

Software & Decision Support Systems for Offshore Wind Energy Exploitation in the North Sea Region

Executive Summary

A report by Overspeed GmbH & Co. KG to the POWER Project



Project: POWER - Pushing Offshore Wind Energy Regions EU

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Pushing Offshore Wind
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Executive Summary and Conclusions

1. Introduction

The study identifies potentials of the application of Software (and) Decision Support (SDS) Systems in the course of the planning and realization processes of offshore wind farms in the North Sea Region. It reports on existing Decision Support Systems and software tools for on- and offshore planning. An internet research, a literature research and a questionnaire was performed to get an overview on corresponding software. Gaps were identified and current demands of the offshore wind energy sector were analysed.

Decision Support Systems

The definition of Decision Support Systems is broad and there is no universal definition beside that those systems are build to assist in decision processes and help to identify and solve problems. Generally Decision Support Systems are multidisciplinary and often include weighting, analysis, and optimisation functions. A wide range of sources is handled including data, information, knowledge and methods. Commonly most Decision Support Systems are aligned to interactive computer software systems called 'Software Decision Support Systems' (SDSS). A Decision Support System is related to different disciplines.

Decision Support Systems in the Offshore Context

are designed to support the development, construction and operation of offshore wind farms. For instance, during the planning process a whole series of requirements from various fields show up (engineering, costs, financing, ecological environment, shipping, military, exclusion zones, sediment properties, accessibility ...). Those Decision Support Systems integrate various data, general information and mathematical models, in order to support problem identification and solving, optimisation and decision-taking processes.

According to current information, Decision Support Systems are used rarely in the offshore wind energy field. That is why this survey also relates to supporting software products. GIS systems, which are usually applied in this field, are a good example for basic Decision Support Systems in which exclusion criteria play a major role, but which generally do not include explicit evaluations and weighting functions.



Approach

As a basis for the study a survey was performed. The goal was to provide an overview of existing Decision Support Systems and individual software tools as well as to define the demand for and requirements of Decision Support Systems for the planning and implementation of offshore wind farm projects in the North Sea area. The parties addressed here were developers, planners, authorities, manufacturers, universities, financing groups etc. An internet research and a literature research on existing Software Decision Support Systems was performed. A questionnaire regarding the use of Decision Support Systems in the offshore sector and related software tools was developed and sent out to relevant parties in Western Europe. The responses were evaluated and analysed. Personal communications and supplementing researches did complement the assessment.

2. Existing Decision Support Systems

The following short overview on existing Decision Support Systems related to the offshore wind energy sector are gathered mainly by an internet and literature research and own experience. In category 'Type' the classification 'Specific' was chosen for software which 'mainly' works in one specific area and 'Integrated' was chosen for systems which cover different specific areas like wind farm layout, restriction areas, geological items, cable route, costs etc.. In the offshore sector several SDS-Systems are under development but already supporting concrete offshore plannings.

Table 1: Existing SDS-Systems/Tools OFFSHORE

Name	Company	Area	Type	Comment
OWECOP	ECN, The Netherlands	Project development	Integrated	-
O&M DSS	ECN, The Netherlands	Operation, Maintenance	Integrated	under dev.
OWFLO	Uni. of Massachusetts, USA	Project development	Integrated	under dev.
ANEMOS	ICBM, Germany	Education Project develop.	Integrated	under dev.
Ventum	TU Delft, Netherlands	Education Project develop.	Integrated	only education
EeFarm	ECN, The Netherlands	Grid Integration, Costs	Specific	-
Maintenance Manager	ECN, The Netherlands	Operation, Maintenance	Specific	-
GIS – cable route	ICBM, Germany	Project development	Specific	development discontinued

More general SDS-Systems for offshore wind farms (**Fehler! Verweisquelle konnte nicht gefunden werden.**) are mainly developed by ECN (Netherlands, OWECOP) and the University of Massachusetts (USA, wind farm Middelgrunden Denmark, OWFLOW). Those systems cover the whole area from project development, wind farm layout, restriction areas, geological items, cable route, grid connection and operation and maintenance in different

detail. Other software systems are for educational training or more specific areas like grid integration.

