

Intra-Plant Communication

Regarding Equipment Maintenance and Alerts

1. Objectives

I PRO 303 begins its first semester as a project designed to enhance the operations of both coal-burning power plants and the Smart Signal© Corporation. When critical equipment fails, it sends a shockwave throughout an organization and into its supply chain. Smart Signal's EPI*Center software solution enables companies to fill the equipment performance gap between current operations and corporate objectives through early, actionable warning of any abnormal performance.

The overall project goal is to recommend a user interface scheme aimed at maximizing the usefulness of EPI center within the operations staff culture of the plants. This semester the team will research the decision making culture and information flow within these coal burning power plants as pertains to equipment maintenance.

The team's objectives this semester are

- To locate coal burning power plants who are not currently customers of Smart Signal for interview.
- To research and design a scripted interview process.
- To interview employees of the power plants.
- The gathered information will then be distilled into a graphical representation and easily digestible report to be delivered to Smart Signal
- The team will also prepare the data we acquire to be passed on to the I PRO which will follow next semester..

2. Background

A. Information on the Sponsor

Smart Signal is a privately-owned corporation specializing in analysis of sensor data, specifically sensor data generated in power generation plants. Smart Signal's solution works alongside the current DCS, or distributed control system, to more accurately detect faults and improper configurations in real-time. Based in Lisle, Illinois, the company has over 20 clients nationwide.

B. User Problems

Smart Signals, early warning system software is not designed well enough for people who make decisions from that software. The software has hundreds if not thousands of alarms. Alarms are prioritized based on seriousness of the problem. Still there are not enough people or time to analyze all incoming data. Another part of the problem is to deliver relevant information to the people who need it (relevant alarms to relevant people).

C. Technology and Science Involved

This project will span two semesters and we are in the first one. There will not be much science or technology directly involved in solving our problems, as we will mainly be focusing on interviews dealing with figuring out how to present the data produced by Smart Signal's system. However next semester's IPRO team will be using our data to suggest a user interface

D. Historical success or Failures addressing the problem

In September 13, 2005 Smart Signal and OSIsoft announced alignment to deliver value to their mutual customers and improve equipment performance. OSIsoft's real-time performance management platform (RtPM), complements Smart Signal technology by gathering information, adding context and ultimately providing a way to analyze and visualize data to deliver predictive capability. The joint solution enables clients to close the equipment performance gap and improve equipment availability, reliability, efficiency and compliance.

There has been previous research done on prioritizing alarms for the person receiving them. That has reduced the number of alarms received; however, it's still not to the point where alarms are manageable size. There has been research on who needs to receive what alarms, however there is room for improvement.

E. Ethical, moral, cultural and scientific issues

The ethical issues that the team will deal with during the semester will be related to our relationship with the power plants. We will have to deal with issues such as proprietary information and interview confidentiality. This is confidentiality for the company as well as confidentiality for the individual we are interviewing. If the subject thinks that what ever they say will be passed on to their superiors they will be much less inclined to speak honestly. There may be cultural issues, although it will be more related to the power plants' cultures than individual people's backgrounds. We will (hopefully) be interviewing people from every part of the plant, and will have to be careful not to offend anyone by going "over their head" or failing to follow the proper order to approach people. The only scientific issues we face are ensuring that we collect valid data, by asking open questions and letting the people we interview answer instead of being led along.

F. Business costs of the problem

With all alarms received by a user, if there is not enough time to analyze alarms then potential unexpected break down or maintenance might occur. This would damage the business of a Coal Fired Power Plant. Similar conclusion might be drawn if alarms are received do not go to the right personnel. If right personnel receive alarm, and there's enough time to analyze it then, potential break down might be prevented.

G. Implementation of the proposed solution

While the solution/information that is presented at the end of the semester will no doubt be helpful to our sponsor its main benefit will be for the next semester's IPRO team. They will use our report and graphical representation to make recommendations for additions to the user interface options of their products.

H.

