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Perceived Concerns and Advocated Organisational Structures of Ownership Supporting 'Offshore Wind Farm – Mariculture Integration'

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1. Introduction

In Germany a major political incentive exists currently to install large offshore wind farms (Tiedemann, 2003; BMU/Stiftung Offshore Windenergie, 2007). The promotion of wind power especially in offshore regions is mainly driven by the policy to reduce dependence on conventional fossil energy resources as well as the need to reduce the environmentally harmful CO_2 loads. Offshore wind farms are defined here as a group of wind turbines in the same confined area used for production of electric power in the open ocean. Moving off the coast to the offshore, wind turbines are less obtrusive than turbines on land, as their apparent size and noise is mitigated by distance. Since water has less surface roughness than land (especially in deeper waters), the average wind speed is usually considerably higher over the open water. At present 47 project applications for wind farms in the Economic Exclusive Zone (EEZ) of the German North Sea and in the Baltic Sea are in the planning process (BSH, 2008) with a total number of wind turbines per farm ranging between 80 and 500 (Buck et al., 2008). The strong expansion of offshore wind farms in the marine environment of the North Sea increases the stress on sea areas that have formerly been used for other purposes, such as for fishery or shipping activities, or that are still seemingly free of human activity (Krause et al., 2003; Wirtz et al., 2003).

Hence, the emerging offshore wind industry is quickly becoming a large stakeholder in the offshore arena (Gierloff-Emden, 2002; Dahlke, 2002; Tiedemann, 2003). This has lead to conflicts of interest among the different user groups and has encouraged research on the prospects of integrating maritime activities under a combined management scheme as newcomers such as wind farms make for additional claims exclude other uses, such as wild-harvest fisheries. In this context, integrating marine aquaculture with designated wind farm areas might provide chances to combine two industries in the frame of a multiple-use concept (Buck et al., 2009). The term marine aquaculture, or mariculture, refers to aquatic organisms cultivated in brackish or marine environments. Offshore aquaculture indicates a culture operation in a frequently hostile open ocean environment exposed to all kinds of sea states as well as being placed far off the coast. Nowadays the increasing limitation of favourable coastal sites for the development of modern aquaculture which is evident in various countries such as Germany, the Netherlands, Belgium, as well as others, has spurned this move offshore (Buck & Krause, 2011). This spatial limitation is mainly caused by the high degree of protected nearshore areas and by the fact that regulatory frameworks that assign specific areas for aquaculture operations are diverse and still emerging (Krause et al., 2003). Thus, little room for the expansion of modern coastal aquaculture systems in nearshore waters remain. In contrast, the number of competing users within offshore regions is relatively low, hence favouring the offshore environment for further commercial development, such as offshore wind farming and open ocean aquaculture. Spatial regulations offshore are scarce so far and clean water can be expected (Krause et al., 2003; Buck et al., 2009).

This chapter examines possible motivations for, and methods of, forming and managing an integrated facility where mariculture production resides within the physical boundaries of an offshore wind farm. It does so from an organisational science point of departure and takes into account the broad literature on organisational science and the particular context of the North Sea. The chapter closes with a short summary on the probable strategies of governance for future potential integration of offshore ‘wind farm – mariculture activities’.

2. Methods

Existing insights relating to the research questions above are yet limited. Thus, an exploratory or discovery-oriented approach was chosen, in which the primary stipulation was that the research should be empirical. The results and deliberations presented here are generated from several focus group meetings, stakeholder workshops, and semi-structured interviews over the course of years of research on the subject of multi-use management of offshore wind farms and mariculture. The key findings are summarised in Buck (2002); Krause et al., (2003); Buck et al., (2008); Michler-Cieluch and Kodeih, (2007); Michler-Cieluch and Krause, (2008). Core of the discussions below are the findings from semi-structured interviews with people involved in the offshore wind farm sector and with individuals of the mussel fishery/farming sector in Germany.

Conclusions about suitable organisational structures are based on participants’ views and their critical understanding of potential ‘wind farm– mariculture integration’. The reason to focus primarily on these two actor groups is that they are potential adopters of such a multiple-ocean use scheme because of being the ones most directly involved in or affected by a possible organisational combination of the two working domains. Moreover, it is assumed that they are most knowledgeable about the particular offshore tasks and also aware of potential interferences between both sectors (Michler-Cieluch and Krause, 2008).

The findings are contextualized to the potential organisational structures and framework requirements expressed during interviews of personnel from the wind farm industry and mussel fishing/farming sector in which the issue of a multiple-use setting in the offshore realm was addressed. Altogether 34 semi-structured interviews were carried out, with most of the interviewees being engaged in operational or developmental activities of either sector.