In the onshore sector several integrated SDS-Systems from different countries are found. They are specific to onshore developments and only parts of those systems may be transferred to the offshore sector. Most promising projects for the onshore sector seems to be the 'Multi-Criteria Analysis with ArcGIS Spatial Analyst (NERI Denmark) and RES-DSS (University of Athens, development state unclear). The 'Multi-Criteria Analysis' seems to implement a good concept also for offshore SDS-Systems. The RETScreen concept (Energy Diversification Research Laboratory, Canada) which implements different project analysis tools on a Microsoft Excel sheet base, meets the interest of several wind farm developers.

3. Classical Software Tools in the Offshore Wind Energy Sector

Classical software tools are playing a more or less important role for the addressed institutions. In the Geographical Information System sector ESRI-Products like 'ArcView', 'ArcInfo' and 'MapInfo' are the most used software in this context.

In the wind energy specific area 'Wasp' and 'Wind-Pro' have great shares in the market. In the area project planning 'Microsoft Project' is established. For electrical systems 'Power Factory', 'PSS SINCAL' and 'PSS/E' are favoured systems. In the financing and economy sector 'Microsoft Excel' plays an important role.

Geographical Information Systems (GIS)			
Name	Developer	Type	Description
Arc-View / Arc-Info	ESRI	Desktop/Server GIS	Geographical data base, Analysis
MapInfo	MapInfo Corp.	Desktop GIS	Geographical data base, Analysis
Grass	Open Source	Desktop / server GIS	Geographical data base, Analysis

4. Questionnaire

The goal of the questionnaire was to get an overview about the usage of existing Decision Support Systems and individual software tools and information about the demands and requirements of possible customers with regard to Decision Support Systems in the offshore sector. The questionnaire was addressed to about 350 members of the following groups related to offshore wind energy developments in the North Sea region:

Project developers, Planners, Authorities, Environmental associations,
 Universities, Banks, Financing groups, Consultants,
 Grid operators, Manufacturers, General contractors, Research centres,
 Operators

Evaluation

The evaluation of the questionnaire was based on 63 answers from about 350 addressed companies and specialists in Europe, a quota of 18%. Answers were gained from Germany, Denmark, The Netherlands, United Kingdom, Norway, Greece and Sweden. Most of the answers (about 94%) came from Germany, Denmark, The Netherlands and United Kingdom.

Areas of Expertise

The area of expertise of the institutions which gave feed back is mainly in the technical sector with a fraction of 55%, ecological and economical ranges around 23%. Multiple orientations per company were possible.

Current Use of Decision Support Systems

The current use of Decision Support System seems to be rather high with about 40% (Figure 1). An explanation for this high value is that on the one hand many institutions which develop (or possible develop) Decision Support Systems were addressed and on the other hand GIS systems as basic SDS-Systems are used. In some cases also classical software tools were named misleadingly as SDS-Systems (which do not meet). Therefore in general the use of Decision Support Systems apart from GIS-Systems is rather low.

For more detailed evaluations the participants were divided into four groups based on their main orientation: Research, Planning, Construction and Approval. The main use of Decision Support Systems is found in the research and approval area. In the planning and approval area at current only GIS systems are playing an important role as basic SDS-Systems. The participants did not differentiate between on- and offshore use.

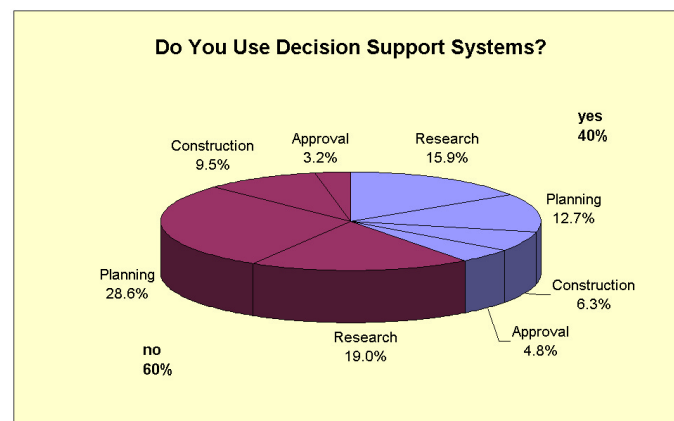


Figure 1: The use of Decision Support Systems
(Entries: Research: 22, Planning: 26, Construction: 10, Approval: 5)

It must be kept in mind that it is reasonable to assume that just institutions which are not interested in Decision Support Systems did not answer the questionnaire at all. So the results must be interpreted carefully.

