EERA-DTOC user requirements

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June, 2012

Agreement n.:	FP7-ENERGY-2011-1/ n°282797
Duration	January 2012 to June 2015
Co-ordinator:	DTU Wind Energy, Risø Campus, Denmark

Support by:

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1 INTRODUCTION

This document outlines the user requirements for the European Energy Research Alliance Design Tools for Offshore Wind Farm Clusters (EERA DTOC) project.

In order to make use of the designed tool, EERA DTOC involves multi-disciplinary design optimization by integrating existing component models. The user requirements have been established through interviews with offshore design professionals, an online survey and a requirements workshop. The primary users of the software are strategic planners and project developers. Research institutions, turbine manufacturers and system operators have been classified as associated users whose functional requirements have been considered as identical to those of the primary users. Ensuring EERA DTOC supports the interchange of different component models is a key non-functional requirement to allow research institutions to make future improvements and innovations. The user types have different perspectives on the design process, different available design options and different definitions of what represents an optimum design. The requirements have been documented via the user story format and assembled into a product backlog which lists the requirements in order of priority. The user stories relating to cluster design have been determined to be of highest priority. Energy production and cost modeling have emerged as essential components not present in the initial list of project partner models.

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2   PRODUCT VISION: WHAT IS EERA DTOC FOR?

The Product Vision describes why the project is being undertaken and what it will achieve. It is sometimes referred to as an 'elevator pitch' i.e. it provides a succinct description of the project that can be communicated quickly and easily. The Production Vision of the EERA DTOC project is as follows:

A robust, efficient, easy to use and flexible tool created to facilitate the optimized design of individual and clusters of offshore wind farms.

A keystone of this optimization is the precise prediction of the future long term wind farm energy yield and its associated uncertainty.

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3 USER GROUPS: WHO WILL USE EERA DTOC?

The prospective users of EERA DTOC fall into the following primary categories:

- **Strategic Planners** are involved in the design process at the highest level. They are commonly responsible the definition of project boundaries and determining what infrastructure should be created to accommodate them. The goals of a strategic planner may include:

  o Achieving a legislated target for installed capacity.

  o Minimizing the cost of energy to consumers.

  o Ensuring the security of the supply of energy to consumers.

- **Project Developers** will work within the broad project definitions determined by strategic planners. The primary goal of a project developer will be to maximize their financial return.

Project developers may work within a project boundary that is so large that it can be decomposed into several subprojects and thus may wish to perform some of the same tasks as a strategic planner e.g. optimum use of infrastructure to connect sub projects.

Additionally we can consider the following types of associated users

- **Consultants** provide services to the primary users.

- **Research institutions** develop new and improved ways of achieving the goals of the primary users.

- **Manufacturers** supply equipment to project developers e.g. turbines, foundations, cables etc.

- **System Operators** may have the following goals:

  o Determining if existing infrastructure has the ability to support a proposed development.

  o Designing new infrastructure to support a proposed development.

  o Efficiently operating the infrastructure which supports an operational wind farm.

  o Determining if a developer's design is grid code compliant.

For the purposes of this document the associated users will not be considered as distinct to the primary users. This has been done in order to simplify the requirements analysis and is justified as follows:

- Consultants are employed by primary users to act on their behalf and therefore by definition share the same goals and requirements.

- Research institutions seek new and innovative ways to fulfill the requirements of the primary users. EERA DTOC should support the interchange of different component models so that research institutions may continue to innovate.

- Manufacturers will share the same design goals as the project developer as this directly influences their ability to make a margin.

- System operators can, for any requirements relevant to EERA DTOC, be classified as strategic planners.

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4   DESIGN: PERSPECTIVES, DECISIONS AND OPTIMUMS

The different users of EERA DTOC will have different; perspectives on the design process, available design decisions and definitions of what represents an optimum:

- **Strategic Planners** will focus on high level design decisions. Their available decisions will include determining sensible sizes and locations for development areas (e.g. to put out to tender to project developers) and making assessments of what strategic infrastructure is required to accommodate these projects (e.g. electrical grid, ports etc.). A strategic planner's will consider a design to be optimum if it fulfills the following:

    o   It minimizes its impact on its environment; shipping lanes, ecology etc.

    o   It ensures the security of the supply of energy to consumers.

    o   It minimizes the cost of energy to consumers.

    o   It can feasibility be developed at rates of return attractive to commercial investors.

- **Project Developers** will have a broad spectrum of design decisions available; from the high level choices such as which transmissions technology to install (e.g. HVAC vs. HVDC) to the detailed design of the array cable network. A project developer will consider a design to be optimum if it fulfills the following:

    o   It minimizes its impact on its environment; shipping lanes, ecology etc.

    o   It complies with all applicable regulations e.g. grid codes.

    o   It maximizes financial return.

    o   It minimizes technical and financial risk.