There is no better way to determine the needed information by coal-fired power plant personnel than to conduct interviews and obtain information directly from the power plant personnel. We found no similar research done to address this problem. There have been numerous reports on coal power plants but the internal decision making structure is outside their scope. Surveying is nothing new and there have been many of those done by the IIT Psychology department, which we are using to help us improve our surveys.

3. Methodology/Brainstorm/Work Breakdown Structure

- **Phase 1: Research, Planning and initial Setup (January 16th - February 27th)**
 1. **Contact Team**
 - I. Communicate with the sponsor to locate coal power plants for interview
 - II. Locate addition interview prospects through research
 2. **Interviewing Methodology Team**
 - I. Research the methodology behind conducting interviews
 - II. Locate Professors on campus who have experience or training in this discipline and can advise the team
 - III. Coordinate information with the Script Team
 3. **Interview Question Team**
 - I. Determine who the intended subject of the interview will be
 - II. Deliver the finalized questions to the interview methodology team
 4. **I PRO Deliverables Team**
 - I. Prepare the Project Plan (January 16th - February 16th)
 - II. Join the Interview question team (February 17th - February 27th)

- **Phase 2: Acquiring Data (March 1st - April 10th)**
 1. **Contact Team**
 - I. Research and establish contacts with the personnel in coal power plants for interviews (March 1st – April 10th)
 - II. (*If sources of contacts exhausted*) Join the Interview Team (March 1st – April 10th)
 2. **I PRO Deliverables Team**
 - I. Prepare the Midterm Report (March 1st – March 22nd)
 - II. Join the interview team (March 23rd – April 10th)
 3. **Interview Team**
 - I. Setup and conduct interviews with contacts established by the the Contact team. (March 1th - April 10th)

- **Phase 3: Data Distillation and I PRO Day Deliverables (April 11th – April 27th)**

A. Definition of the Problem:

1. To find Coal-Fired Power Plant(s) and arrange key personnel to be interviewed.
2. To develop appropriate interviewing methods for different power plant personnel.
3. To understand the decision-making and sources of information of that personnel regarding plant failure and maintenance.
4. Structure the findings in to a report with the goal of making recommendations for changes to SmartSignal's user interface.

B. How the Team will solve the problem

The team assignments will change as we move forward. Right now we are divided in to groups to improve our surveys and are working on contacts with power plants. Eventually will split into different interviewing groups, and analyze obtained information from interviews to understand the decision making process within a power plant.

The groups will be split into three or four different surveys: plant manager, maintenance, shift-operator, and operations manager. The communication between these groups, decision-making, and sources of their information will be surveyed. The results will then be studied and presented to Smart Signal. If all goes well, we should have an idea of decision-making and sources of information made by different power plant groups.

C. Testing the Solution

We will not be presenting the final product to the Smart Signal, only the objectives they requested. This will be ongoing for two semesters and we are working the first one. To test our results, our obtained ideas would have to be incorporated into existing Smart Signal product, which will be the objective of a later IPRO team. Then this product would have to be tested in real world power plants, and the feedback would have to be obtained from power plan personnel. The testing part is beyond our control and will be left for Smart Signal to decide which ideas they like.

D. Research and Testing

As stated in part C there will be no testing because our sponsor is not interested in final product, only an idea. The survey will be document either by paper and pen or voice recording or obtained directly from email and put in word document or other text application. From electronic documents, the information will be modified and saved as needed.

E. Analysis of Results

Here is how we will analyze surveyed information. The team will be split into different groups to analyze different plant personnel groups, their decision-making, sources of information, and their communications with other groups. For example how does operations manager decide if power plant needs to be shut down? What are his/her sources of information? Who does (s)he need to communicate with? There will be about three or more groups.

F. Deliverable Reports

The tasks involved in generating IPRO deliverables will be split among different groups. Group working on maintenance will document decision making of maintenance personnel, and so on. A set period of time in advance of the deadline, members will present their initial work to the group for peer editing, allowing everyone to have the opportunity to review mistakes and or critique. Scheduling of tasks will be handled by team leader, and will be reviewed and updated at each IPRO meeting.

