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Firm agency and global production network dynamics

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Abstract

The Global production networks (GPN) framework has been influential in the analysis of globally coordinated economic arrangements. However, research on GPNs tend to focus on a well-established industries and their existing governance structures with a very little attention to the temporality and changes in these networks and their governance structures. Specifically, despite the central role of 'lead-firms' in GPNs, the literature lacks a clear depiction of their competitive and evolutionary trajectory. In response, this paper is concerned with (re)opening the 'black-box' of firms and showing how lead-firms' strategies and practices shape the evolutionary dynamics of GPNs. The paper argues that changing lead firm strategies play a crucial role in shaping the evolution of GPNs, reflecting changes in the industrial and/or business and institutional environments. The paper investigates the Danish, multinational energy company, Ørsted, and discusses the importance of accounting for firm dynamic capabilities, i.e. *intra-firm practices* and *extra-firm (evolutionary) dynamic* drivers, in analytical frameworks that analyse GPN dynamics and industries. Lead-firm strategies are shaped by firm-specific capabilities, industry-specific competitive dynamics, and institutions. Accordingly, GPNs' evolutionary process can be understood as an adapting and/or response mechanism by lead-firms to changes in local and international business as well as multi-scalar institutional environments.

Keywords: Firm agency; GPN dynamics; dynamic capabilities; offshore wind Power; Ørsted

1 Introduction

As an emergent economic geography approach, the Global Production Network (GPN) framework has been influential in the analysis of globally coordinated economic organizations and activities. GPNs are organizational platforms through which actors in different regional and national economies compete and cooperate for a greater share of value creation, transformation, and capture, through geographically dispersed economic activity (Coe, Hess, Yeung, Dicken, & Henderson 2004; Henderson, Dicken, Hess, Coe, & Yeung 2002; Yeung & Coe 2015). The GPN framework offers a powerful tool in explicating the rationale behind and consequences (developmental outcomes) of spatial configurations of particular industries' production networks (Coe et al. 2004). However, it gives less attention to the actual development process and/or emergence of these network structures overtime. This reflects how the internal dynamics of the lead-firm, which is central in GPN analysis, continues to be treated as a 'black box' (Coe, Dicken & Hess 2008). The actual practices employed by lead-firms, as well as their strategic motivations and intentional actions need further clarification if we are to advance our understanding of the evolutionary dynamics of GPNs and industries (Fuller & Phelps 2018).

The purpose of this paper is to show how lead-firms' strategies and practices shape the evolutionary dynamics of GPNs by (re)opening the 'black box' of the firm based on evolutionary tools, and the dynamic capability based view of the firm (Maskell 2001; Teece 2007), drawing on evolutionary economic geography (EEG) (Boschma & Martin 2007) and management perspectives respectively. The approach is based on the understanding that changes and/or evolution in lead-firms is constituted by and is constitutive of changes in business and intuitional environments (Fuller & Phelps 2018; Mackinnon 2012; Yeung 2016). In investigating GPNs evolutionary dynamics therefore, the paper argues that we need to (1) contextualize the process by shedding light on the 'extra-firm dynamics', i.e. the drivers of the changing business and institutional environments, and (2) analyse lead-firms' 'internal-practices', i.e. how they integrate, build, and reconfigure internal and external competences in order to address the extra-firm dynamics. This focus on firm agency, i.e. lead-firms' internal practices and their changing capabilities overtime can in turn add a vital historical depth and insights to the evolutionary dynamics of GPNs.

The arguments of this article are based on a case study of a Danish lead multinational energy company, namely, Ørsted. Despite having Oil & Gas (O&G), nuclear, and coal legacies, Ørsted has been able to establish itself as a global leader and a trendsetter in the emerging Offshore Wind (OW) industry. In addition, Ørsted's home country, Denmark, is a pioneer in the development of commercial wind power, and is a global leader in the industry, as large share of the global OW industry is located in the country (Garud & Karnøe 2003; Markard & Petersen 2009; Simmie 2012). The paper investigates the dynamic drivers and strategies through which Ørsted developed from an O&G and coal intensive Power Company to its current (2019) position as a global leader in the OW sector as it offers a distinctive opportunity for studying the evolutionary dynamics of the industry. The analysis reveals that GPNs evolutionary dynamics can be understood as an adapting and/or response mechanism by lead-firms to changes in local and international business and institutional environments. In the process, lead-firms' strategies are shaped, by firm-specific capabilities, industry-specific competitive dynamics, and the multi-scalar institutional environments.

2 Theoretical Background

2.1 Global production networks (GPNs)

The global division of labour that intensified in the 1980s and 90s has very much facilitated the globalization of economic activities through outsourcing of mostly services and manufacturing activities. Thus, a rich literature has emerged in economic geography to elucidate the organization, governance structures and the developmental outcomes of these globally dispersed but functionally integrated economic activities (see Coe et al 2004; Dicken 2015; Gerrefi, Humphrey & Sturgeon 2005; Gereffi & Korzeniewicz 1994; Henderson et al. 2002; Yeung & Coe 2015). Adopting an explicitly networked approach, building on the elements of the Global Commodity Chains (GCC) (See Gereffi 1994), actor-network theory (see Latour 2005) and varieties of capitalism (see Hall & Soskice 2001), the GPN approach particularly, has become influential in providing a more holistic understanding of the globally organized production activities (Coe et al. 2004, 2008; Henderson et al. 2002). The GPN framework views firms embedded within a local and regional institutional environment as important channels of creating, enhancing, and capturing value (Coe et al. 2004). This multidimensional, multi-scalar, networked approach emphasizes the

interlinkages and tensions between firm and extra firm network actors (including territorial institutions) involved in the process of creation, enhancement and capture of value, and how these are structured both organizationally and territorially (Coe et al. 2004, 2008; Dicken 2015; Henderson et al. 2002).

However, the GPN framework is often criticized for lacking causality and hence explanatory power. Though it has outlined the three overlapping conceptual categories of value, power, and embeddedness, it lacked an explicit depiction of the causal mechanisms through which global production networks emerge (Yeung & Coe 2015). Furthermore, although the firm is clearly and explicitly the central actor in all the global commodity chains, global value chains and global production network (GCC-GVC-GPN) analyses, it is consistently treated as a black box (Coe et al. 2008). The GPN/GVC literature largely emphasizes the inter-firm relationships and somehow neglects of intra-firm dynamics, and the ways in which the internal structures and relationships inside firms play a critical role in how GPNs operate (Coe et al. 2008, 277). Coe & Young's (2015) influential work is an attempt towards reframing the existing GPN-GVC debates away from industry-level generalizations toward a more dynamic theory of GPNs by focusing on the structural competitive dynamics and actor-specific strategies that shape these networks and their organizational configurations within and across different industries and localities. The analytical focus of this so-called, GPN 2.0 is the actors and their organizational relationships that constitute GPNs in different industries (with the lead-firm being at the center and a necessary prerequisite), and on the multiple locations that are bound together by the economic relations between these actors (Yeung & Coe 2015).

