Wind Power Generation
Cost Impact of Equipment Failures
Background

**SmartSignal, our sponsor**

*SmartSignal Inc.* offers software which models machine and equipment behavior, and can distinguish between normal and abnormal conditions.

This information is used by machine operators to proactively deal with potential problems before they cause faults and unplanned downtime.
Problem Statement

SmartSignal’s Objectives:

1. Explain faults that are occurring in wind turbines and why
   - Gain a general understanding of how wind turbines work
   - Identify turbine components and major failures
   - Determine turbine faults
   - Determine most costly/most common reasons for turbine downtime

2. Provide detailed overview of current maintenance practices and procedures
   - Provide listings of maintenance procedures available
   - The advantages and disadvantages of current maintenance practices
   - Determine who is responsible for maintenance (i.e. manufacturers or 3rd parties)

3. Technical Business Case
The Team Structure

Initially, to better tackle the various objectives the team subdivided into three groups.

Team 1- The Research Team:
members: Jesus Cervantes, Samad Erogbogbo, Robert Keane, Kristina Lakiotis, Mithun Michael
This sub group will be involved in researching how wind turbines work and identifying the major failures that this IPRO team will be focusing on.

Team 2- The Questionnaire team:
members: Sara Claxton, Earl Fairall, Aaron Melko, Viral Patel, Donald Ruffatto
This sub group will be in charge of preparing questionnaires for the contact team.

Team 3- The Contact team:
members: Christopher Catalina, Olaoluwa Adeola, Richard Ike
The contact team will be responsible for contacting operators, third party maintenance, and manufacturers to schedule interviews.
### Gannt Chart (Progress)

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research How Turbines Work</td>
<td>15 days</td>
<td>9/17/08</td>
<td>10/8/08</td>
</tr>
<tr>
<td>Identify Major Failures</td>
<td>15 days</td>
<td>9/17/08</td>
<td>10/8/08</td>
</tr>
<tr>
<td>Contact Operators</td>
<td>15 days</td>
<td>9/17/08</td>
<td>10/8/08</td>
</tr>
<tr>
<td>Contact 3rd Party Maintenance</td>
<td>15 days</td>
<td>9/17/08</td>
<td>10/8/08</td>
</tr>
<tr>
<td>Contact Manufacturers</td>
<td>15 days</td>
<td>9/17/08</td>
<td>10/8/08</td>
</tr>
<tr>
<td>Prepare Questions for Contacts</td>
<td>4 days</td>
<td>10/7/08</td>
<td>10/10/08</td>
</tr>
<tr>
<td>Compile Listings of Maintenance Procedure</td>
<td>14 days</td>
<td>10/7/08</td>
<td>10/24/08</td>
</tr>
<tr>
<td>Compare Advantages and Disadvantages</td>
<td>14 days</td>
<td>10/7/08</td>
<td>11/13/08</td>
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<tr>
<td>Compare Current Procedures to Smart Si</td>
<td>14 days</td>
<td>10/7/08</td>
<td>11/13/08</td>
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<tr>
<td>Understand Warranty Agreements</td>
<td>9 days</td>
<td>10/7/08</td>
<td>10/17/08</td>
</tr>
<tr>
<td>Calculate the cost of planned</td>
<td>19 days</td>
<td>10/27/08</td>
<td>11/20/08</td>
</tr>
<tr>
<td>find out how often operators do planned</td>
<td>19 days</td>
<td>10/27/08</td>
<td>11/20/08</td>
</tr>
<tr>
<td>find out about Government Subsidies and</td>
<td>19 days</td>
<td>10/27/08</td>
<td>11/20/08</td>
</tr>
<tr>
<td>Design Poster/Brochure</td>
<td>5 days</td>
<td>11/20/08</td>
<td>11/28/08</td>
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<tr>
<td>Prepare Presentation</td>
<td>9 days</td>
<td>11/20/08</td>
<td>12/2/08</td>
</tr>
<tr>
<td>Design Exhibit</td>
<td>5 days</td>
<td>11/20/08</td>
<td>11/28/08</td>
</tr>
<tr>
<td>Project Plan</td>
<td>6 days</td>
<td>9/12/08</td>
<td>9/19/08</td>
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<tr>
<td>Midterm Review Presentation</td>
<td>4 days</td>
<td>10/1/08</td>
<td>10/6/08</td>
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<tr>
<td>Ethics Statement</td>
<td>11 days</td>
<td>10/1/08</td>
<td>10/15/08</td>
</tr>
<tr>
<td>Final Report</td>
<td>11 days</td>
<td>10/1/08</td>
<td>12/4/08</td>
</tr>
</tbody>
</table>