Demand for Decision Support Systems in the Offshore Wind Energy Area

The demand for Decision Support Systems in the offshore wind energy area is not focused on specific issues and therefore seen to be very high in many different areas leading with project development, approval, ecological evaluation and financing followed by maintenance and

operation, cable route and logistics. The demand for Decision Support Systems for the electrical system and grid integration is relatively low. This may be due to the fact that for the design, analysis and optimisation of electrical systems several professional tools are existing. From personal consultations it was found that the idea of an Decision Support System is often valuated positive in general but often the own need is very unspecific and unclear.

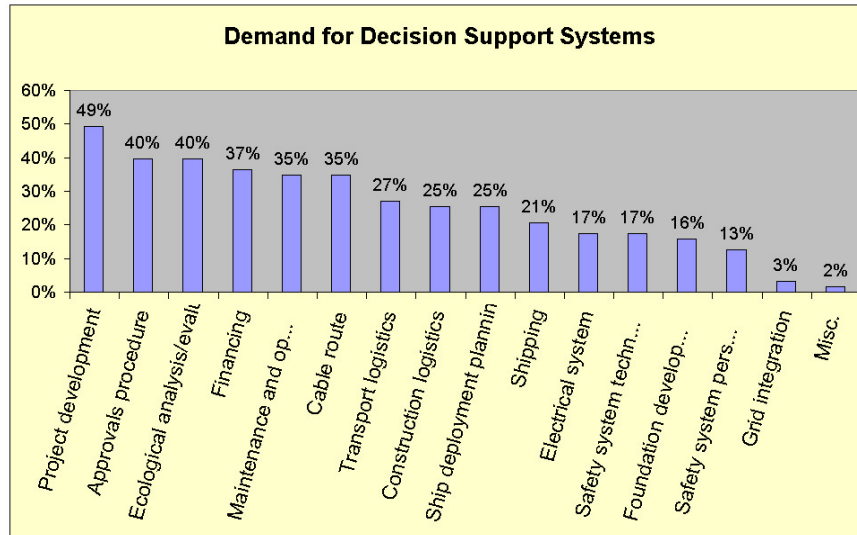


Figure 2: The demand for Decision Support Systems in different areas

The Potential to Use Decision Support Systems

Most of the participants would like to use Decision Support Systems in their work especially in the area of planning (as expected). But there is a minority of more than 35% which don't like to use Decision Support Systems (Figure 3).

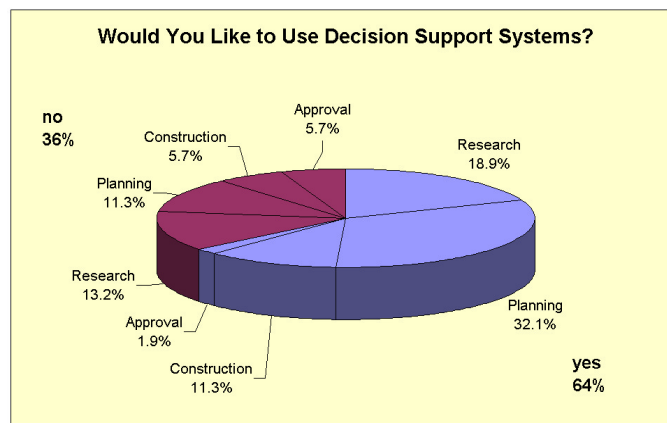


Figure 3: The potential to use Decision Support Systems

The category approval shows the opposite relation and a low demand to use Decision Support Systems (note: only 5 entries).