Coe & Yeung's (2015) theorization of the causal role of cost-capability, markets, finance and risk environment as "competitive dynamics" is helpful in specifying and deepening the existing analytical scope of global production network (GPN 1.0). Accordingly, optimizing Cost-capability ratio emphasizes the dynamic decision-making process by which firms capture value, in response to competitive pressure, not only through cost-based factors such as outsourcing, but also through the capability to organize, manage and utilize resources such as labor, capital, technology and knowledge. In addition, GPN 2.0 conceptualization of sustaining market development emphasizes the role of producers and consumers in creating markets through processes of dynamic negotiation, but tied to their particular motives (such as consumer demand for higher quality and lower cost

goods) (Fuller & Phelps 2018). Furthermore, working with financial discipline (e.g. performing well in the stock markets); can influence firm-specific strategies and the subsequent GPN configurations. On the other hand, firms need to 'manage risks' so as to reduce uncertainties that can be related to the disaggregation of production through outsourcing and/or increasing technological changes (Coe & Yeung 2015). Risks can be also related to product (e.g. damage to brand and reputation); regulation (e.g. emergence of new international standards); labor (e.g. industrial action); and environmental (e.g. natural catastrophe) (Coe & Yeung 2015).

The GPN 2.0 conceptualization illuminates why and how the above four competitive dynamics interact with firms and extra firm actors under uncertain market conditions to produce four different actor-specific strategies in organizing GPNs: intrafirm coordination, inter firm control, inter firm partnership, and extra firm bargaining (Yeung & Coe 2015). Intrafirm coordination strategy relates to how production is internally organized by GPN firms in response to competitive market dynamics (e.g. cost control). Instead, inter firm control can occur where a firm outsources production responsibilities, largely because of high internal costs and often in relation to low value-added activities, but where they still retain relative control over suppliers and/or contractors. Inter firm partnership entails more horizontal and collaborative relations between lead-firms, strategic partners and specialized suppliers, with the purpose of taking advantage of differential cost-capabilities, high market need, financial discipline and managing risks. Moreover, strategies of extra firm bargaining involve relations between firms and non-firm actors, typically nation states, including the nexus between market and non-market (e.g. societal & political) values and priorities (Coe & Yeung 2015; Fuller & Phelps 2018).

The GPN 2.0 framework's main strength is its application of ontogenetic ontology. It emphasizes agency and incentives in the analysis of actors and their strategies in configuring production networks. However, the actual explication of the four firm-specific strategies remains abstract requiring more work to be done for further conceptualization of the actual "intra-firm practices" of lead-firms in producing, organizing and governing GPNs (Fuller & Phelps 2018). Therefore, the GPN's evolutionary (historic) mode of analysis needs further development by complementing the relational understanding of firm with a dynamic evolutionary perspective (see Hodgson 1998; Nelson & Winter 1982). Doing this requires (re)opening the black-box of firm to unravel lead-firm value capture and evolutionary trajectories, and understand how changes in lead-firms are

constituted by and are constitutive of changes in the interrelated dynamics of policy and industrial and/or business environment (Coe & Yeung 2015; Hall & Soskice 2001; Mackinnon 2012; Teece 2007; Yeung 2016). Adding historical depth and insight to the GPN 2.0 categories through a focus on lead-firm agency, i.e. their strategies and changing capabilities over time can in turn illuminate the evolutionary trajectories of lead-firms, GPNs and industries. To do this the paper draws on perspectives from the Evolutionary economic geography (EEG) on new path creation and the dynamic capabilities based view (DCV) of the firm, from the management literature.

2.2 Firm agency in GPN and industrial dynamics: the role of firm dynamic capabilities (DC)

Teece et al. (1997, 515) define dynamic capabilities as: *"[firm's] capacity to renew competencies so as to achieve congruence with the changing business environment"* by *"adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competencies."* Dynamic Capabilities (DC) signifies why (motives) and how (practices) firms integrate, build, and reconfigure internal and external competences to address rapidly changing environments (Eisenhardt & Martin 2000; Teece 2007). Building DC rests on firm processes that alter current positions, leading to an effect on firm performance and competitive advantage, as well as to new positions and paths (Eisenhardt & Martin 2000). DC illuminates the organizational and strategic routines by which managers alter their resource base in order to successfully diversify their businesses and generate new value creating strategies. According to Teece (2007), DC of opportunity identification (*"sensing"*) and investment in these opportunities ("*seizing"*) lead to new positions and paths. Subsequent to investment, dynamic capabilities for recombination and reconfiguration of resources can alter ("*transform"*) the accumulated asset base of the organization, enhancing the firm's competitive advantage, leading to new positions and paths.

According to this view, the business environment is perceived to be in a constant flux. All the internal and external factors that affect the functioning of the firm, including its customers, management, market, employees and regulatory environments, induce firms to frequently update their capacities, and make flexible changes based on the changes in the environment and create new responses and strategic decisions to satisfy the market mechanism (Teece et al., 1997). Similarly, according to the EEG perspective, changes in firms' business environment and/or the

emergence of new business opportunities and/or paths are shaped by factors and processes, that extend far beyond the market-driven processes and firm dynamics of knowledge creation and diffusion (Binz, Truffer, & Coenen 2016; Boschma 2017; Dawley 2014; Hassink, Isaksen & Tripple 2019; Martin & Sunley 2010). It is rather a multi-scalar and dynamic process involving heterogeneous firm and non-firm actor networks and institutional contexts (Binz et al 2016; Binz & Truffer 2017; Boschma 2017; Garud & Karnøe 2001; Hassink et al 2019; Mackinnon, Dawley, Pike & Cumbers 2019; Tödtling & Trippl 2018).

Therefore, based on the above arguments, building dynamic capabilities can be understood as an enactment of agency that impact upon relations and configurations of GPNs through the mobilization of resources by lead-firms and other GPN actors. Nevertheless, the nature of lead-firms' capabilities very much influence the types of strategies they deploy in configuring their GPNs. A lead-firm with higher capabilities and a lower market imperative is likely to pursue intrafirm coordination strategy. On the other hand, lead-firms with lower capabilities will seek inter firm control to reduce costs through outsourcing in mature market, and/or inter-firm partnership to reduce costs and/or develop capabilities within GPNs to enhance value capture (Coe & Yeung 2015). This results in the emergence of different types of power relations (e.g. partnership and coordination, control, arms-length…etc.) between production network actors, and institutional arrangements (actors), depending on the importance of complementary assets held beyond the lead-firm (Coe & Yeung 2015; Fuller & Phelps 2018).

To sum up therefore, the conceptual framework of this paper is based on: (1) the relational (GPN); (2) evolutionary (EEG) tools, as well as (3) the dynamic capability view (DCV) of the firm. The framework is employed in the analysis of the evolutionary and value capture trajectories of a lead-firm, which in turn is crucial in capturing the evolutionary dynamics of GPNs, and industries. The theoretical discussion above shows that the reconfiguration of resources and/or GPNs by lead-firms is key to unlocking and the constant enactment of capabilities. Hence, the paper argues that infusing firm agency, i.e. shedding light on lead-firm practices and strategies and changing capabilities overtime, can enrich our understanding of GPNs' and thereby industries' evolutionary dynamics. These lead-firm practices and strategies are linked to new market development and domination, i.e. sustaining competitive position in markets through the constant enactment of capabilities, by optimizing cost and capability ratios, as well as financial discipline and risk

minimization. Furthermore, to add historical depth and insights to these intra-firm practices and strategies, the analysis addresses the extra-firm (evolutionary) dynamic drivers with a special focus on firm-specific business and sectoral imperatives and the role of multi-scalar institutional environment.

