The different types of wind turbine failures were classified into teams as the semester progressed. Work on over the course of the semester was divided into different types of wind turbine failures and equipment behavior.

Fall 2008 Summary
- Our sponsor, SmartSignal gave the team objectives to work on over the course of the semester.
- The team's objectives focused on the cost impact of equipment failure in large scale wind farms.
- To maximize productivity, our group divided into different teams as the semester progressed.
- Initial research was carried out to learn about the wind power industry.
- Research was also done to learn how wind turbines worked.
- The different types of wind turbine failures were classified.
- Contact was made with wind farm operators and companies throughout the semester.
- The research was used to create cost analysis spreadsheets.

SmartSignal has asked the IPRO 303 team to research and analyze the costs associated with the wind industry.

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Objectives
- Explain the how wind turbines work and fail
- Provide an overview of maintenance practices
- Prepare a technical business case

Gather Information
- Research using library and internet sources
- Establish contacts for interviews

Organize
- Focus Goals
- Analyze Research
- Have interviews

Compile Data
- Create spreadsheets
- Prepare final report

Finalize
- IPRO Day Deliverables
- Present final report to SmartSignal

Wind Turbine Components
- Low speed shaft: the turbine rotor runs this shaft (usually 30-60rpm)
- High speed shaft: this shaft drives the generator via a step up gear
- Brakes: Stops the rotor in an emergency
- Gearbox: gears connect the low speed shaft to the high speed shaft
- Nacelle: Sits on top of the tower, and includes the gearbox, high and low speed shafts, generator, controller, and brake system
- Pitch: Blades are turned out of the way of the wind direction when wind speeds are too high or low in order to regulate rotor speed
- yaw Drive: Orients the turbine in the direction of the prevailing wind. A yaw motor powers the drive mechanism.
- Wind Vane: Measures the wind direction and communicate to the yaw mechanism
- Tower: The control and electrical systems are located inside the tower

Cost Analysis Spreadsheets
- Our cost analysis is presented as user interactive spreadsheets.
- There are two sets of spreadsheets that show the calculations of the various costs associated with wind turbines including:
  - The cost of turbine failures
  - Ownership costs
  - The profit of wind turbine output
  - The amount of energy produced
- One focuses on a single wind turbine
  - Provides yearly figures
  - Calculates net income of the wind turbine
- The other spreadsheet focuses on a wind farm
  - Can support multiple types of turbines at a single farm
  - Provides wind farm's total operational cost hourly
- Users can enter in their own figures to set up different scenarios
  - The users are provided with initial figures and help text to use the spreadsheets effectively

Wind Turbine Failures
- Gearbox failure
  - Problems with the bearings and the gears cause failures
  - Monitoring and scheduling routine oil changes can help prevent failure
  - Not as common as other failures, but it is the most costly
  - Replacing one can cost more than 25,000 dollars for a 660 kW turbine
- Other major failures can occur in the:
  - Electrical system
  - Sensors malfunction
  - Control systems
  - Blades and pitch

Sponsor Information: SmartSignal
- SmartSignal offers software which models machine and equipment behavior.
- Their software is used to help detect equipment failures before they become problematic.
- SmartSignal would like to expand its market to the wind power industry.
- SmartSignal has asked the IPRO 303 team to research and analyze the costs associated with the wind industry.