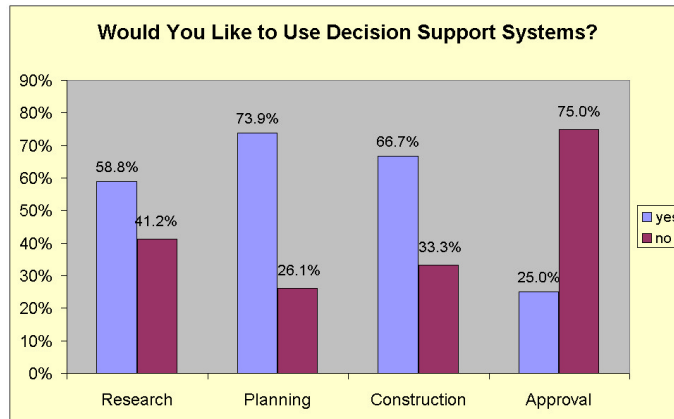


Figure 4: The potential to use Decision Support Systems by user groups

It must be kept in mind that the motivation of institutions to give feed back on this questionnaire may be higher from those who are interested in Decision Support Systems as from those which are not.

Software Decision Support Systems as Integrated Systems or a Collection of Individual Programs?

The need of SDS-Systems as integrated systems or a collection of individual programs is nearly balanced (Figure 5). The choice ‘Individual Programs’¹ has a slightly higher value. This result is rather dependent on the composition of addressed institutions. Integrated systems are mainly demanded by approval and research institutions.

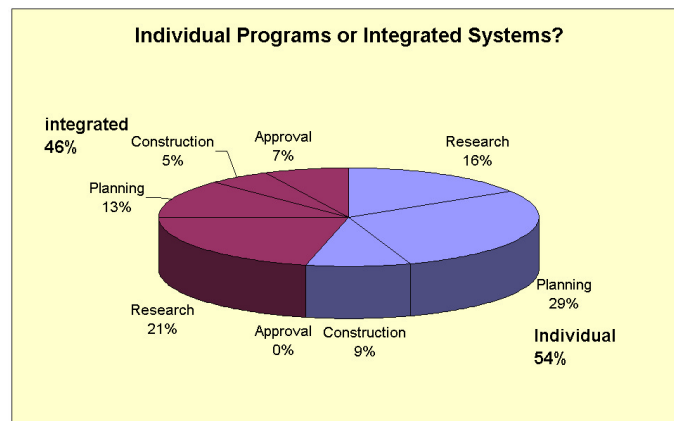


Figure 5: The desired type of SDS-Systems

From personal communication the need for individual specific software in the different areas of focus was underlined but also the need for uncomplicated data exchange (standard interfaces) between software tools.

¹ In this context ‘Individual Programs’ means separated programs with defined standard interfaces for data exchange.

Software Tools Which Play an Important Role in the Decision-Finding Process

Software tools which play an important role in the decision-finding process are shown in the following (Figure 6, Figure 7). Excel sheets are leading the 'hit list' up to 60% including the project planning tool MS-Project and database MS-Access. The use of the GIS-Tool Arc-View is relatively high with 25% as the first non-standard tool (and SDS-System!). Wind specific software is following with 'WaSP' (17%) and 'WindPro' (16%). But also own developed software for economic calculation has to be recognised (11%).

