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Multi-use maritime platforms - North Sea oil and offshore wind: Opportunity and risk

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ABSTRACT

Multi Use Platform (MUP) concepts integrate different maritime economic activities within the same space. In line with the EU's Blue Growth Strategy, this new type of business model provides a series of potential advantages: efficient use of marine space, sharing of risks and costs, sharing resources, reduced environmental impacts, and enhanced socio-economic benefits. Delivering this vision will require tools that identify viable multiuse combinations allowing for the optimal use of sea space. The analysis performed here shows how the combined use of statistical analyses and Geographical Information Systems (GIS) might achieve this task in the context of oil & gas and offshore wind in the North Sea. Results provide a delimitation of the study area according to the spatial distribution of oil resources and the best technological configuration required by the wind industry. The analysis opens the door for the identification of additional factors that might influence the development of this new business model; for example differences between the Norwegian and UK's energy markets, climate policies or oil production patterns have to be highlighted. After reviewing these aspects, it can be concluded that current Norwegian policy and market features provide a promising starting point for the development of this specific MUP concept.

1. Introduction

The seas and coasts of Europe are important contributors to the European economy and have the potential to be greater still. Nearly six million jobs and €500bn Gross Value Added (GVA) per year depend upon maritime activities and industries (EC, 2012). Technology is enabling new marine industries such as offshore aquaculture, renewable energy (wind, wave, tide and thermal), biotechnologies and the mining of seabed minerals to take hold. Of the traditional industries, shipping freight has doubled in the last twenty years and is forecast to double again in the next twenty. With 127000 directly employed in the sector, fisheries are of significant social importance, especially in peripheral coastal areas, although of relatively small economic value, contributing to less than 0.03% of the EU gross domestic product in 2011 (EU, 2013). In the 1970's and 80's offshore oil and gas was a leading 'new' industrial activity in the sea. It remains important but is now in decline and will soon be overtaken by tourism as the most economically valuable marine activity globally (OECD, 2016).

The EU Blue Growth strategy aims both to strengthen existing industries (shipping, oil and gas, fisheries and tourism) and to plot the route to expansion of the new industries (aquaculture, marine energy, biotechnologies and seabed mining) (EC, 2012). Increasing human pressure will lead to conflict and competition for maritime space. However, disruptive competition also encourages innovation and new business models to reduce the potential conflict between the resource users and minimise environment impact. In furtherance of its Integrated Maritime Policy (IMP), the EU has pursued a policy of research into the concept of the multi-use of marine space (Stuiver et al., 2016). Since 2010, a series of EU funded research projects have explored the practicalities and the risks and benefits of business concepts for multi-use platforms (MUPs) at sea (e.g., TROPOS, H2OCEAN, MERMAID, MARINA and MARIBE). The multi-use concept can be defined as a multi-use platform (MUP) or multi-use of space (MUS) where the combination of two or more marine industry sectors yields benefits to each and to the whole. Combinations have, in theory, the potential to offer:

1. Environmental savings in the use of space.
2. Technical savings in the share of infrastructure, equipment and resources.
3. Economic savings in the share of development, operation and maintenance costs and risks.
4. Social savings in skill transfer and job creation as well as minimising impacts

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Identifying opportunities for the multi-use of sea space will require analytical tools that can identify potential business synergies. This task will inevitably have a strong spatial element.

Taking as a case study the potential combination between the oil and gas and offshore wind industries, the primary objective of this paper is to study the life-cycle phase of the currently oil producing fields in relation to their available wind resource, distance to shore, depth and country of production. Also differences in the CO_2 emission levels of both countries will be compared. Using Geographic Information Systems (GIS) and statistical tools the aspects that can influence the potential for combination of both industries will be identified. Findings will be discussed according to three main aspects: (i) technological development options; (ii) environmental benefits; and (iii) market and legal framework. This specific case study may serve to highlight the factors that might influence the development of multi-use concepts as a new type of business model in maritime regions.

2. Offshore oil and offshore wind in a multi-use context

A marine platform combination between offshore O&G and offshore wind has already moved beyond the area of academic research and into the real world of industry. At the European level, sectors of the offshore O&G industry are taking the lead with Norwegian and UK interests to the fore. By way of example in Scotland there exist several projects that can be considered as starting points for further potential synergies between both industries. The operators of the Beatrice oil production platform in the Moray Firth (Scotland) installed two 5 MW fixed turbines adjacent to the platform in 2007. The water depth is 45 m and the platform is 22 km from the coast. A much larger wind farm comprising 84 fixed turbines is now approved close to the site. In addition to sharing space, O&G companies increasingly view wind energy as a business opportunity. Making headway in the renewable market, the Norwegian state owned oil company, Statoil, is leading the consortium that has constructed the Hywind floating turbine wind farm located 25 km off the Scottish coast near Peterhead. Although small with just five x 6 MW turbines, it has recently started its production, as the world's largest offshore floating wind farm. This represents a significant milestone in the commercialisation of the technology. Located within Scottish waters, both projects are subject to Scotland's sectoral Marine Plans for Offshore Wind, Wave and Tidal Energy (Marine Scotland, 2013). The plan seeks not only to maximise the contribution of offshore renewable energies, but also to maximise socio-economic development opportunities while minimising conflicts with other important marine activities in the region (e.g., fisheries). The multi-use of sea space may help achieve both goals.