3 Methods

The theoretical argument of this paper is based on a qualitative case study of the Danish lead multinational energy company, Ørsted. As a methodological approach, case study allows a study to retain holistic and meaningful characteristics of real-life events, such as organizational changes and processes, cross-border activities and relations, and maturations, changes, and evolutions of industries (Yin 2003). It additionally offers a suitable tool to access the interplay between network relations, firms' decision-making, and territorial development processes (Yeung 1995).

The paper investigates the development of Ørsted from an O&G and coal intensive power company to its current (2019) position as global leader in the OW sector. Based on a variety of data sources, the paper provides rich empirical insight on Ørsted's actual "intra-firm practices" in producing, organizing and governing GPNs. The paper elucidates GPNs and industries evolutionary trajectories by shedding light on Ørsted's evolutionary trajectory, and offering a conceptual validity by uncovering and addressing the causal mechanisms as well as complexities of the process (George & Bennett 2005). Thus, building on the historical analysis of Ørsted, the paper emphasizes the overlooked aspects of temporality and change in GPN research.

Ørsted is chosen primarily because it is the first multinational energy company to achieve a global lead position in the emerging OW industry. Furthermore, Ørsted's home country, Denmark, is the cradle of the OW industry, and a large share of the global OW industry is located in the country (Markard & Petersen 2009). The case was based on an extensive data on Ørsted's market development strategies, gathered from multiple sources. The primary data is gathered from six semi-structured interviews in 2017 and 2018, with high-ranking company representatives and experts who are active in the OW industry and with an extensive insight in the history of Ørsted and its current activities (see Table 1). The interviews were conducted face-to-face and via skype and lasted approximately one hour.

The interviews mainly focused on the evolutionary process of Ørsted from its inception to growth and expansion as well as to its diversification to the OW industry and attainment of lead position in the sector. The interviews were individually tailored according to the informants' background but the broad themes discussed include, the role of the company's core competencies and legacy; market development and diversification imperatives and strategies; growth, expansion and market domination strategies; role of institutional contexts; sourcing strategies; as well as financing and risk imperatives. The interviews were complemented with Ørsted's company documents that include, corporate history, annual and sustainability reports, OW farm project documents, financial reports, press releases, conference proceedings and panel discussions, as well as Danish OW related public policy documents.

Table 1. Overview of Interviews

Role	Organization	Date of interview
Business analyst	Global wind industry research firm	28 November 2017
Senior analyst	Scandinavian based consultancy firm	30 November 2017
Senior Consultant	Independent renewable energy experts group	13 February 2018
Director, Wind and Solar	National Industry networking organization	3 march 2018
Research and Development (R&D)	Ørsted	11 June 2018
Head of offshore wind communications infrastructure	Multinational energy company	18 June 2018

4 The role of firm agency in GPN and industrial dynamics: the case of Ørsted

Dansk Olie og Naturgas A/S (Dong), the Danish state-owned company was established by the Danish state in 1972. The main reason for the establishment of the company was the concern over Denmark's dependence on oil from the Middle East during the oil crisis of the 1970s. These concerns led Denmark to introduce natural gas into the Danish energy system and the company was assigned with the responsibility to manage natural gas and oil resources in the Danish sector of the North Sea. In 2005, after years of operations in the O&G sector however, the company made an expansion to the electricity market through mergers and acquisitions (M&A) with other five Danish power companies. The six companies that constituted Dong energy include two electrical power producers, Elsam and Energi E2, and three electricity distribution (public utility) companies, NESA, Københavns Energi and Frederiksberg Forsyning. The European commission approved the M&A in 2006, resulting in the official creation of DONG energy (hereafter Ørsted). At present, the company is involved in the distribution and trading of energy and related products, and is a leader in the global OW market. Dong energy's evolution to a global leadership in OW market can be attributed to a number of dynamic drivers that are both internal as well as external to the company. These dynamic drivers are elucidated in the subsequent sections.

4.1 Extra-firm dynamic drivers

Ørsted's expansion to the electricity market through the M&A and the subsequent creation of Ørsted in 2006, as an integrated energy company can be seen in light of the changing business environment in the power sector in the 1990s. In 1990s, new EU directive meant changes in the regulatory frameworks in the energy sectors of many European countries. These changes entailed the deregulation of the energy market of many EU countries, including the Danish energy sector, which was liberalized between 2000 and 2004. The changes had a major impact on the strategies as well as the overall organization of many European power companies:

> "*[T]he market liberalization opened the energy markets of the EU member states for competition with one another, and this created new value creation opportunities for many European power companies […] At that period, merger [and/or] acquisition-driven growth, became the predominant strategy, and resulted in the formation of large international*

energy groups […] the merger made Ørsted, better equipped for working on technological development in the energy field." (*Expert interview, November 2017 [Q1]***Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.**)

As can be understood from the above statement, the changing business environments very much shaped the company's strategies. To achieve congruence with the changing business environments (Teece 2007) and position itself in the electricity market, it is evident that the Ørsted had to gain access to and/or develop new capabilities. Furthermore, to be competitive in the European market, size was considered as key denominator: "*large, diversified production capacity is a vital competitive advantage for many energy companies in Europe"* (*Expert interview, November 2017* [Q2]). This is in line with the argument that firms' evolutionary and value capture trajectories, are shaped and constituted by changes in the interrelated dynamics of policy and business environment (Binz et al 2016; Coe & Yeung 2015; Mackinnon 2012). In this case also by changes in the international policy and business environments.

In 2019, Ørsted was the largest power producer in Denmark with market shares of 49% for electricity production and 35% for heat production (Ørsted 2019). Since its establishment, the company was transformed from being one of the largest operators in O&G, and coal-intensive utility in Europe to a global leader in the OW market. Ørseted's evolution to its current lead position in the OW industry can be partly explained by Denmark's aspirations of developing national wind power capabilities.

Denmark is a pioneer in the development of commercial OW power. OW development in Denmark can be traced back to the 1970s. Consequent to the energy crisis of the 1970s, Denmark also started to consider the possibility of developing renewable energy and wind power in particular (DEA 2017). This was taking into account the country's locational advantages as it is surrounded by water. Particularly, its exposure to wind along Jutland's long coastline made it an ideal location for OW power development. At that period, Danish technology developers, mainly in the agriculture and maritime sectors, were searching for alternative use of their products. Some Danish universities were also involved in the experimentation activities in the wind energy sub-sector (*Interview with Ørsted representative, June 2018*). Hence, when the Danish state launched its

ambitious OW development program in the 1980s, it was based on these early wind energy development activities.

