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Qualification Requirements in the Wind Energy Sector: On- and Offshore[1]

Extract from a study accomplished by Institut Arbeit und Wirtschaft der Universität / Arbeitnehmerkammer Bremen (iaw)[2].

Qualification:

Quality assurance module

Quality assurance and quality management are among the central challenges of the industry, which are gaining importance as a result of the increasing demands of the banks and insurance companies. In so doing, the requirements in the certifying of new materials, processing and testing procedures relate to all areas of the value creation process in the wind energy sector. The risks connected with the offshore technology will raise these requirements even further. Only qualified staff can meet these high expectations.

They must be able to evaluate products and processes on the basis of their technological, legal and business knowledge. In addition, they must be able to recognise and execute the correct actions. Qualification is therefore an important issue for all areas within the industry.

The qualification requirements described here are based on interviews with approx. 30 representatives of companies, associations and certifying institutions. In addition, 90 companies were sent a questionnaire, 30% of which were returned. The results are therefore not representative, but indicate trends that can be extrapolated to the entire industry.

The companies queried are acting in the following areas of the supply chain:

1: Planning/Development/Finance/Insurance
2. Mechanical engineering and plant construction (e.g. gears)
3. Plastics and fibre composite technology (e.g. rotor blades, nacell cladding)
4. Electrical engineering (e.g. construction of generators)
5. Assembly and logistics
6. Foundation technology and tower construction
7. Service, maintenance, repairs
8. Maritime construction and service

Current qualification profile in the industry:

The charts on qualification profiles in the wind energy industry are not statistically representative, due to the small data basis. However, the distribution indicates general trends. In the planning/development, electrical engineering and maritime construction areas, engineers are strongly represented, whereas the share of unskilled or on-the-job trained persons is higher in plastics and fibre composite technology as well as in service and maintenance.

The overall qualification profile:
Unskilled/On-the-job trained 29.9

[1] Translated for “Power”

[2] **A Joint project of: cities of** Bremerhaven and Cuxhaven, administrative district Cuxhaven, Wind Energy Agency Bremerhaven/Bremen e.V., Institute Labour and Economy of Bremen University / Germany – in cooperation with the Chamber of Labour of the State Bremen

Administrative jobs	11.6	
Service technicians	4.5	
Mechatronic engineers	0.6	Information in %
Electrical engineers and fitters	11.4	
Process engineers	2.2	
Construction, industrial mechanics	15.6	
Concrete workers	1.6	
Business managers, Legal experts	8.2	
Engineers, scientists	14.3	

Qualification profile in the areas planning/development, electrical engineering and maritime construction:

Unskilled/On-the-job trained	19.1	
Administrative jobs	17.0	
Service technicians	5.1	
Mechatronic engineers	1.0	Information in %
Electrical engineers and fitters	17.3	
Process engineers	0.2	
Construction, industrial mechanics	8.4	
Business managers, Legal experts	12.2	
Engineers, scientists	19.6	

Qualification profile in the areas plastics and fibre composite technology and service and maintenance:

Unskilled/On-the-job trained	51.5	
Administrative jobs	2.7	
Service technicians	6.5	
Electrical engineers and fitters	1.2	Information in %
Process engineers	10.0	
Construction, industrial mechanics	14.6	
Concrete workers	8.1	
Business managers, Legal experts	1.2	
Engineers, scientists	4.2	

Qualification requirements in the wind energy industry

Wind-specific general engineering knowledge:

As a wind energy system (WES) represents a system of interlocking components, classically trained engineers must do additional training. The aerodynamic properties of the rotor and the moving masses of the generator are, however, also of relevance to a gear manufacturer. Furthermore, the dynamic stress on offshore WES through wind and waves is hitherto uncharted territory, scientifically. As a result, classic courses of study should not be replaced but rather supplemented by additional wind energy-specific modules. Large automotive groups already utilise this principle internally, for the specialisation of their engineers. For cost reasons alone, this approach is not suitable for small to medium-sized companies in the industry. Associations, research and coordination institutions in the industry should therefore cooperate with engineers in working groups to develop additional wind-specific modules to be included in engineering studies at universities and colleges.

Interlocking of engineering and business management knowledge: In the companies of this industry engineers often take on the responsibilities of project manager. This includes acquisition, the processing of approval procedures, the construction management as well as the establishment of cost-benefit analyses and business controlling. In addition, project managers should be able to present their customers with a basis for their investment decision, which is comprehensible technologically and from a business management point of view. As a result, engineers in the industry increasingly require business management knowledge, whereas the administrative professions require a sound technological basis. The staff of banks and insurance companies in the "wind business" also need some knowledge of wind energy technology. In the context of the survey, companies therefore mentioned a need for further education to link business management knowledge more closely with technical knowledge of WES and financial calculations in respect of wind energy.

