**Wind Turbine Technology Battles: Gearbox versus Direct Drive - Opening up the Black Box of Technology Characteristics**

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**Abstract**

*Often, when new innovative and high-tech sustainable technologies are developed, multiple technological options are developed simultaneously by competing (groups of) firms. Then a battle for a dominant standard may ensue, after which often one wins. Scholars have refered to this as ‘standards battles’ (*[*M.A. Schilling, 1998*](#_ENREF_4)*,* [*2002*](#_ENREF_6)*;* [*Shapiro & Varian, 1999*](#_ENREF_8)*)or ‘battles for dominant designs’ (*[*Suarez, 2004*](#_ENREF_9)*;* [*Utterback & Suarez, 1993*](#_ENREF_10)*). Firms or policymakers that invest in the technology that turns out to be the losing one have to change to the winning technology and this may be accompanied with a lot of additional investments. Various scholars have studied battles for standard dominance albeit the focus mostly lies on sectors such as telecommunications and ICT (*[*Den Hartigh, Ortt, Van de Kaa, & Stolwijk, 2016*](#_ENREF_1)*;* [*Gallagher, 2012*](#_ENREF_2)*;* [*Gallagher & Park, 2002*](#_ENREF_3)*;* [*M. A. Schilling, 1999*](#_ENREF_5)*;* [*M.A. Schilling, 2003*](#_ENREF_7)*;* [*G. Van de Kaa, 2009*](#_ENREF_11)*;* [*G. Van de Kaa, De Vries, Van Heck, & Van den Ende, 2007*](#_ENREF_13)*) where strong network effects are apparent and many standards are competing for market dominance (*[*G. Van de Kaa, Den Hartog, & De Vries, 2009*](#_ENREF_14)*). And scholars that focus on standard development prior to market launch also tend to focus on these sectors (*[*G Van de Kaa, Papachristos, & De Bruijn, 2018*](#_ENREF_19)*). This paper focuses on the energy sector and studies the battle between two types of wind turbines, the gearbox wind turbine and the direct drive wind turbine. Based on expert interviews and a comprehensive literature review, we identify applicable determinants that affect technological dominance for the wind turbine drive trains case. By applying the Best-Worst Method, we allocate the relative importance to the determinants to understand which of the two wind turbine drive train types has the highest chance of achieving success. The results show that energy cost and reliability are the most important determinants, and that at this moment both drive train types still have the potential to become dominant. We contribute to the literature on dominant designs by focusing on the energy sector; a sector that has only scarcely been studied before with respect to design dominance. We contribute by establishing weights for factors for the technology dominance for the case of technology battles for wind turbine technology thus contributing to the existing body of literature that attempts to assign weights to factors for standard selection (*[*G. Van de Kaa, De Vries, & Rezaei, 2014*](#_ENREF_12)*;* [*G. van de Kaa, Fens, & Rezaei, 2019*](#_ENREF_15)*;* [*Van de Kaa et al., 2019*](#_ENREF_16)*;* [*G. Van de Kaa & Greeven, 2017*](#_ENREF_17)*;* [*G. Van de Kaa, Janssen, & Rezaei, 2018*](#_ENREF_18)*;* [*Geerten Van de Kaa, Scholten, Rezaei, & Milchram, 2017*](#_ENREF_20)*) for different contexts and cases. Specifically, we arrive at two aspects of the characteristics of a technology that affects its success; cost of energy and reliability.*

*Keywords:**Wind turbine; Direct drive; Gearbox; Standards; Dominant designs, Best-Worst Method.*

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