The main reason for Denmark to particularly focus on OW was the scarcity of land for onshore sites, and the abundance of shallow waters with ample wind resources coupled with the first mover advantage it would give the country in the nascent sector. That is to take advantage of: *"the considerable economic gains, such as the opportunities for exporting wind energy components and job creation"* (*Expert interview, November 2017* [Q3]). Therefore, in 1985, under an executive order from the Danish Minister of the Environment and Energy, the two large Danish power utilities, ELSAM (Ørsted's predecessor) and SEAS were given a responsibility to develop large-scale experimental OW farms. This resulted in the subsequent commissioning of two demonstration farms, namely, Vindeby and Tunø Knob in 1991 and 1996 respectively (DEA 2017).

Denmark's position in the OW industry can be attributed to two lines of developments: technological, i.e. years of research and innovations in wind energy technology; supported by intuitional developments. The Danish wind energy development path was shaped by inputs from actors who possess knowledge and capabilities and were able to gradually transform the emerging industrial path to higher degrees of functionality (Garud & Karnøe 2003). This process resulted in a steady accumulation of artifacts, tools, practices, rules and knowledge that shaped actors in the domains of design, production, use, evaluation and regulation (Garud & Karnøe 2003).

Furthermore, broad political understanding and support characterize the Danish framework conditions. This was vital in the development and diffusion of the renewable technologies and the evolution of the new industrial path (Garud & Karnøe 2001; Markard & Petersen 2009; Simmie 2012). This support was also crucial in positioning Danish companies such as Ørsted as market leaders in this burgeoning sector (DEA 2017). As result of these interlinked developments in Denmark, once a brainchild of a handful of idealistic pioneers, the OW became a global industry dominated by big multinational energy companies in just few decades. Nevertheless, gaining a fuller grasp of the development of the OW industry necessitates having a clear understanding of the role of firm agency in the process, i.e. the role of firm strategies and changing capabilities overtime. The following section details this process based on Ørsted's diversification to and the subsequent attainment of global leadership in the OW industry.

4.2 Intra-firm dynamics: Ørsted's OW market development strategies

As discussed above, Ørsted is a pioneer in the deployment of OW farms. However, it was in the mid-2000s that the company began its serious journey to OW. Ørsted's move (diversification) was partly induced by:

> *"the maturity of the North Sea basin and the subsequent rise of costs of O&G drilling coupled with low electricity prices, [and partly] by the emergent new business opportunities, that accompanied the rising environmental concerns globally."* (*Interview with Ørsted representative, June 2018* [Q4])

Accordingly, Ørsted's diversification to OW can be understood as an adapting/response mechanism to the changing local and international business (sectoral) and institutional environment (Teece 2007). In the process of diversification, the past legacies of firms may very well influence the way they create value in the future. Nevertheless, Ørsted's O&G legacy: *"was not that valuable in the company's diversification to and in operations in the OW park deployment segment"* (*Interview with Ørsted representative, June 2018* [Q5]). This is contrary to the current understanding on the role of past legacies in providing firms with their current stock of capabilities and in constituting a platform from which they grow and shape their on-going evolution (see Boschma & Frenken 2009). However, the role of Ørsted's internal engineering and project management capabilities was crucial, especially in the early OW farm construction phase. This is in line with Steen and Weaver's (2017) observation that knowledge and expertise gained from traditional O&G activity was vital for firms' successful OW operations.

In 2002, Ørsted kick started new market development in renewables by becoming a lead investor in a venture foundation called, *New Energy Solutions*, with a main aim of developing renewable energy and new energy forms. This was vital for the company in gaining access to innovations and technological developments in the sector. The same year the company installed Horns rev, a world's first large scale, 160 MW offshore wind farm in Danish waters. This project not only did help the company enhance its experience and capabilities but also was vital in positioning the company in the development of future large-scale commercial OW projects. Furthermore, in 2007, Ørsted launched an innovative business model, *Climate partnership*, together with a global healthcare company, NOVO Nordisk. This climate partnership ensured a long-term financial

commitment that made the construction of Horns Rev II in 2008 financially feasible, as Novo Nordisk committed to buying renewable energy certificates until 2020.

Based on the partnership model, Ørsted provided Novo Nordisk with energy consulting services, including guidance on energy-consumption audits and energy efficiency improvements. In exchange, Novo Nordisk's resulting financial savings were allocated for the purchase of renewable energy certificates from Ørsted's wind farm, Horns Rev II (Novo Nordisk 2018). Since 2007, the company entered into more than 100 similar partnerships with various organizations (including Mærsk, Codan, Philips, Siemens, Novozymes, a number of Danish municipalities …etc.). The model was instrumental for the company in developing a niche position as it enabled it: "*to obtain a strategic differentiation in the energy market compared to traditional energy providers."* (*Expert Interview, November 2017* [Q6]). The model further enabled the company, as a market maker, to benefits from its first-mover advantage, i.e. to be better positioned to continually develop its access to new markets. Thus, in 2007 it started international expansions with the deployment of the Burbo Bank offshore wind farm in the United Kingdom (UK).

In adapting to a changing business environment, it is imperative that firms reconfigure their internal and external organizational skills, resources, and functional competencies by integrating, building, acquiring and/or shedding resources (Teece et al. 1997). Thus, the company made strategic and organizational reorientations by shifting from being an entirely O&G and coal based power utility to an integrated company with activities across the entire energy value chain, including production, distribution and trading of energy sources.

As it had a major stake in the company (76% over the years leading up to 2016), the Danish state played a key role in positioning the company in the global OW market. This is because, in Denmark's bid to gain a first mover advantage and the attainment of lead position in the OW industry, Ørsted was an integral part of the Danish government's policies that focused in the development of the country's national technological capabilities. As discussed in the previous section, ELSAM (one of the power companies that constituted Ørsted), was given the responsibility and support to engage in large-scale offshore wind power experimentations in order to develop OW capabilities. In addition:

> *"[The] Danish government played an important role in the international expansion of the company, through bilateral and multilateral agreements, as well as overseas promotional activities."* (*Expert interview, February 2018* [Q7])

Consequently, starting in 2007 the company's offshore wind portfolio began increasing in size, and subsequently in 2013, sizeable new assets (including London Array, Lincs and Anholt) came online. Moreover, 2015 marked the start of Ørsted's expansion outside Europe with the acquisition of RES Americas Developments Inc.'s more than 1000MW project, off the coast of Massachusetts (Ørsted, annual report 2016). In 2018, Ørsted was officially a global leader in the OW industry with 26% of installed global capacity. As an indication of its strategic transformation, i.e. its move away from coal and O&G, to renewable energy, the company abandoned Dong as its name, and shifted to Ørsted (Hans Christian Ørsted, a Danish scientist who discovered electromagnetism). Fig. 1. depicts Ørsted's evolutionary trajectory to global leadership in the OW market.