**Project Plan Team**

**Midterm Team**

**Ethics Statement**

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**ILLINOIS INSTITUTE OF TECHNOLOGY**

**smartsignal**
Research Team

Tasks:

- Gather general information about wind turbine systems
- Research faults specific to turbine components. List the most commonly occurring and the costliest.
- Find information regarding currently installed models of wind turbines and associated operational problems
- Research wind turbine monitoring systems, fault prevention and maintenance practices

Progress:

- Team has successfully gathered information detailing turbine system components and its operation.
- Started documenting our findings into reports.
Research Team

Challenges and major obstacles:

• There is so much information on wind turbines available, it was difficult at first to know where to start.
• An open ended research is challenging given the time constraints.

Overcoming these problems:

• Prioritize what information is needed and most critical.
• Narrow down research topics and clearly define the scope.
• Divide the research work amongst team members.

Future work to be done:

• Conduct more specific research.
• Complete and then compile the research work into an easy to read format that can be utilized for the rest of the project.
Questionnaire Team

Tasks:

• Compile a list of general questions to be used during the initial phase of conducting verbal/telephone interviews.

• Prepare a comprehensive questionnaire (paper based) that will help gather statistical data and specific technical information about wind turbine technology and maintenance practices.

Progress:

• Incorporated research team findings, compiled a list of general questions.
Questionnaire Team

Challenges and major obstacles:
• Extracting statistical data from electronic reports
• Phrasing questions appropriately.

Overcoming these problems:
• Decrypted the electronic documents and extracted the data.
• Scheduled a meeting with IIT's psychology department to prepare for working successfully with outside contacts.

Future work to be done:
• Examine the data gathered from reports and compile to a spreadsheet.
• Use the above to design illustrative charts/diagrams which will be useful for our sponsor
• Collaborate with research team to prepare the questionnaire.
Contact Team

Tasks:

• Contact turbine manufacturers and wind energy companies to understand fault occurrences and current maintenance practices.

Progress:

• Succeeded in gathering contact information and compiled a detailed list of contacts for:
  - Turbine manufacturers
  - Companies with wind farms
  - Universities with wind energy projects.

• In the process of contacting the above by phone/email.
Contact Team

Challenges and major obstacles:

• Contact information leads to corporate offices rather than wind industry personnel or specialists.
• Manufacturers are unwilling to divulge (sensitive) information.
• Contacts are reluctant to participate in live interviews.

Overcoming these problems:

• Use the help of the psychology department to better our interviewing skills
• Rephrase questions in a manner that is both persuasive and also puts the interviewee at ease.

Future work to be done:

• Establish industry contacts. Find companies willing to do initial phone interviews.
• Follow up with a detailed questionnaire.
Gannt Chart (Future Tasks)
Some future IPRO team tasks

• Schedule a meeting with our sponsor, SmartSignal
  • Present progress report, and discuss future plan of action.
  • Mid course correction if necessary.

• Generate new teams to carry out the new tasks.

• Team visit to a wind farm.
Ethics

The IPRO team is to consider these issues.

1. Honoring the confidentiality agreement with our sponsor, SmartSignal, when dealing with our contacts.
2. Actions to be taken should unequal contributions amongst team members occur.
3. Address how communication among IPRO team members may be impacted by our cultural diversity

How to work with these issues:

1. Break up into groups, and discuss these issues from different perspectives.
2. Fix a date for ethics discussion, and each group shares their ideas and conclusions.
Conclusion

Thank you for listening!

QUESTIONS?