International laws, agreements and standards: The qualification requirements of the industry also include courses that give an overview of which legal areas are relevant for specific company issues. In so doing, environmental protection laws, construction law, laws on international maritime law, customs regulations for export, contract law and national industrial standards must be observed. The companies do not consider this offer of further education as a replacement but rather as complimentary to in-house legal expertise or advice.

IT technologies in the wind energy sector: Here, four areas are of key importance:
a) Mathematical modelling and constructive plant design,
b) Liquidity management and financial controlling,
c) Supply chain management,
d) Condition monitoring system (CMS).

The first three areas are strongly company-specific or as in the case of supply chain management platforms are only used by very large companies. They are therefore less suitable for a general qualification offer. An introduction to PC basics and the software used can, however, be helpful to skilled workers and service technicians who work with IT supported measuring and diagnostic procedures or with CMS.

Welders: an important new procedure in welding technology is the powder welding. Inert gas shielded arc welding procedures often do not withstand the higher requirements of large modern plants. New qualifications are needed. Suitable training courses for welding technology are already being offered. However, there is often an information deficit about institutions offer training courses with acknowledged certificates. Companies should be made aware of existing courses.

Electricians: for WES: the use of communication technologies and IT competence supplements the basic knowledge of electrical engineering. Working with documentation in English is standard. In addition, working with high-voltage currents requires particular care with regard to occupational safety. According to the companies queried, there is a lack of suitable seminars on the preparation for use of modern communications technology (including CMS). Safety aspects in dealing with high-voltage currents should be taken into account in future further education offers, as should special English courses for technicians (specialist vocabulary). With respect to professional training, it can be concluded from companies' statements that an extension and greater integration of the existing training "Electronic operations engineering with special knowledge of WES" is in line with the companies operating procedures.

Plastics and fibre composite technology: three manufacturing procedures are common in the construction of rotor blades. Along with manual production through the lamination of textile fibres, vacuum injection and pre-impregnated fibre technology are used. This procedure and the load mechanics that apply in the component, due to physical and chemical processes must, in future, be included in training and further education, according to the companies queried. Toxic fumes and superfine grinding dust (aerosols) make demands on occupational safety and healthcare. Respiratory protection technologies and methods of hall ventilation, which enable adherence to MAK levels must be taught. According to the companies surveyed, qualification measures, in particular part-time training, which meet the demands of the high share of unskilled workers in this industry, would be useful. The status of important regulations in initial professional training, i.e. apprenticeship, in the area of plastics and fibre composite technology, is at the 1980s. The professional abilities of the graduates are often restricted to the production of small plastic components. The companies queried have therefore suggested to extend training by a further item, fibre composite technology for wind energy systems.

Foreign language courses (English): due to the increasing export orientation, companies require language courses for their employees, which not only offer general business English but also wind-specific specialist terminology.

Further education for service technicians: modern service technicians need to combine the specialist abilities of industrial mechanics with the knowledge of electricians, process engineers for plastics, etc. and have a minimum IT knowledge. As specialists on site, they are not only flexible and mobile, but must also be able to cooperate with different systems. They must be able to negotiate with customers and explain technical facts. The existing further education as "Service technician for WES technology" already corresponds with the qualification contents demanded by the companies. This further education opens up the opportunity to gain an acknowledged certificate on the basis of the regulation of the Bremen Chamber of Commerce and the Chamber of Industry and Commerce Bremerhaven, which is based on contents developed by the Renewable Energies Education Centre (BZEE = Bildungszentrum Erneuerbare Energien) in Husum. The following areas are included in the profile of requirements: law, business management and work organisation, specialist English and comprehensive training in all areas of WES technology, including plant management. The companies have recommended the constant adaptation of existing training opportunities with regard to qualification contents between the educational institutions and the companies to include current developments.

Offshore training: most of the companies queried are already active offshore in neighbouring European countries or overseas or are currently preparing to launch into this area. In future, the companies will need seaworthy vehicles and personnel to develop, maintain and repair the WES. In addition, law requires safety training for all those working in the offshore sector. Here, companies expressed their need for training that conveys nautical skills such as abseil and rescue techniques.