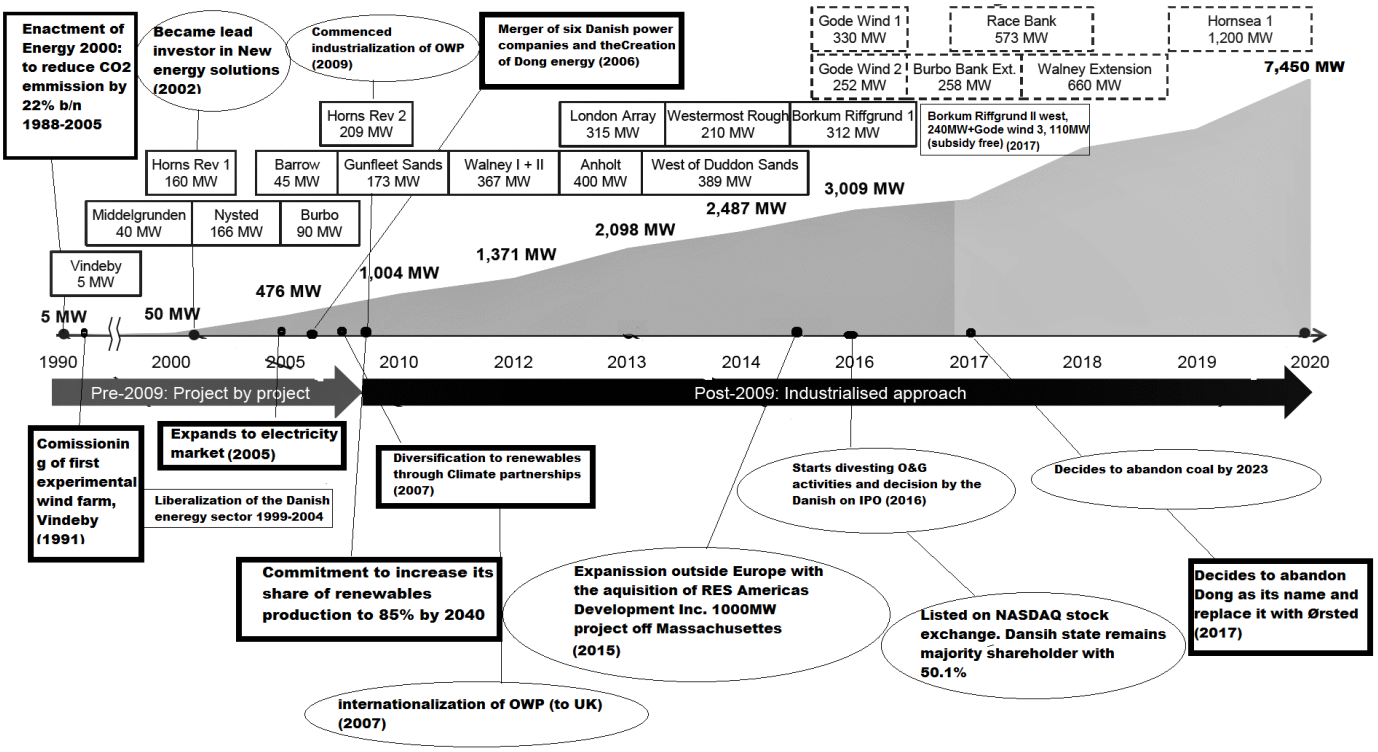

Fig. 1. Ørsted's OW journey (1990-2018). Source: Ørsted, and author's own elaborations.

However, once a new market is created, lead-firms tend to seek market domination in order to capture as much value as possible from their proprietary products or services (Coe & Yeung 2015). The following section discusses Ørsted's market domination strategies.

4.2.1 OW market domination strategies

Ørsted's lead position in the OW market can be attributed to its dynamic recombination and reconfiguration capabilities that altered its accumulated asset base, and enhanced its competitive advantage, leading to new path and dominant position. This dynamic capability emphasizes Ørsted's ability to optimize its cost-capability ratio, i.e. the dynamic decision-making process through which it captured value, in response to competitive pressure not only through cost leadership but also through the capability to organize, manage and utilize its resources such as labor, capital, technology and knowledge. This also included pioneering the financialization of the OW industry. The actual strategies and practices through which the company dominates the OW market are detailed in the subsequent sections.

4.2.1.1 Optimizing Cost capability ratio

In 2009, Ørsted commenced the industrialization of offshore wind with serial assembly and lower-cost deployments. In doing so, "*it altered its organizational and strategic routines, its resource base, acquired, integrated, as well as divested from some of its traditional activities."* (*Interview with Ørsted representative, June 2018* [Q8]). This was a step change from the project-by-project approach practiced Pre-2009. Pre-2009 Ørsted's organizational capability was structured around the traditional power plant experience. The company planned and executed projects independently and consequently, bottlenecks in markets often caused operational challenges (Interview with Ørsted, June 2018). However, post 2009, as a crucial de-locking mechanism (Martin & Sunley 2006) on part of the company, and pertinent to lead-firms' intra-firm coordination strategy (Coe & Yeung 2015), the company redesigned its organizational structure around offshore wind experiences (see fig. 2.). Consequently, wind Power became a separate business unit. Furthermore, based on its in-house engineering capabilities developed through various Research and Development (R&D) collaborations (see below), it designed an innovative and integrated, end-to-end model, which entailed planning, contracting and executing projects simultaneously, which also was vital in cost reductions through fast feedback and learning across the entire organization:

> *Our standard concept for offshore wind farms is one of the factors helping us to reduce cost. The concept provides economies of scale and contributes to optimum utilization of wind turbine capacity. Another case in point is that our engineers have designed lighter*

foundations that require less steel, making them less costly. (*Anders Lindberg Senior Vice President of Wind Power EPC, Ørsted, conference proceeding, 2016* [Q9]).

