Wind Turbine Fulfillment Center

A Streamlined Approach to Knowledge Capture, Retention and Communication for Wind Turbine Suitability Analysis

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The set up of a wind farm involves multiple analysis steps to determine the feasibility of installing wind turbines in specific locations. In addition to considering government, environmental and legal policies, it is essential to determine the engineering feasibility of installing wind turbines of a selected make and model. The engineering feasibility of a specific wind turbine is based on ambient wind conditions, turbulence and geographical data in the selected location and the capabilities of the selected wind turbine model. This engineering evaluation involves site-specific suitability analysis. Typically, various stages of the suitability analysis are performed by experts in their localized environments, often spread across multiple geographic locations. Though the multiple analysis results are always manually integrated to produce the final evaluation, it is difficult to avoid inconsistent methods, human errors and the loss of technical and process knowledge.

Researchers at the General Electric Global Research Center have created the Wind Turbine Fulfillment Center (WTFC), a centralized system that provides a streamlined, automated approach to information gathering, information analysis, knowledge generation, knowledge retention and knowledge communication. Information on ambient wind conditions, turbulence and geographical data at a specified location along with the characteristics of a selected set of wind turbines form the input to this system. All the engineering programs and related libraries used in the analyses are stored in a centralized location for remote execution by the experts. As the analysis programs are enhanced or replaced, they can be swapped out or added to the system without disrupting the neighboring processes, thus becoming immediately available to all users. The automated analysis works for approximately eighty percent of the cases. Exceptions are handled by the experts, but within the confines of the system to ensure the capture of that expert knowledge. The results of all analyses are captured in a knowledge bank in such a manner that the results from any past analysis can be recreated at any time. The communication of the generated knowledge takes the form of technical report generation, performance scorecards and process management reports.

The WTFC was developed using internally created algorithms and models, in combination with commercial -off-the-shelf (COTS) tools. For the user interface and interaction with engineering programs, Enterprise Accessible Software Applications (EASA) tool was used. EASA allowed for rapid user interface development, automated queuing and seamless connectivity to compute servers. Custom algorithms were developed to analyze the output of engineering programs, and workflow management. Data is stored in a combination of network accessible storage, for files, and a relational database for all other data.

The WTFC has been implemented as a web-based system, accessible across global GE locations with a current user base of more than 125 global users located in 3 continents. The WTFC system has resulted in an error-proof process that provides consistent and reproducible results, a knowledge base that allows validation and verification of past analyses, enhanced productivity and a quicker turn-around on complex analyses.

Future work aims at enriching the knowledge base with wind farm layout knowledge and the possibility of employing AI techniques for automated knowledge generation.