However, different actors' relative power to bring about system change must be considered in investigating plausible future organisational structures. This also includes decisive legislative bodies that determine the specific constitutional rules to be used in crafting the set of collective-choice rules for multiple-use settings.

3. Results

The stakeholder analysis revealed that there are different types of actors involved in the offshore realm as in contrast to nearshore areas. Different types of conflicts, limitations and potential alliances surface. These root in the essential differences in the origin, context and dynamics of nearshore- versus offshore resource uses.

For instance, the nearshore areas in Germany have been subject to a long history of traditional uses through heterogeneous stakeholder groups of the local to national levels (e.g. local fisheries communities, tourism industry, port developers, military, etc.), in which traditional user patterns emerged over a long time frame. In contrast, the offshore areas have only recently experienced conflict. This can be attributed to the relatively recent technological advancements in shipping and platform technology, both of which have been driven by capital-strong stakeholders that operate internationally. Whereas there is a well-established organisational structure present among the stakeholders in the nearshore areas in terms of social capital and trust, as well as tested modes of conduct and social networks, these are lacking in the offshore area. Indeed for the latter, a high political representation by stakeholders is observed, that possess some degree of "client" mentality towards decision-makers in the offshore realm. These fundamental differences between the stakeholders in nearshore and offshore waters make a streamlined approach to multiple use management very difficult.

However, when addressing the identified offshore stakeholders, most of the interviewees were generally interested in this specific type of multiple-use setting and vitalized the conversation around the guiding questions with their own comments and ideas. Concurrently with judging 'wind farm – mariculture integration' as an idea worthy to consider, interviewees mentioned several framework requirements for initiating and effectively pursuing cross-sectoral offshore operation and organisation. Not only had certain preconditions to be fulfilled, for example the need to clarify the working tasks and siting of aquaculture installations in the forehand, but also overall regulatory conditions, e.g. determination of working rules, allocation of responsibilities, as well as commercial arrangements or actuarial regulations (Figure 1). The issue of sharing responsibilities in the context of everyday organisation and questions of ownership were especially stressed. In the following, we discuss the organisational structures of such multiple-use setting from an organisational perspective in more detail.

4. Discussion

The results of this stakeholder survey can help us to differentiate the likelihood of various mariculture-wind farm integration scenarios going forward, specifically regarding the various forms of ownership and management such a venture might take. The attitudes and perceptions of these groups prior to implementation are informed by their views on the possible synergies in production and organisational structure. Framing the results of the surveying and other contextual information in the well-developed literature of inter-firm organisation and cooperation will provide a basis for understanding the potential of this concept.