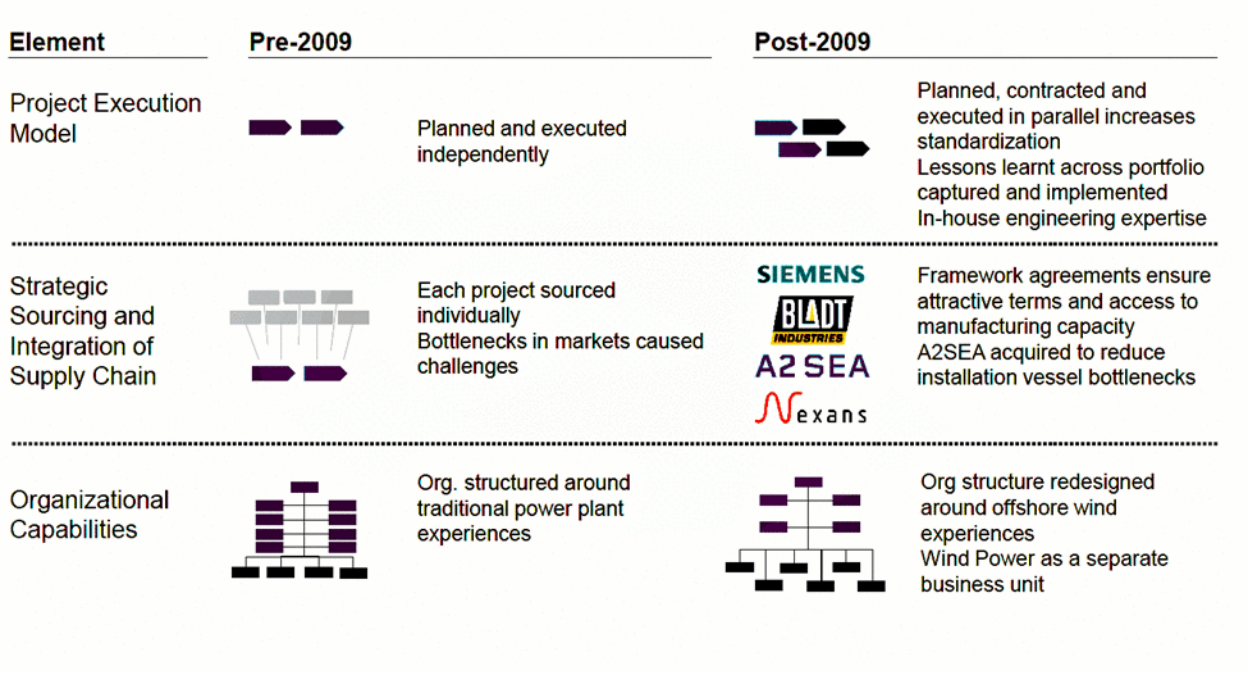

Fig.2. Ørsted's industrialized approach to OW

In the OW industry, cost is an important competitive parameter, both in relation to the other OW developers but also the traditional power generation technologies (expert interview, November 2017). To drive down the cost of OW development therefore, the company used multiple levers: *Scale, Innovation and Industrialization*. *Scale* entails approaching the process as a pipeline of activity (production line approach) instead of project-by-project basis:

> "*We have a very robust pipeline and we have started planning on the basis of our whole portfolio of offshore wind developments, [this is akin to] what Henry ford did with the manufacturing of cars…"* (*Anders Lindberg Senior Vice President of Wind Power EPC, Ørsted, conference proceeding, 2016* [Q10])

To realize the benefits of scale, *asset clustering*, i.e. combining projects located near one another has become a key approach (see Fig. 3.).

"*Offshore wind has been a scale-play and will continue to be. The logic of the auction in April [2017] in Germany was to combine projects. The three that Ørsted won aggregate together are close to 600MW, while stand-alone they are sub-scale.*" (*Henrik Poulsen, CEO Ørsted, press conference 2017* [Q11]).

This approach is crucial for achieving economies of scale: *"Scale enables synergies, which can translate into lower logistics costs, fewer technician hours; fewer facilities needed and lower inventory levels."* (*Expert interview, November 2017* [Q12])

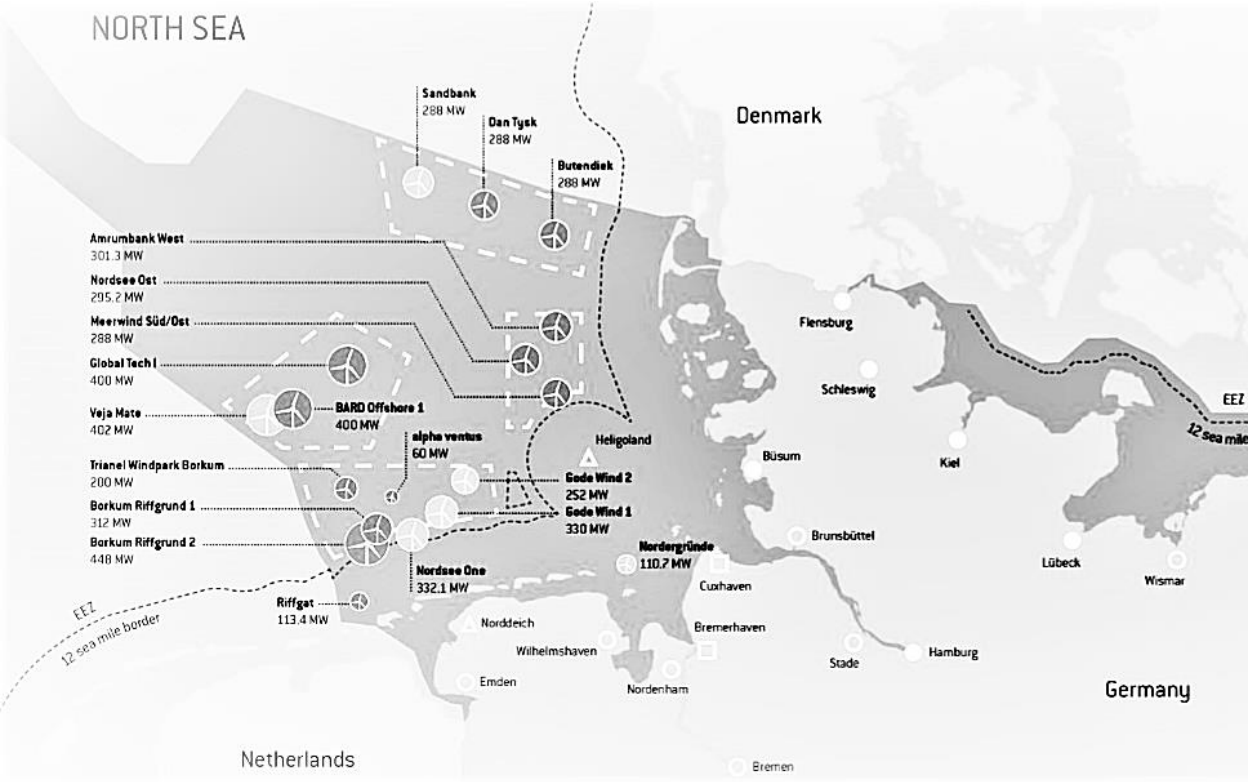

Fig. 3. Asset clustering approach. Adopted from Deutsche WindGuard (2016)

The second lever through which Ørsted brought (and continues to bring) down costs, and thereby sustain its competitive advantage is *Innovation*, and through adopting innovative solutions that enhance its capabilities. As an important aspect of building DC, innovation is a vital means of sustaining firm's competitive advantage (Teece 2007). Innovation in OW entailed employing innovative solutions, such as larger and more efficient wind turbines and related components, advanced foundation designs…etc. To realize this Ørsted developed R&D strategy that enabled it

in addition to cost reduction, to increase its pipeline of projects, reduce risks, enhance HSE performance, and design standard improvements as well as develop competences. The company's R&D activities are organized in small collaborative R&D projects and programs, joint industry projects as well as large R&D consortiums. Some of Ørsted's R&D collaborations involve Universities and research institutions such as Oxford University, Technical University of Denmark (DTU), Norwegian University of Science and technology (NTNU) … etc. Ørsted is further involved in joint demonstration and commercialization projects in collaboration with prominent international expertise such as the Carbon Trust (a UK based independent expert group). These collaborations are vital for the company: "*in building competences leading to improved R&D capability*" (Jørn Scharling Holm, Technology partnership manager, conference proceeding, 2018 [Q13]).Based on its R&D capabilities, Ørsted pioneered new foundation concept, suction bucket jackets (a transition from Monopiles), which according to the company was vital in deployments in deep waters and resistance to heavier loads as well as in reducing installation time. It also increased vessel size from 2-4 wind turbines to eight wind turbines, resulting in less transit time and higher utilization. There has also been transition from AC cables to 2nd generation HVDC cables that mitigated the distance to shore problem.

Furthermore, Ørsted was the first in the world to install MHI Vestas' 8MW wind turbine at Burbo Bank Extension, which was commissioned in the first half of 2017. Larger wind turbines means, increased 'capacity factor', which in turn means enhanced ability to harness more OW power, in a more cost-effective manner (see fig. 4).