The combination of existing O&G platforms with offshore wind power represents only a fraction of what might be possible across many maritime industry sectors in the future. However, this combination represents real world industries already operating commercially. Fig. 1 shows the straightforward multi-use concept of this combination. An offshore wind farm uses some of its electricity production to supply the electricity needs of the oil producing platforms and exports the remaining production to land electricity grids. This combination is especially appropriate to the North Sea region to the benefit of two already important industries of oil recovery and electricity generation.

Explained below are key economic, environmental and technical features, which make this combination particularly promising in the North Sea region:

- *Resource availability*. Norway and the UK are the two leading European countries for the offshore oil and wind industries. Norwegian offshore oil production represents more than 130% of the total production in EU-28, of which 75% corresponds to production from the UK (JRC, 2015). Regarding wind, both Norway and the UK have the largest share of available offshore area for wind energy generation in Europe (EEA, 2009), and a mean annual offshore wind speed above 7.5 m/s (Fig. 3). In fact, the UK accounts for nearly half of all the installed offshore wind capacity in Europe (EWEA, 2016)
- *Decline of offshore O&G production.* The North Sea is a mature oil basin and all the large fields are past peak production. Significant gas discoveries took place in southern North sea in the early 1960's followed a decade later major oil discoveries in the northern sector. Over the period 2003 to 2014, crude oil production in Norway and the UK has decreased by 48% and 62% respectively (EUROSTAT, 2016). The energy requirements for oil production processes and daily life on production platforms are commonly supplied by gas turbines. Although inefficient (Nguyen et al. 2014), fuel for gas turbines is obtained directly from the O&G production process itself and providing the convenient source of energy. However, the use of wind energy as an alternate energy source permits reduced use of gas turbines (meeting environmental regulations and targets) and a potentially more profitable use of the oil resources.
- *Economic contribution.* The O&G sector is an important contributor to the UK economy and fossil fuels are the main source of energy. Domestic production accounts for 60% of the total consumption and cessation would require an increase in imports of about £17 billion. The sector supports over 300000 direct jobs; and, every £1 million of industry expenditure sustains around 17 jobs in the national economy (Oil and Gas UK, 2017a). The industry is equally important in Norway. The sector accounts for 50% of total Norwegian exports and 21.5% of GDP; supporting 150000 direct jobs, and 250000 jobs across the wider economy (Ministry of Petroleum and Energy, 2014). Despite the decline in production levels, O&G remains a key economic pillar for both countries.
- *Environmental.* Offshore O&G production is energy intensive and responsible for large quantities of greenhouse gas emissions (GHG). These activities constitute a significantly to total domestic emissions (Gavenas et al., 2015). Gas turbines are the largest contributors to these emissions and reducing their use will significantly reduce regional GHG emissions (Nguyen et al. 2016).
- *Technical feasibility*. Oil production fields can be located at very remote locations where fixed wind turbines are not possible due to water depths for example. However, the development of floating wind turbine technologies overcomes this barrier (Weinzettel et al. 2009; ETI, 2015). High-voltage direct current (HVDC) transmission systems are efficient over long distances and avoid the power losses originated in high-voltage alternating current (HVAC) transmission systems over similar distances (Behravesh and Abbaspour, 2012).

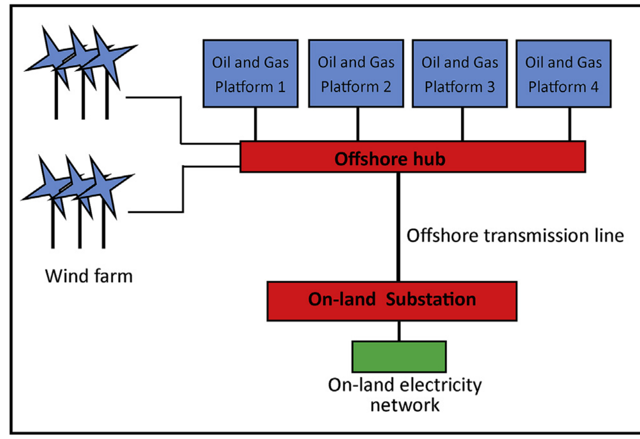

Fig. 1. Generic model for a multi-use of space concept combining offshore oil and wind industries.