4. Expected Results

- To research and design an interviewing process with question that will provide answers that describe the maintenance behaviors of a plant. This will require research into the general interviewing process as well as special concerns regarding the plant's organizational hierarchy and behavioral norms.
- The actual interview process will consist of phone and face to face meetings with the Plant Manager, the Operations Manager, the Shift Manager, and employees in maintenance.
- The gathered information will then be distilled into a graphical representation and report to be delivered to Smart Signal
- The team will also pave to way for next semester's team to begin work on suggesting a user interface that will streamline the flow of information in a digestible and effective way.

1. **Provide details on expected activities of results involved in the project.**

The team will have to firstly locate coal burning power plants who are not currently customers of Smart Signal who are willing to be interviewed about the structure of their plant. The focus of the interview will be in regards to the plant's maintenance and the decisions and information that determine the course of action.

2. **Describe expected data of results from research or testing involved in the project.**

Throughout the semester the team will be collecting data on decision making structure of coal power plants as relates to maintenance. Most of the collected data will be in the form of interviews both face to face and over the phone. The notes, which will essentially be a transcript, will then be distilled down to the highlights and main points. These notes, both transcripts and corresponding main points, will be studied to identify trends and patterns.

3. Define potential products resulting from research and testing.

The potential product that could come about from the team's research is a revised and modified user interface for Smart Signal's EPI center software. Suggestion for a modified user interface will be the responsibility for next semester's IPRO team. This user interface will be designed using a knowledge of information flow and maintenance decisions gained from this semester's research, interviews and final report and graph.

4. Discuss the expected results in terms of deliverables that will be produced by the project team (i.e. a working prototype).

This extrapolated information will then be used to create a graphical representation of the decisions, and information flow in the plants. The visual representation will be accompanied with a report that will explain it in more detail.

5. Discuss whether or not the results you expect address the problem of the sponsor/customer.

The results of the research and interviews are expected to meet meet the goal of our sponsor Smart Signal.

6. Discuss how the expected results will be incorporated into the proposed solution or solution framework.

At the completion of the first semester, it is expected that the project's objectives be fully realized. That is, that our team has successfully developed and provided SmartSignal© with a functional representation or diagram of the decision making structure as pertains to maintenance for a coal-firing power plant. This in turn will be used With this, it is believed that we will have a complete and knowledgeable understanding of the internal operations of such a plant, thereby allowing our team to map out a process by which plants communicate important information. It is then presumed that we will be able to expand upon this gathered data in order to develop an improved software interface for Smart Signal© by the following semester.

5.0 Project Budget

Since we are not making a final product and only preparing a report there are expected to be minimal material costs for this project. However, as we conduct interviews and continue to talk with our sponsor it may be decided that a travel budget would be useful for face to face interviews and talking with our sponsor.

Item	Quantity	Price	Total
Photocopying	500 copies	\$35	\$35
Transportation to potential sponsors/partners	-	\$200	\$200
Long distance interviews	-	\$75	\$75
Total		\$310	\$310

6.0 Schedule of Tasks and Milestones Events

Task	Start	Finish	Hours	Members
I PRO First Class Briefing Session	1/16/07	1/16/07	1.25	11
Set up iKnow and iGroup accounts	1/16/07	1/16/07	1.25	11
I PRO games	1/20/07	1/20/07	4	2
General I PRO briefing about the purpose (Don)	1/30/07	1/30/07	1.25	11
Presentation of Smart Signal	2/1/07	2/1/07	1.75	11
I PRO Project Management Workshop	2/3/07	2/3/07	4	4
Determination of Overall format and First Research	2/6/07	2/6/07	5	11
Determine the questionnaire and documentation	2/6/07	3/6/07	20	6
Writing Project Plan	2/6/07	2/16/07	20	3
Slack Time	2/6/07	4/18/07	10	11
Learning Objective test	2/13/07	2/13/07	1.25	11
Determine the questionnaire and target company	2/20/07	3/6/07	16	4
Determine the method of interview and survey	2/27/07	3/6/07	5	2
Start Interview and Survey (Visit or phone	3/1/07	4/10/07	40	8

