International Journal ofe-Navigation and Maritime Economy 6 (April, 2017) 044–052

e-Navi

Available online at www.sciencedirect.com
ScienceDirect

Original article

Text-Mining and Gamification for the Qualification of Service Technicians in the Maintenance Industry of Offshore Wind Energy ☆

Thies BEINKE [a*], Annabell SCHAMANN [b], Michael FREITAG [c], Klaas FELDMANN [d], Matthias BRANDT [e]

[a*] BIBA - Bremer Institut für Produktion und Logistik GmbH at the University of Bremen, Bremen, Germany, ben@biba.uni-bremen.de, Corresponding Author

[b] Deutsche Windtechnik Offshore und Consulting GmbH, Bremen, Germany, a.schamann@deutsche-windtechnik.com

[c] Bremer Institut für Produktion und Logistik GmbH at the University of Bremen and Faculty of Production Engineering, University of Bremen, Bremen, Germany, fre@biba.uni-bremen.de

[d] Deutsche Windtechnik Offshore und Consulting GmbH, Bremen, Germany, k.feldmann@deutsche-windtechnik.com

[e] Deutsche Windtechnik AG, Bremen, Germany, m.brandt@deutsche-windtechnik.com

Abstract

The competition of maintenance services in the offshore wind industry is continually increasing. The quality of the services acts as the distinguishing feature in the industry. Furthermore, there are public standards, which lead to the permanent necessity to offer further education and training programs for employees. To meet the requirements for further training in the specific field of application within the offshore wind industry, a gamified e-learning application has been developed and is introduced in this paper. It consists of a complete solution, which contains the automated analysis of service protocols to identify qualification needs, the involvement of service technicians in the generation of learning materials, the preparation, transmission as well as the further development of those materials in accordance with the principles of e-learning. Finally, the solution contains a gamified mobile application for qualification, which is designed to meet the individual learning needs of the service technicians. This concept paper follows a problem-centred approach. Based on the current state of technology and research, the problem and motivation are identified and the urgency is verified. Furthermore, a detailed specification of the solution and a first implementation approach is presented.

Keywords: Offshore Wind-energy, Maintenance, Qualification, Text mining, Gamification

☆

Peer review under responsibility of International Association of e-Navigation and Ocean Economy.
☆ This is a revised version presented at the 4th Ai-MAST held at Mokpo, Korea, December 12-15, 2016.

http://dx.doi.org/10.1016/j.enavi.2017.05.006

1. Introduction

Cost reduction in the area of qualification of service technicians in the offshore wind industry is a crucial competitive factor for service companies in the German market. At the same time, the quality of work of the service technicians is the main distinguishing feature. This paper proposes an approach, which addresses the dilemma of investing in higher quality further training as well as reduction of cost for qualification measurements.

The paper is organised as followed: Firstly, the current state of the offshore wind industry and the scope conditions for maintenance of offshore wind turbines (OWT) and requirements for qualification of service technicians are outlined. This is followed by the research approach described in section 2. The focus of this contribution is on the area of qualification for the maintenance work on OWT, on e-learning and gamification approaches in this context as well as on the analysis of large quantities of information via text mining methods on the basis of service protocols. Accordingly, the current state of research of the three areas is illustrated in section 3. In section 4 the description of this theoretical basis and the solution application are presented. The paper concludes with a summary and an outlook in section 5.

1.1 Research Background – Maintenance of Offshore Wind Turbines

With about 91 % of the globally installed ca. 9 GW offshore wind energy (OWE) capacities being located in European water and of that ca. 5 GW in the North Sea, the OWE in this region has gained increased relevance (Fried et al., 2015). The majority of those OWT is currently being planned or built. In order to remain competitive in the long term, it is necessary to guaranty a high level of availability and reliability of a vast number of turbines after they have been built to secure profits and minimize costs in the operational phase (García Márquez et al., 2012). To secure the availability of the OWT and by that to secure profit high quality maintenance is necessary. According to the DIN 31051, maintenance is defined as the combination of technical and administrative measures, this incorporates taking all measures to maintain and restore the nominal condition as well as to assess and evaluate the current condition. In the context of OWT the aim is therefore to minimize the error rate as well as to prevent long term consequences and damage of the OWT (Alsyouf 2011).

Performing maintenance activities on OWT is categorically different from those on onshore wind turbines. Indeed the maintenance process of OWT is substantially costlier in both effort and money. Furthermore, due to the great distance between the shore and the OWT it is not possible for the service technicians to commute between one place and another immediately (Burkhardt 2013). The transfer time to the OWT as well as the influence of the weather on the transfer and further factors have a direct influence on the ability to react to the maintenance activities. Down time, loss of speed and quality are the factors that have an impact on production time of the OWT beside the maintenance factors. In figure 1, this issue is depicted and it highlights the importance of maintenance for economic operation of the OWT.

1.2 Research Motivation – Need for Qualification in the Maintenance of Offshore Wind Turbines

Grantz et al. (2013) show that the amount of further training in the field of OWE in the north-west region of Germany continues to increase. Due to a quantitative coverage of the need for qualification, the quality of the qualification offers turns increasingly important. Here, not only the technical qualification but also increasingly the mediation of interdisciplinary competencies as well as managerial responsibility and security awareness are foregrounded (Grantz et al., 2013). The cost for high quality further training programs at certified institutions and further training facilities is significant for the maintenance branch. In the first four years of employment, more than eleven thousand Euro and at least 24 full working days were spent on training technicians and this does not include expenses of the trainers. Each year on average, the total amount spent on refresher trainings lies at above two thousand Euro and costs seven working days per person. Those significant costs for the qualification also face competition in the field of maintenance of OWE as well as the need for a high availability of OWT.

Due to the large number of OWTs which are required to be serviced and maintained, there is an urgent need for skilled workers as well in the next few years. Moreover, the quality of their qualification will play a