The wind energy industry: From Onshore to Offshore - evolution between incremental and radical innovation -

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Abstract

Classical approaches describe technological evolution using the dichotomy of incremental and radical innovation. Especially radical innovations are said to have a major impact on industries. However, technological discontinuities are not necessarily radical.

The wind energy industry during its shift from onshore to offshore is struck by a phenomenon that can be described as Architectural Innovation (AI). Technological discontinuities such as AI affect industries whose products are shaped by a dominant design (Anderson & Tushman 1990). The importance of dominant designs in the wind energy industry is shown in several studies (cf. Gaur & Kamere 2003, Menz & Kammer 2011).

A minor change of a dominant design possibly affects the whole industry and thus might have an impact like a radical innovation, without being radical itself. Henderson and Clark (1990) suggest that especially Architectural Innovation has such an effect on industries. Changes in the product architecture alter how the different components of a product work together. Thus new capabilities in coordination, organization and communication throughout the whole value chain are required.

While the core components of a wind turbine or a wind farm remain largely the same, upscaling and the new field of application offshore result in reconfigurations on different technological and organizational levels. In an ex post approach some of the failures during the installation of offshore wind farms in the past decade can be identified as classical issues of Architectural Innovation.

On the WTG-level classical interface problems have been bearing failures (i.e. main bearings, pitch bearings) due to corrosion, heavier loads and different oscillations. On a higher level in the product hierarchy especially the grouting issues between towers, transition pieces and foundations are representative for different interface interactions and the problems they are causing. On the plant level the up-scaling procedures lead to an increased number of installed units. This step leads to an increased total power output and causes an adjustment of cables and transformer units and the respective interfaces. From this angle of view, new interactions and linkage patterns emerge again due to a differing park configuration offshore.

Architectural Innovation

“The essence of an AI is the reconfiguration of an established system to link together existing components in a new way. This does not mean that the components themselves are untouched by AI. AI is often triggered by a change in a component - perhaps size [...] (and) creates new interactions and linkages with other components in the established product. The important point is that the core design concept behind each component and the associated scientific and engineering knowledge remain the same.” (Henderson & Clark 1990: 12) As AI challenges Industries and the technological community of a respective field AI should be classified as a Technological Discontinuity.

Conclusion

The Poster/Paper wants to highlight the importance of the concept of architectural innovation for the whole supply and value chain of the wind energy industry. Creating awareness for the practical and theoretical interface dynamics between components and the need for better communication between suppliers and other stakeholders is crucial for minimizing failures, future installation of floating turbines, further cost reduction and a lasting success of the (offshore) wind energy industry.

Nevertheless it seems that the organizational and co-ordinational capabilities have not yet been aligned throughout the industry as the difference between onshore and offshore is still not recognized by all stakeholders. We therefore highly recommended in order to push the maturation of the industry and in order to fulfill the ongoing cost out programs to take a step back and look closer at technology interface management. Awareness of the concept of Architectural Innovation leads to a better systemic understanding and to responsible management decisions.

References