interview)				
Spring Break (Prepare Midterm Report)	3/14/07	3/21/07	8	3
Complete the Mid-term Report and submit	3/20/07	3/23/07	20	3
Complete Interview and Survey (Visit or phone interview)	3/28/07	3/28/07	8	4
Prepare website and Poster	4/11/07	4/18/07	5	4
Interview result presentation	4/11/07	4/11/07	2	2
Prepare the final report draft and final presentation	4/11/07	4/18/07	6	11
Web Site	4/18/07	4/18/07	7	2
The Exhibit	4/18/07	4/18/07	2	11
The One-Page Abstract	4/18/07	4/18/07	5	1
The Final Oral Presentation	4/18/07	4/18/07	3	11
The Final Project Report	4/25/07	4/25/07	6	4
Team Work Product & Team Minutes	4/25/07	4/25/07	4	1
Comprehensive Deliverables CD	4/25/07	4/25/07	3	1
IPro Projects Day Conference	4/27/07	4/27/07	1.25	11
IPro Debriefing Session	5/2/07	5/2/07	1.25	11

7. Individual Team Member Assignments

Mohammed Omaid Rehman

Mohammed has attended IIT since fall of 2004 and is currently majoring in both Electrical Engineering and Computer Engineering. He has programming skills in Java and Visual Basic and is knowledgeable in digital design and circuit analysis. Mohammed served as a teachers assistant for the Computer Science Department, interned at J. Walter Thompson Asiatic in Karachi, Pakistan, and has held a managerial position for Honda Motorcycle©. Mohammed is an active member of IIT Union Board, Indian Students Association, and Institute of Electrical and Electronics Engineers.

Sarunas Palikevicius

Sarunas is an IIT undergraduate majoring in Electrical Engineering. He received his Associates degree at the College of Du Page in 2004. Sarunas is skilled in circuit analysis, digital systems, and electrodynamics to name a few. He has interned at S&L Consulting services where he designed and maintained electric substations. Sarunas is skilled in the C++ programming language as well as Autocad .

Kevin Lyles

Kevin is a computer science and computer engineering major here at IIT graduating in December of 07. His experience includes: Quality Assurance Intern at Harman/Becker (Summer '05), Service Technician at Statewide Office Systems (Summer '04), and team member of Travel Flash Inter professional-Project (Fall '05). Kevin is familiar with C, C++, Java, and a number of other programming languages as well. Familiar with Windows, Linux, and DOS operating systems, and has actively participated in in the Food and Housing Committee and Residence Hall Association here at IIT.

Chihwan Lee

Chihwan has been a part of the IIT community since August of '05, and currently majors in mechanical engineering. In addition, Chihwan has briefly attended Ajou University in Suwon, South Korea, where he there received his Bachelor's Degree in Industrial Engineering. Chihwan carries with him the experience of an engineer, as he has professional experience as an Assistant Industrial Engineer. Chihwan was an enlisted marine for the Republic of Korea Marine Corps in April '01 until June '03.

Taeho Hwang

Taeho is chemical engineering major here at IIT and will be graduating in December of '07. To accompany his B.S. in chemical engineering, he will be graduating from Ajou University in South Korea with a B.S. in Environmental Engineering. Taeho comes equipped with intern experience with Bukang Tech as a Research Assistant, military experience as an Office Assistant in South Korea's Army: Tiger Division, and has volunteered his time as a high school tutor in mathematics and physics. This is Taeho's second IPRO; he participated in IPRO 269 (Fall '06). His skills range from being fluent in Korean and English, and has some working knowledge of Chinese characters.

Jamie Amber

Jamie is a fourth-year Electrical Engineering undergraduate here at IIT. He has been employed for the City of Unalaska, Alaska, and during 1998 and 2003, and worked there as a maintenance mechanic class II, working with and maintaining small block engines and medium equipment operation.

Migun Choi

Migun is a senior at IIT and majors in Manufacturing Technology and Management. She is also admitted to Hong Ik University in Seoul, Korea as senior in an Industrial Engineering program. Her work experience encompasses customer relations, being a project manager, a marketing operations manager, and a high school English teacher in Korea. Migun is skilled in the craft of film making and Photo-shop as these are her passions outside of her academic field of engineering.