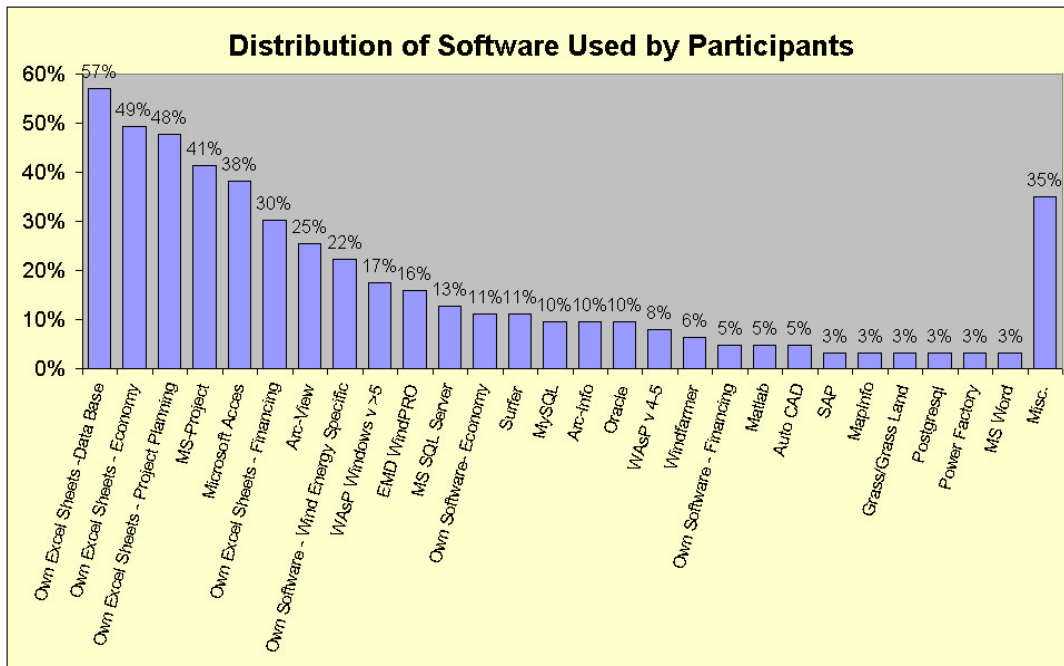


Figure 6: Distribution of software tools used by the participants, sorted by fraction. Software tools which are used only by one participant are pooled under 'Misc.'

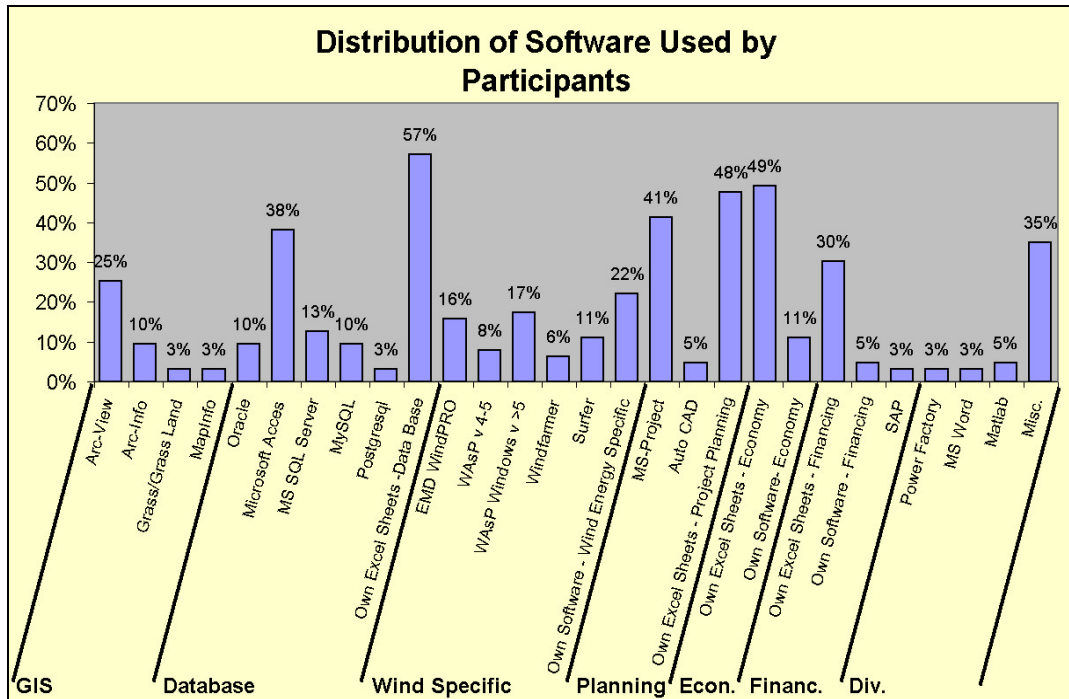


Figure 7: Distribution of software tools used by the participants, sorted by category. Software tools which are used only by one participant are pooled under 'Misc.'

An interesting result in Figure 7 is that in the economic and financial area Excel sheets and own software plays the major role. Specific software for the ecological area is not named.

5. Assessment and Conclusion

Main Fields of Applications

The evaluation of the questionnaire and personnel interviews are showing mainly needs for SDS-Systems in the area of project development and in planning processes including the approval procedure from the planner's point of view. GIS systems as basic SDS-Systems are a must in offshore planning, not only for own needs but even to exchange information with the authorities. Authorities are using GIS systems during the approval procedure in the offshore region but mainly for map generation with the different restriction areas and infrastructure items.