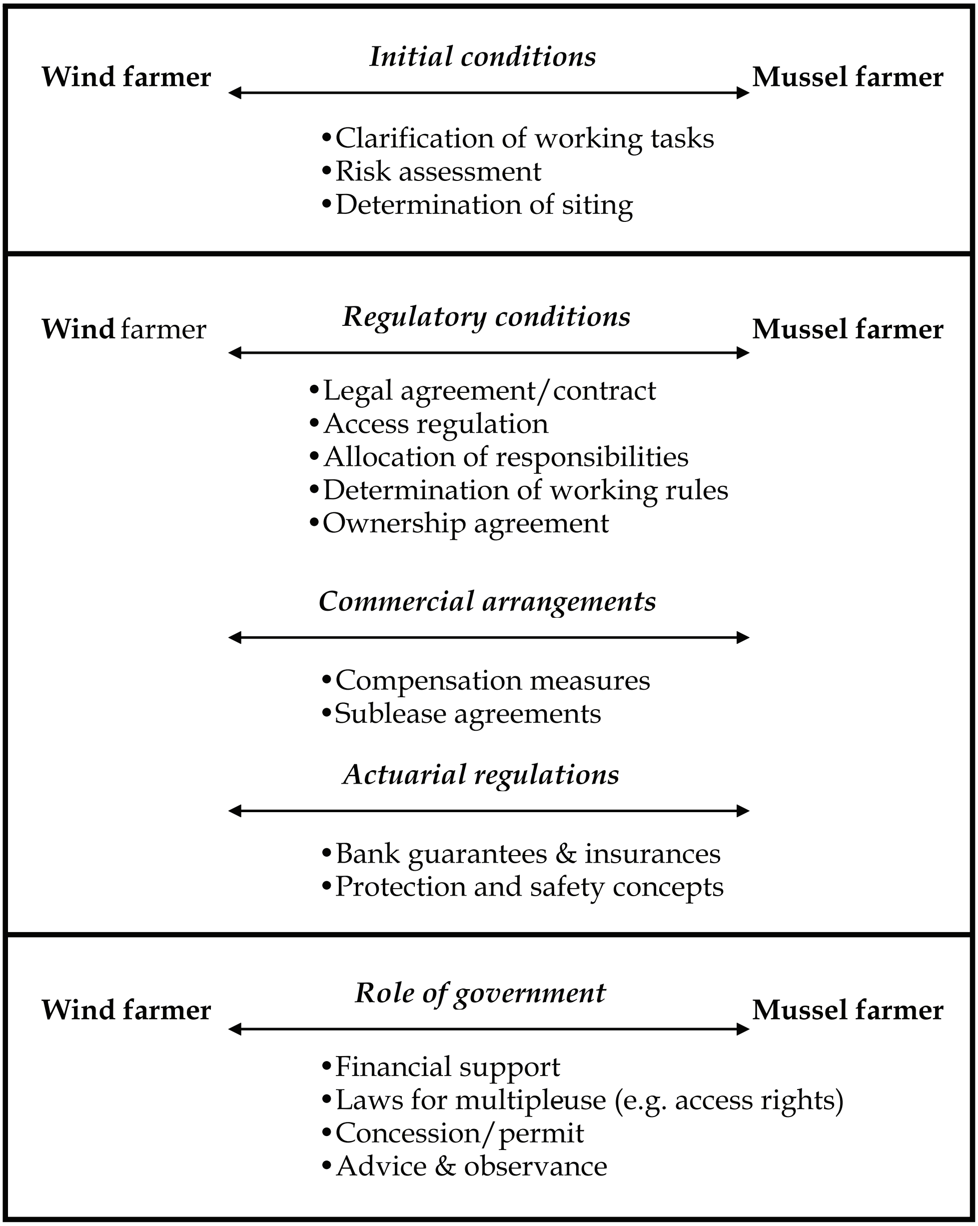

Fig. 1. Framework requirements for managing 'wind farm–mariculture integration' (modified after Michler-Cieluch and Krause, 2008).

The study of the formation of inter-firm organisations for the purpose of a mutually beneficial project or venture has roots in many research fields, with theories ranging from sociology, economics, psychology, business, and population ecology, amongst others (Osborn and Hagedoorn, 1997). The approach and methodology varies widely between these fields. Oliver Williamson has pioneered one economic approach, couching the study of governance and alliances in terms of transactions costs; see Williamson (1996) for a complete treatment. A related, but divergent approach is the work of Mark Granovetter, who takes the sociological concept of "social embeddedness" and uses it to justify the motivations and outcomes of inter-firm cooperation; see Granovetter (1985) for a review. The following analysis will incorporate, where possible, these related approaches and others to comprehensively view the challenges and potential of this new idea for offshore co-production.

4.1 Antecedent variables

There are many literature reviews that attempt to identify the basic elements necessary to conduct comparative research into inter-firm organisational structures and processes (Grandori & Soda, 1995; Osborn and Hagedoorn, 1997). Following Grandori and Soda's (1997) framework, the discussion will first identify the motives for cooperation between mariculturists and wind farmers and then look at some likely scenarios that may evolve for cooperation.

4.1.1 Production

A first motivation compelling these groups to consider a cooperative venture is the cost savings that may be available through production complementarities. Offshore construction and operation is more expensive than nearshore or onshore facilities for both industries, due primarily to large transportation costs and variables associated with the unpredictable and high-energy environment of the North Sea. Available working days per year may only be as much as 100 in the German North Sea (Michler-Cieluch et al., 2009a). It is of mutual interest of both groups to reduce their potential operating costs by collaborating in this difficult environment.

As outlined by responses in the survey, logistical cooperation is of joint interest. The ability to coordinate personnel movement to make joint use of transportation capital is a potential cost-saving avenue for either firm. In an offshore setting there could be significant potential for economies of scale in transport. Marginal increases in vessel capacity (boat or helicopter) could provide for reduced joint transportation costs, if an equitable agreement could be made for funding that capacity expansion.

It is worth noting that the operations and maintenance schedule of both offshore facilities will need to be highly coordinated internally, dictated by servicing schedules and operational tasks unique to each facility. Interlacing these schedules and any jointly used assets would however likely raise the costs of coordination, partly offsetting any gains made through complementary logistical planning.

There exists potential for other complementarities that may reduce costs for both firms in an integrated mariculture-wind farm facility and provide a motive for coordination:

- Interaction at the initial stages of planning and throughout the operating lifetime of the facility may possibly shorten the duration of the adaptive learning process that occurs in many businesses employing new technology or methods (Inkpen 2008; Nielsen 2010). The experience each group brings to the venture may provide a two-way information transfer that may improve each firm's technical efficiency of production. These economies of experience and shared experience effects may lower the average cost of production for each firm over time at a faster rate than if operating alone (Henderson, 1974).