> *"Our integrated business model and in-depth technical expertise provide a good basis for maintaining our position as market leader within offshore wind while at the same time retaining a sound risk and return profile."* (*Samuel Leupold, CEO, Wind Power, Ørsted, conference presentation, 2017* [Q14]).

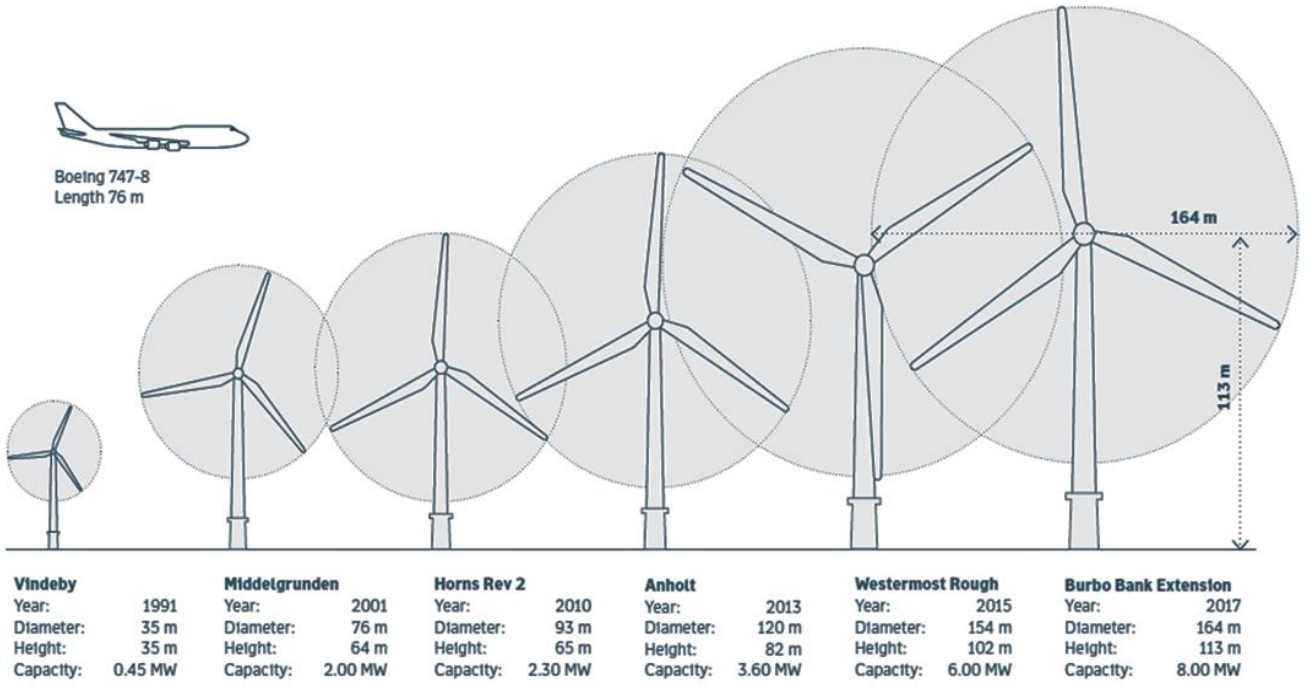

Fig. 4. The evolution of wind turbine size. Source: Ørsted annual report (2016)

Nevertheless, the specific sourcing strategy that lead-firms' deploy is contingent upon their in-house capabilities (Coe & Yeung 2015). Thus, as part of its inter-firm partnership strategy, it implemented framework agreements that involve contractual agreements for open collaboration with its strategic partners. These agreements ensured attractive terms and access to manufacturing capacity of its strategic partners, such as the turbine manufacturers (e.g. SIMENS and MHI Vestas). Furthermore, it acquired A2SEA, world-leading installation vessels and crew, which was helpful in developing optimal offshore installation capabilities.

To optimize its cost and capability ratio the company very much emphasizes on building close relationships with capable, competitive as well as innovative suppliers. Signifying the importance of, relational value chain governance in product customizations and component innovations (Gereffi et al 2005), early involvement of the supply chain as well as the use of system suppliers was key to increase and improve cost reduction opportunities:

> *"[W]e are very close to all major OEMs for offshore wind turbines and therefore have a deep insight into their development pipelines. We consider ourselves a partner in the development of their next generation turbine. This is not bid specific but rather a*

continuous process which we believe is a competitive advantage which we have compared to other players." (*Samuel Leopold, CEO wind power, Ørsted, Conference presentation 2017* [Q15]).

Industrialization is the third lever through which the company has maintained its cost leadership. This entails transitioning from a single supply base to multiple global suppliers and purpose built factories, and involves procurement for multiple projects and is mainly applicable for standardized supplies. In a maturing sector, industrialization can be seen as part of the response mechanism, by utility companies directly exposed to energy price competition (Karlsen 2017). The company achieved this through a multi-contracting approach. This involves breaking down the construction work and the supply chain into as many individual packages as possible to enable it to have a direct control and management, which in turn is crucial in cutting costs.

Furthermore, in order to further secure efficient sourcing and thereby keep costs down the company to some degree is involved in building local supply chains in collaboration with the local industry. In addition to organizing local meet the buyer events, Ørsted is also involved in the Local Enterprise Partnership programs in OW markets such as the UK, which has an expressed local content expectation of 50% (Afewerki, Karlsen & Mackinnon 2018). This is significant part of the company's extra-firm bargaining strategy and help it to accommodate the local content expectations of host countries. The levers through which Ørsted optimizes its cost capability ratio are summarized in table 2.

	Development		Impact
Scale	▪ Turbines and rotor size	6-8 MW → +10 MW	▪ Fewer positions
	▪ Sites	200-300 MW → +1 GW	▪ Greater overhead leverage ▪ Scale effects
	▪ Vessel size	2-4 wind turbines → 8 wind turbines	▪ Less transit time ▪ Higher utilisation
	▪ Cable capacity	300 MW → 400 MW	▪ Fewer substations ▪ Fewer cables
Innovation	▪ Foundation design	Monopile → Suction bucket jackets	▪ Greater water depth and heavier loads possible ▪ Faster installation time
	▪ Electrical	AC → 2nd generation HVDC	▪ Longer distance to shore ▪ Less grid loss
Industrialisa-tion	▪ Supply base	Single supply → Multiple global suppliers and purpose built factories	▪ Broader and more robust supply base ▪ Low-cost country sourcing ▪ Efficient production

Table 2. Ørsted's approach to OW cost reduction

4.2.1.2 Financialization of OW

In 2009, Ørsted pioneered financing of OW through a unique partnership model that involves attracting big financial players. This 'Farm-down' model, also known as 'asset rotation' involves selling stakes in green power assets to institutional investors seeking long-term stable yield: *"this unique risk-sharing model allows the investors to only share the risks they are comfortable with*" (Expert interview, November 2017 [Q16]). Based on the approach Ørsted typically divests 50% of its offshore wind farms to industrial and institutional partners and re-invest the money in new OW projects:

> "*This approach is an important enabler of scale as it provides us with a possibility to reinvest the capital in subsequent projects, and allows us to maintain a high-paced build-out of offshore wind farms.*" (Interview with Ørsted representative, June 2018 [Q17])

Through this model, Ørsted has been able to attract strategic partners ranging from Danish and international institutional debt, infrastructure and/or sovereign wealth funds, as well as Corporations such as, Lego, Danish Kirkbi, and Pension funds from Europe, North America, Middle East and Asia pacific. With less capital and reduced risk, this partnership model has resulted in significant up-front value realization for the company. This is mainly because these financial partners are brought in at a price around Orsted's cost of capital: "*what we do is we develop and operate them, but we sell typically half part to financial partners. It is part of business model through which we generate capital and create value.*" (*Samuel Leopold, CEO wind power, Ørsted, Conference proceeding 2017* [Q18]).