Amanda Featherstone

Amanda is a Civil Engineering major here at IIT and is looking to graduate with her Bachelor's Degree in Spring of '07. Amanda is already accredited with her Bachelor of Arts from Dominican University, where there she double-majored in Mathematics and Civil Engineering. Amanda specializes in structural engineering, and uses her skills in MathCAD and AutoCAD to intern at Elstner Associates Inc. In addition, Amanda has worked as a museum service assistant, and has volunteered her time with Habitat for Humanity. Amanda has worked on a prior IPRO, the only one of us who has, and therefore Amanda brings IPRO experience to the team.

Michael Hatch

Michael is in his third year as a Computer Science major here at IIT with a minor in Information Technology Management. He is an experienced software developer and has experience in the team building and functioning process. As an up-and-coming software developer, he has knowledge in Java, C/C++, and OCaml programming languages, and has developed bug tracking software in his previous software development teams. As a web developer, he has used his HTML/XHTML, CSS, PHP, and Flash skills to use and has produced multiple web pages, both for personal and outside individual use.

Kevin Tung

Kevin is looking to receive his B.S. in Electrical and Computer Engineering by Spring '08. Kevin has been employed by IIT as a Network and Computer Systems Administrator, where he has built and maintained computer labs and equipment for the Biomedical Engineering Department. In the Summer of '04 Kevin worked as a Research Assistant for the University of Oklahoma in Norman, Oklahoma. Kevin is skilled in MATLAB, C/C++, Visual Basic, and digital and analog circuit design. Look for Kevin in Eta Kappa Nu (Electrical Engineering Honor Society) or as an active member of Triangle Fraternity.

John Rhoda

John is a third-year undergraduate and majors in Aerospace Engineering. He is quite skillful in his field, as he has a good understanding of aerodynamics and incompressible flows. He is able to analyze structure stresses and has experience in performing material tests. John has held the title of Vice President of Finance for Sigma Phi Epsilon Fraternity (Summer '06 – Spring '07), which he still is an active member of. John is also an active midshipman in the United States' Navy Reserve Office Training Corps. His leadership role required him to oversee the development of a ROTC section in Galvin Library and was in charge of midshipman recruitment in 2006.

Sub teams

Team Leader

The team leader's function is to provide coordination of the sub teams and maintain a view on the larger picture.

Power Plant Contact Team

- The Power Plant Contact team is required to locate and get in touch with local Midwestern power plants. Their objective is to relay the details of our project in hopes of gaining admittance to an on-site tour of a plant facility.
- Team Leader: John Rhoda
- Team Member(s): Mohammed Rehman.

IPRO Deliverables Team

- The Project Plan team is required to compile all information and produce the standard IPRO project plan leaving the other member free to start other aspects of the project.
- Team Leader: Michael Hatch
- Team Member(s): Sarunas Palikevicius

Interview Methodology Team

- The interview methodology team's job was to research proper interview methods. The goal of this research is to provide an organized collection of questions and ensure a certain level of comfort for the interviewers as well as maintain the quality of the interview data.
- Team Leader: Chihwan Lee
- Team Member(s): Migun Choi

Interview Questions Team

- The Interview Questions team is required to practice the interview script developed by team “In-Your-Face” and then apply it in real-time to power plant employees. This team gathers the data collected by these scripted questions for later analysis.
- Team Leader: Amanda Featherstone
- Team Member(s): Kevin Tung, Taeho Hwang, and Kevin Lyles.

8. Additional Responsibilities

Team Position	Position Responsibilities	Team Member
Minute Taker	Records decisions made in meetings	John Rhoda
Agenda Maker	Creates an agenda for each meeting	Jamie Amber
Time Keeper	Ensures meetings follow team agenda	John Rhoda
Weekly Time sheet Collector	Update all members with summary report	Jamie Amber
Master Schedule Maker	Comprise a master schedule for entire group	Jamie Amber
iGroups	Ensures the organization of the team's iGroup account	Michael Hatch