- The current regulatory framework in countries on the North Sea makes few, if any, allowances for simultaneous economic use of the ocean area allotted for wind energy production. However, a strong momentum exists on the EU level to implement multiple concurrent uses of ocean space within the new Marine Strategy Framework Directive. In the event that these laws permit such activity in the future, there may exist an opportunity to reduce costs related to bureaucratic requirements and payments. For instance, if a given area was required to be leased from the government, the two firms may be able to split the cost of leasing. Similar logic applies to splitting the cost of pre-construction environmental studies and perhaps even engineering and other pre-construction plans. Cost savings may be offset by the extent to which these projects become more costly by including an expanded suite of activities.
- Current regulations in some North Sea countries also require insurance for offshore wind farms (Baugh, 2009). Dependent on the structure of the inter-firm agreement and the extent of the policy coverage, there may be an opportunity to hedge risk and lower insurance premiums versus operating independently at different sites. The extent to which this is possible is, in one way, determined by the economic viability of a joint operation and its associated organizational structure in the first place. As this is the focus of this paper and concurrent research on the economic feasibility of a joint mariculture-wind farm facility (Griffin and Krause, 2010), a more rigorous treatment of insurance is beyond the scope of this chapter.

The first, and most obvious, motive when looking at an inter-firm agreement from the vantage point of a mariculture firm is the ability to locate their operations in a protected offshore environment. Wind farms may be able to provide some safety for mariculture activities as well as provide a foundation for anchoring infrastructure (James and Slaski, 2006). One of the largest challenges to moving mariculture offshore is being able to protect it from the impacts of these high-energy environments (Bridger & Costa-Pierce, 2003). Recent development of innovative culturing devices for seaweed, mussels and fish (Buck and Buchholz, 2004; James & Slaski, 2006; Buck et al., 2006, Buck, 2007) within the offshore setting and particularly in wind farms may provide a cost benefit in installation and maintenance of infrastructure versus a stand-alone offshore farm.

Michler-Cieluch et al. (2009a) and Buck et al. (2008) suggest some other advantages that may reduce costs to mariculture firms:

- The offshore area provides a high quality environment for culturing the likely first candidates for offshore aquaculture, with high water quality, good oxygen conditions, less pollution, and less eutrophication than nearshore sites. This suggests that to meet a similar yield offshore may cost less due to superior growing conditions.
- The co-use of service platforms offshore may allow for more cost-effective maintenance and servicing. Dependent on the arrangement, personnel, equipment, or vessels may optionally have access to the service platform, providing flexibility in servicing and harvesting amongst other possibilities.
- James and Slaski (2006) mention that direct access to electrical power could allow for increased photoperiod production and higher levels of automation and remote operation.

- A first insight into the commercial benefit of a multiple-use scenario with aquaculture in offshore wind farms was calculated for a suspended mussel cultivation enterprise as a case study in the Germen North Sea (Buck et al., 2010).

The decision to partner with mariculture firms may also be motivated by cost considerations for wind energy firms. In an offshore setting where many users are competing for space, allowing the concurrent use of a wind farm for mariculture may provide a dual benefit to wind energy producers. First, depending on the form of cooperation, the wind energy firm may receive some level of direct compensation from the mariculture firm. This may come in the form of shouldering common costs, or be a direct stream of income as a "rental" rate, amongst other possibilities.

Secondly, the wind energy firm may experience a reduction of conflict with other users (James and Slaski, 2006). An integrated facility will likely not allow other users to enter that space which could jeopardize the safe operation of a heavily utilized offshore area (Mee, 2006). A corollary to this is that an integrated facility could be perceived as a sign of good faith and cooperation by wind energy producers in the often contentious sociopolitical landscape of exclusionary utilization of offshore commonly held resources. To date, the offshore wind farm operators hold "client" ties with the decision-makers, in which other users and their interests are not included in development considerations. By finding solutions which could be perceived as "win-win" for multiple stakeholders in the offshore setting, the wind energy operator may improve their public perception (Gee, 2010). In turn this may have the positive economic impact of reducing their political risk and potentially their cost of financing and insurance premiums.

This is not to suggest that there is only upside for a wind energy firm in collaborating. It is possible that they may experience a reduction in flexibility to engage in infrastructure projects as a result of inflexible growing seasons on the mariculture side (Mee, 2006). Taking on mariculture to the exclusion of shipping, wild harvest fisheries, or other interests may still result in alienation and political risk if excluded parties are not granted concessions elsewhere. It may also be the case that the transaction cost of implementing a joint agreement may be high enough to discourage entering into such an agreement. Flexibility in changing the collaborative arrangement as production strategies are adapted may encourage cost savings (Grandori and Soda, 1995), but may also be more costly to initially build into the agreement.

