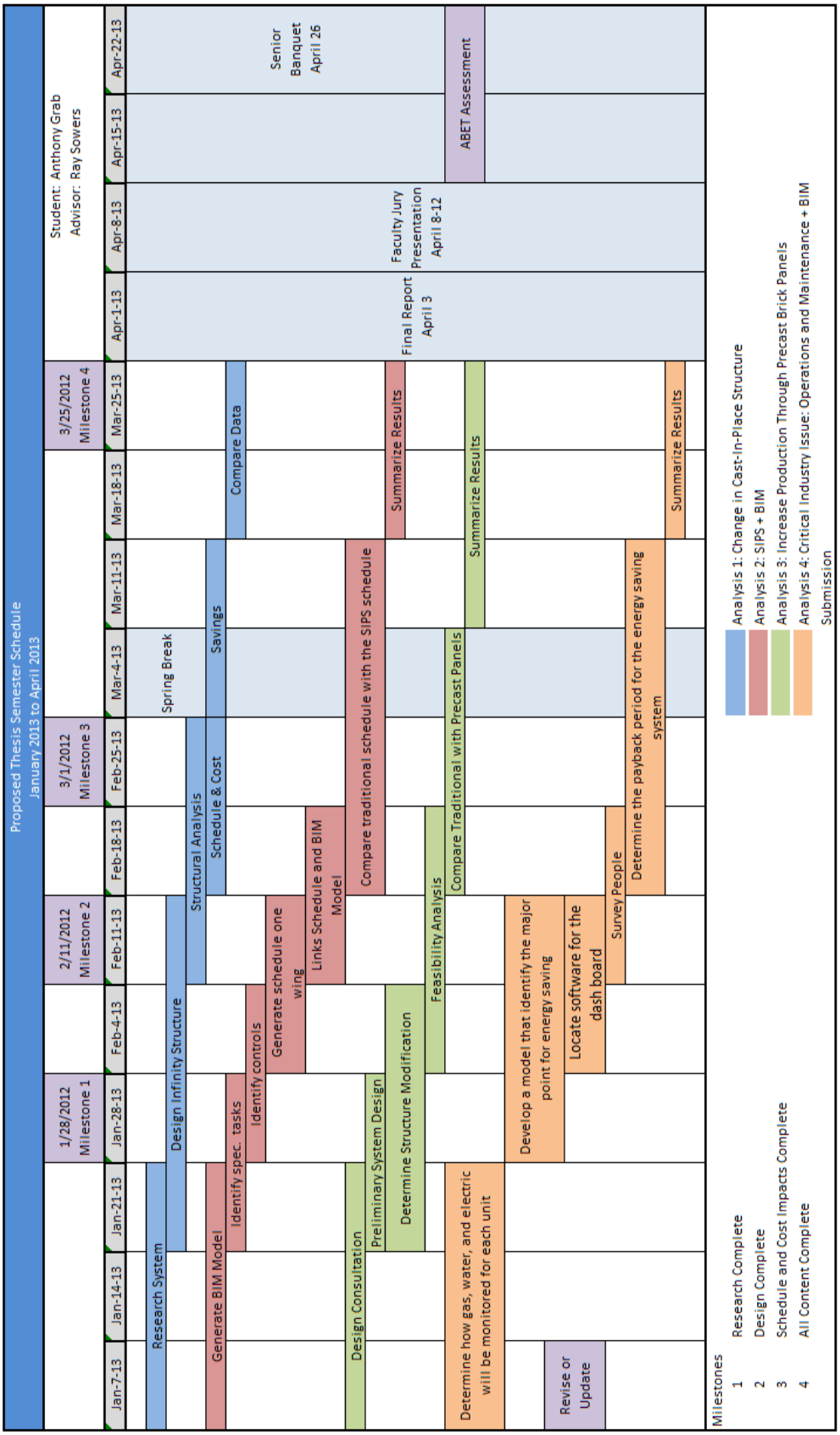
Mechanical Breadth: *Contributes to Technical analysis 3*

Through extensive design and research, the implication of prefabricated brick façade panels would substantially increase productivity, decrease site congestion, and improve trade coordination while achieving a similar building aesthetic. With a potential increase in cost, the fast installation of the brick veneer will compensated by an earlier move in data for the tenants.

The new exterior skin chosen requires a performance analysis to determine the change in the energy loads and ensure R-value requirements are met. Similarly, the upgrades to the windows will be looked at for durably and energy performance.

Appendix B

Senior Thesis Spring Schedule


Proposed Thesis Semester Schedule
January 2013 to April 2013
Student: Anthony Grab
Advisor: Ray Sowers
1/28/2012 Milestone 1
2/11/2012 Milestone 2
3/1/2012 Milestone 3
3/25/2012 Milestone 4
Jan-7-13
Jan-14-13
Jan-21-13
Jan-28-13
Feb-4-13
Feb-11-13
Feb-18-13
Feb-25-13
Mar-4-13
Mar-11-13
Mar-18-13
Mar-25-13
Apr-1-13
Apr-8-13
Apr-15-13
Apr-22-13
Research System
Design Infinity Structure
Structural Analysis
Schedule & Cost
Spring Break
Savings
Compare Data
Generate BIM Model
Identify spec. tasks
Identify controls
Generate schedule one wing
Links Schedule and BIM Model
Compare traditional schedule with the SIPS schedule
Summarize Results
Final Report April 3
Faculty Jury Presentation April 8-12
ABET Assessment
Senior Banquet April 26
Design Consultation
Preliminary System Design
Determine Structure Modification
Feasibility Analysis
Compare Traditional with Precast Panels
Summarize Results
Determine how gas, water, and electric will be monitored for each unit
Develop a model that identify the major point for energy saving
Locate software for the dash board
Survey People
Determine the payback period for the energy saving system
Summarize Results
Revise or Update
Milestones
1 Research Complete
2 Design Complete
3 Schedule and Cost Impacts Complete
4 All Content Complete
Analysis 1: Change in Cast-In-Place Structure
Analysis 2: SIPS + BIM
Analysis 3: Increase Production Through Precast Brick Panels
Analysis 4: Critical Industry Issue: Operations and Maintenance + BIM Submission

Appendix C

Draft Collection Tool

Critical Issue Draft Tool

Is the software on the market for a dash board energy system?

Survey to see how many people would cut back based on dash board?

Interview owners to see if they would be interested in implanting an energy savings dash board in there building.

Survey people to see what measure they are taking every day to save energy.