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5 USER REQUIREMENTS: WHAT WILL EERA DTOC DO?

5.1 Product Backlog

The user stories for the EERA DTOC project were initially established through interviews with offshore wind farm design professionals. The proposed user stories were then appraised via an online questionnaire and requirements workshop to examine their relevance and relative priority. The user stories were then assembled into a Product Backlog which is a simple 'to do' list of requirements ordered in terms of priority. Several requirements initially identified have been excluded from the Product Backlog either because of their overlap with other requirements or their low priority.

5.2 Priority

The priority of the different requirements has been established via a combination of an online survey and user requirements workshop. Although substantial differences in opinions were encountered the following key conclusions were made:

- **Cluster design requirements are highest priority.**

- Determining the optimum spacing and positions of turbines within a wind farm is the next highest priority.

- After cluster design and turbine spacing the stories relating to the cable layout are the next height priority i.e. determining optimum cable layout, electrical configuration and number of substations.

- The online results suggests that the remaining requirements are still important, just not as important as the above high priority stories.

- Determining the optimum transmission technology (HVAC vs. HVDC) was the most polarized requirement. It was considered by some to be very high priority and others very low priority.

5.3 Limitations of Scope

It is important to acknowledge that certain aspects of offshore wind farm design are beyond the scope of EERA DTOC. In particular the management of constraint information (e.g. ecologically sensitive areas, shipping lanes etc.) will not be addressed within this project. This is justified by the fact that such information may be efficiently handled by Geographical Information Systems (GIS) which are in widespread use within the offshore wind industry.

5.4 Optimisation Philosophy

EERA DTOC will not attempt to fully automate the design process i.e. it will not offer a 'push button' approach to optimization. This is because many subtleties of the design process require human interaction which makes a fully automated tool of practical usefulness impossible to achieve. Instead EERA DTOC will focus on facilitating the design process by allowing users to efficiently explore and compare many design scenarios in search of their optimum.

5.5 Non-functional System Requirements

In addition to the functional requirements described by the Production Backlog EERA DTOC has some non-functional requirements which are described in Appendix H.

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6 MODEL INTEGRATION

The core concept behind EERA DTOC is the combination of different component models into an integrated design tool. The user requirements described in this document will inform the decision as to which models are the highest priority to integrate e.g. the high priority cluster design requirements may require very different models than the lower priority wind farm design requirements. Furthermore it is clear that some form of wind farm production and cost modeling is essential to fulfill the user requirements. As cost modeling is an extremely broad and complex subject in itself, EERA DTOC will focus on relatively simple methods of sufficient detail to facilitate the optimization process.

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7 EVOLUTION OF USER REQUIREMENTS

It is important to acknowledge that some form of requirements change is inevitable for all but the most simple of software projects. Therefore, despite the thorough requirements analysis completed to date, it is anticipated that there will be some evolution of user requirements as the project progresses. It is therefore planned that the definition of the user requirements and their relative priorities will be reassessed after the initial 'dry run' is completed.

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APPENDIX A: USER REQUIREMENT WORKSHOP

The user requirement workshop was held Monday 16th April 2012 during the EWEA conference from 17.30 to 20.00 in room 18, Bella Centre, Copenhagen.

Agenda

- 17:30 – 17:45 Welcome and EERA DTOC Project Recap
- 17:45 – 18:15 Results of online survey of user requirements

- 18:15 – 18:45 Breakout Session 1
- 18:45 – 19:00 Breakout Session 1 Discussion

- 19:00 – 19:30 Breakout Session 2
- 19:30 – 19:45 Breakout Session 2 Discussion

- 19:45 – 20:00 Final Wrap Up and Next Steps

Breakout sessions will involve subdividing the participants into groups to discuss in detail a subset of the software requirements. At the end of each breakout session one member of each group will present the outcome of their discussion.

The attendees

- Alex Clerc (RES)
- Charlotte Hasager (DTU),
- Daniel Parades Beato (Iberdrola Renovables),
- Francisco Varela (RES),
- Gerard Schepers (ECN),
- Gregor Giebel (DTU),
- Idar Petersen (Sintef),
- Jan Matthieson (Carbon Trust),
- Jose Palma (FEUP),
- Julia Gottscholl (Iwes Fraunhofer),
- Leif Warland (Sintef),
- Luis Mariano Faiella (IWES Fraunhofer),
- Olimpo Anaya-Lara (Strathclyde),
- Peter Stuart (RES),
- Pierre-Elouan Réthoré (DTU),
- Rikard Roth (Hexicon),
- Vitor Gomez (Porto),
- William Leithead (Strathclyde University)

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