Overview of current qualification requirements

	1. Qualification profile of the employees	2. New qualification requirements
I Planning Development Finance	- Engineers (approx. 60-80%) -Scientists (geologists, biologists) - Business managers, Legal experts - Industrial clerks/Export clerks - Industrial/Construction mechanics - Service technicians	- Project planning/management - PC-supported construction and calculation of wind farms - Quality management - Negotiation competence (with customers, investors and banks) - Contract law, national and international standards and laws (environmental protection, maritime law, customs, industrial standards) - Foreign languages (English, Spanish)
II Tower construction Foundation technology	- Engineers (approx. 5%) - Business managers - Construction and Industrial mechanics - Concrete and steel workers - On-the-job-trained workers (approx. 10%)	- New basic qualifications (welding technology: powder welding instead of inert gas shielded arc welding) - Quality assurance (tolerances and IT flange measurement) - Team work (cooperation of systems) - Negotiation competence (acquisition and customer consultation) - Foreign languages (English)
III Mechanical engineering and plant construction	- Engineers (approx. 5%) - Industrial mechanics (approx. 80%) - On-the-job-trained workers	- Comprehensive engineering knowledge, negotiation competence - Quality management (new diagnosis and measuring procedures; condition monitoring) - Basic qualifications (new grinding technology: flexible grinding) - CNC machine operation - Team work (standalone production) - Foreign languages (English)
IV Plastics/fibre composite technology	- Engineers (only in large businesses) - Plastic process technicians (approx. 5%) - On-the-job-trained workers (new to the profession or unskilled), (approx. 95%)	- Basic qualifications (manual lamination, vacuum injection, pre-impregnated fibre technology) - Occupational protection and healthcare (grinding dust & aerosols, toxic fumes from glues and hardeners) - Quality assurance

3. Trigger of new qualification requirements	4. Need for further education: a) Contents b) Form c) Results for initial professional training
- New products (offshore projects) - National and international law (environmental law, maritime law) - Globalisation (international contract law) - IT (virtual construction, calculation and design of systems; inflow and slipstream, stochastic wind fields; software ANSYS, WIND-Pro)	a) Linking of engineering and business management knowledge - international contract law - foreign languages b) In-house training - block seminars c) Naval Architect as ideal - comprehensive further education of engineers
- Products (offshore requirements) - Globalisation (quality, punctuality, price on an international comparison)	a) Basic qualifications Industrial mechanics, Electricians - further education as service technician b) In-house training with experts - block seminars - as exception: courses with exemption c) Service technician as independent profession - WES specialisation Mechatronic engineers
- New products (hardened internal gears) - IT (measuring technology, condition monitoring, CAD/CAM) - Innovative forms of work (standalone production) -Globalisation (international contract law, foreign languages	a) Comprehensive further education for engineers - further education as service technician - international contract law (export) b) In-house training - block seminars c) System engineer wind energy (comprehensive)
- New materials - New techniques	a) Basic qualifications: introduction to new plastics and procedures - offshore training for rotor blade service technicians (maritime safety) b) In-house training

	1. Qualification profile of the employees	2. New qualification requirements
V Electrical engineering	- Engineers (electrical engineering) - Electricians (if components are not only designed but also built)	- CMS auto-diagnosis procedures (slip ring system) - Specialist English - High-voltage technology and occupational safety - IT (software for mathematic modelling) - International law and industrial standards
VI Assembly and logistics	- Business managers - Forwarding and export clerks - Specialists for inventory management - On-the-job-trained workers	- Quality assurance Inventory management - Teamwork (packagers and technicians) - IT: e-commerce and supply chain management, digital consignment tracking - Negotiation competence - International law (customs, contract law) - Foreign languages
VII Service and maintenance	- Engineers (very few) - Industrial mechanics - Electricians - Service technicians - On-the-job-trained workers	- Universal qualification WES - Specialist English - New IT: condition monitoring - Business management knowledge - Negotiation competence in dealing with customers
VIII Maritime construction	- Engineers (construction, shipbuilding) - Scientists (geologists, biologists) - Service technicians (if construction is implemented on site)	- Comprehensive engineering knowledge - Project management - IT: software for design and calculation of maritime components - Negotiation competence in dealing with customers - International law - Foreign languages

3. Trigger of new qualification requirements	4. Need for further education: a) Contents b) Form c) Results for initial professional training
- New products (offshore projects) - Globalisation (international contract law) - IT (virtual construction, calculation and design of systems)	a) Comprehensive engineering knowledge - foreign languages b) In-house training - block seminars c) No requirements
- New products (measurements and weights represent new requirements) - IT - Globalisation - International law	a) IT and software (in-house training) - personnel management - foreign languages - international contract law b) In-house training - occasional block seminars c) No requirements
- New IT (condition monitoring) - Negotiation competence in dealing with customers	a) Electrics of high-voltage systems - hydraulics (rotor blade adjustment) - IT knowledge (CMS) - business management knowledge - safety training offshore b) Largely in-house training c) Service technician as independent profession
- IT - Globalisation - International laws and standards	a) Comprehensive further education for engineers - IT and software training - offshore training b) In-house training c) Naval Architect or similar

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