As argued by Coe & Yeung (2015), financialization works hand in hand with global production networks to sustain capitalist accumulation. Thus, between 2010 and 2016, the company secured over DKK 42Bn through this approach (Ørsted, annual report 2016). This partnership model is also an important part of the company's risk diversification strategies, which mainly is associated with currency volatility, energy (electricity) price fluctuations and changes in government policy.

Table 3. Summary of the dynamic drivers, Ørsted's strategies and causal effects

Dynamic drivers	Strategies	Causal effects
Extra-firm dynamics **(Q*1, Q3)**	Merger & acquisitions (M&A) (Q2,)	Business expansion and diversification to OW
Intra-firm dynamics **(Q4)**	Inter-firm partnership & extra-firm bargaining (Q5, Q6, Q7)	OW market development
• **OW market domination** • **Optimizing cost capability ratio**	Intra-firm coordination, Inter-firm control & Inter-firm partnership (Q8, Q9) *Scale* (Q10, Q11, Q12) *Innovation* (Q13,Q14,Q15) *Industrialization* (Q8) *Financialization of OW* (Q16, Q17, Q18)	OW market Leadership

**corresponding quote in text*

5 Conclusion

This paper contributes to the GPN debate through focus on the evolutionary trajectory of a lead-firm by shedding light on its strategies and changing capabilities over time. More specifically, this paper expands on the recent contributions to the GPN debate, that have called on the opening of the 'black box' of firm and further conceptualization of the actual "intra-firm practices" of lead-firms in producing, organizing and governing GPNs (see Coe et al 2008; Coe & Yeung 2015; Fuller & Phelps 2018; Mackinnon 2012). By complementing the relational understanding of the firm with a dynamic evolutionary perspectives (Hodgson 1998; Nelson & Winter 1982; Teece 2007) the paper (re)opens the 'black box' of the firm and sheds light on how (lead) firms' strategies

and practices shape the evolutionary dynamics of GPNs and industries. More specifically, the paper complements the GPN (2.0) framework with the EEG and DCV perspectives, and argues that, in investigating GPNs' evolutionary dynamics: (1) we need to contextualize the process by shedding light on the "extra-firm dynamics", i.e. the drivers of the changing business and institutional environments, and (2) analyze lead-firms' "internal-practices", i.e. how they integrate, build, and reconfigure internal and external competences in order to address the extra-firm dynamics. This focus on firm agency, can in turn add a vital historical depth and insights to the evolutionary dynamics of GPNs and industries.

The paper's arguments are based on the analysis of the evolution of Ørsted, the Danish multinational energy company, as global leader in the OW industry. Drawing on the GPN 2.0, EEG and DCV perspectives, the paper investigated the evolutionary trajectory of Ørsted with a particular focus on the extra-firm dynamic drivers and the intra-firm practices and strategies that shaped the process. The analysis reveals that Ørsted's diversification to OW was driven by extra-firm dynamics in a varied ways. First, Ørsted was an integral part of the Danish government's policies in the support for the development of the country's national technological capabilities in the wind power sector. Emphasizing the role of extra-regional and extra-firm dynamics, as well as the multi-scalar intuitional environment in new path creation process (Binz et al 2016; Binz & Truffer 2017; Hassink et al 2019; Tödtling & Tripple 2018), this was prompted by concerns over national energy security, national and global environmental concerns, liberalization of European electricity market and the national industrial development imperatives. Secondly, uncertainties, maturity and unfavorable business conditions in Ørsted's core business (e.g. rise in costs of O&G drilling resulting from the maturity of the North Sea basin) were instrumental drivers for the company's profit induced search for new business opportunities, in areas where it could leverage its firm-specific capabilities. Hence, Ørsted's diversification process can be understood as an adapting and/or response mechanism to a dynamic local and international business and/or sectoral as well as the multi-scalar institutional environments.

Based on the DCV (Teece 2007), for firms to achieve congruence with the changing business environments, it is imperative that they develop, renew, and adapt their competencies, by integrating and reconfiguring internal and external resources and functional competencies. Accordingly, in order to ensure new market development and domination, it is vital that lead-firms

enhance their capabilities and minimize costs through recombination of organizational assets and/or (re)configuration of their GPNs. In so doing, a lead-firm can alter its organizational and strategic routines, its resource base, acquire, integrate, as well as divest from some of its traditional activities. Nevertheless, as argued by (Coe & Yeung 2015), the types of strategies that lead-firms pursue in (re)configuring their GPNs is contingent upon their firm-specific capabilities and/or organizational assets that in turn are contingent upon their past legacies (Martin & Sunley 2010). In the case of Ørsted, these recombination and reconfigurations were achieved through leveraging in-house capabilities (i.e. intra-firm coordination strategies), and devising innovative partnership models and R&D collaborations (i.e. inter-firm partnership strategies), to ensure access to innovations and innovative solutions and technological developments as well as financing.

Furthermore, as part of the multi-scalar institutional environments, both the home and host country national states play vital role in shaping lead-firms' evolutionary and value capture strategies and thereby the evolutionary dynamics of GPNs. An important policy implication of the research is therefore that, home country national state can play a vital role by providing both financial and political support. This may include fostering the international expansion and growth of a lead-firm, through various bilateral and multilateral agreements as well as overseas promotional activities. Home country national state can further facilitate the development of pilot and demonstration projects within their territories, which are crucial in fostering innovations and the development of national technological capabilities and hence, the competitiveness of the local firms. Host states on the other hand, in an effort to embed OW developments within their territories can introduce local content requirements and various support schemes and this in turn can compel lead-firms to implement sourcing strategies that favor host country suppliers. Nevertheless, this can be highly contingent on the capabilities of the host country suppliers and may differ according to the different market and institutional contexts (Afewerki et al 2018).

The paper's analysis supports Coe & Yeung's (2015) arguments that lead-firms' ability to maintain their competitive (lead) position is contingent upon their ability to enhance their capabilities and reduce costs. However, the actual practices through which lead-firms maintain their lead position is dependent on the industry-specific competitive dynamics, which in turn are shaped by the nature, structure and maturity of that industry. Hence, better insight could be gained through a comparative research of lead firm evolutionary trajectories in different industrial contexts. These studies should

start by shedding light on the extra-firm dynamics that shape lead-firm strategies and their changing capabilities overtime. Doing this can provide an important historical depth and insight, on the actual "intra-firm practices" of lead-firms in producing, organizing and governing GPNs, i.e. GPNs evolutionary dynamics.

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