The need for development and application of SDS-Systems is not confirmed by the authorities as urgent as expected. Possible advantages of SDS-Systems on GIS basis must be communicated. People who are working with GIS software (and preparing the input for the GIS software) are not necessarily the people which handle the permission process. The application of related systems is also limited by the complexity of such software tools.

Main fields of applications for Decision Support Systems were identified more on a general basis. In principle all formulated areas of offshore wind energy do have a high priority led by project development, financing, approval and ecological evaluation.

From personal consultations of planning people and authorities the need and the field of application was formulated in most cases very unspecific.

Adopting Existing Systems

The question “can existing systems be adopted or should new systems be developed” is answered by many project developers and planning people clearly: Existing tools should be extended with additional features in the direction SDS-Systems. Interfaces and data formats of existing software tools should be standardised for easy data exchange. A good example for extending common used standard software may be the “Multi-Criteria Analysis with ArcGIS Spatial Analyst “ which extends standard software with tools for complex valuations

An interesting result of this study is that research institutes and planning / permitting institutions have significantly different views regarding the use of integrated systems or alternatively a collection of software tools. From research and approval institutions the integrated concept is preferred. From planning people there are big doubts that the big amount of planning details and special evaluations could be handled by ‘one big’ system. Also the transparency of decision or valuation processes of SDS-Systems was questioned. From experience decision processes are in most cases iterative processes often motivated by politics and economic short time interests.

General approaches for SDS-Systems including ‘simple’ models for different areas don’t help during detailed planning. The combination of very specific tools, modular concepts, with specialists for each part could be a solution. The maintenance of each software package could be done by specialists for the according sector.

To find acceptance for the application SDS-Systems work has to be done. Good examples have to be published and disseminated. From the questionnaire and personal communication it was found that people like the idea of Software Decision Support Systems but have some doubts of practicability.

Conclusion

The number of available Software Decision Support Systems for the offshore sector is limited. At current accordant SDS-Systems are under development primarily by two institutions. First applications to support concrete offshore plannings are performed but commercial application is at the beginning. Different other approaches are more in the education and research stage. For onshore the situation is similar.

The needs for Software Decision Support Systems are found in nearly all main areas of offshore wind energy with focus on project development, approval procedure, ecological evaluation, financing, maintenance and operation, cable route and logistics. This reflects also the bottlenecks and needs formulated by preceded POWER studies ([2],[5]). It was found that many people and institutions did not (or not in detail) deal with the ideas of Software Decision Support Systems before. It must be communicated more insistent that SDS-Systems do not “make” decisions but “support” decisions and can give a high-quality data and knowledge basis for decisions.

Simple to use software systems are desired but integrated SDS-Systems tend to be very complex. Scepticalness for the feasibility, quality, and handling of complex SDS-Systems seems to be appropriate. A combination of specific software tools with standard interfaces and modular concepts seems to be a suitable solution, just if they are based established “standard” software tools which are already in use. Acceptance is a major topic.

Because at current most of the offshore wind developments in Europe are in the planning and engineering stage the main focus is directed to project development, approval procedure, ecological evaluations, financing, maintenance and operation planning, wind farm and cable

installation. The time schedule for this stage is in the area of several years for a single project. But the perspective to use SDS-Systems during the next 20 years of operation must be kept in mind. Operation, maintenance, safety and energy market etc. are main topics for SDS-Systems during this stage.

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- [3] Logistic Service Agentur, Universität Flensburg, ipc: *POWER- Offshore Wind Supply Chain Study for Germany*. Final Report. Germany, October 2005. <http://www.offshore-power.net/> (15.08.2006)

- [4] Sjoerd Zeelenberg: *Offshore Wind Energy in the North Sea Region*. POWER and the University of Groningen. Netherlands, 2005, http://www.offshore-power.net (15.08.2006)

- [5] Douglas-Westwood: *POWER – Transnational Offshore Wind Supply Chain Study*. United Kingdom, May 2006, <http://www.offshore-power.net/>(15.08.2006)

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