The motivations cited above are descriptive in nature and do not endeavour to model or quantify the interactions or the nominal values of these factors. As a set of potential cost savings from complementary production activities, they make a case for exploring additional motivations for collaboration.

4.1.2 Organisational coordination

4.1.2.1 Research

Grandori and Soda (1995) point out that collaboration is often motivated by reductions in governance costs and other factors unique to the industries or to the context in which the agreement is made. This section will first describe predictors from the literature which may support or impede collaboration, then will address related themes from each industry.

There has been extensive research into the pre-agreement predictors of collaboration, and the ongoing success of this collaboration. These can be related to the role of the respective asset portfolio. In this context of considerable natural resource dependency, the capital assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) determine the income and the "livelihood platform" of users of natural resources (Niehof, 2004; Bond et al., 2007). Capital assets are not only resources that people use in building livelihoods, they are assets that give them the capability to be and to act (Badjeck, 2008).

In particular, asset-specificity is thought to be an important predictor of whether or not an inter-firm collaboration will emerge (Williamson, 1981; Grandori and Soda, 1995). Asset specificity is defined as the extent to which the investments made to support a particular transaction have a higher value than they would have if they were redeployed for any other purpose (McGuinness, 1994). In a successful agreement, bilaterally held assets and rights would be clearly specified, as well as the specific conditions under which the agreement could take place. This should prevent an opportunistic change of strategy by either party.

Of special importance in this case is site-specificity. The mariculture firm is specifically looking to gain the right to produce at an offshore wind energy site; this is the most essential piece to an agreement. A successful agreement must convey secure access to these rights foremost, and also clearly delineate any other joint assets or rights. In some areas of the North Sea where suitable alternative sites for mariculture are difficult to find, this may be even more important. Contracts should be comprehensive enough to avoid creating an incentive structure which undercuts the initial reasons for cooperation. The complexity of the joint agreement is also affected by additional interdependencies which refine the nature of the assets exchanged (Obsorn & Baughn, 1990, Bond et al., 2007).

The degree of differentiation between firms is a strong predictor of inter-firm coordination. This includes the distance among the objectives and orientations of these firms, as well as psychological differences in cognitive and emotional processes. It is interesting to note that while an excessive degree of differentiation in this regard has been identified as a cause of bureaucratic failure and disintegration of firms in the literature, diversity of resources controlled by the collaborating parties is considered a successful predictor of cooperation (Grandori and Soda, 1995). Williamson (1981) stated that "there are so many different types of organisations because transactions differ so greatly and efficiency is only realized if governance structures are tailored to the specific needs of each type of transaction."

Even more, Granovetter (1985) argues that all economic relations between firms occur in a broader social context, and this "embeddedness" plays a strong hand in market outcomes. Social and market conditions at the time of agreement may change the nature of the agreement or preclude the possibility altogether. The next section will discuss the context and common views held by the primarily affected stakeholders.

4.1.2.2 Context and Views

The mariculture industry in the North Sea has historically been concentrated entirely in the nearshore areas. Increasing competition from shipping, energy facilities, and conservation initiatives has added to pressure from wild harvest fisheries to constrain or reduce the available area for cultivation (CWSS, 2002; Michler-Cieluch et al., 2009b). Of the countries poised to make major commitments in the near term to offshore wind energy in the North Sea, there is not a particularly strong mariculture sector. That is the case in England, which has experienced significant offshore wind development already, though there is a well-developed salmon rearing industry in Scotland. Currently, no significant mariculture operations are being conducted outside of 12 nautical miles in Germany (Michler-Cieluch et al., 2009a), and there is considerable doubt about whether appropriate equipment and technology is available to do so

(Mee, 2006). There has been some consolidation across the industry in this area, especially among the salmon producers (James and Slasksi, 2006), but these businesses have a relatively small capitalization in comparison to wind energy developers.

Studies have shown that seaweed and mussels could be the best candidates in an extensive culturing environment based on biological, engineering, and economic considerations (Buck, 2002; Buck and Buchholz, 2005; Buck et al., 2008); this has the added advantage of being seen as "fitting in" in an environmentally and socially responsible manner over fish culture (RICRMC, 2010). Finfish cultured at offshore sites may have more economic potential in the market, but could have larger direct costs due to the intensive nature of culturing in a remote location (RICRMC, 2010) and are potentially more controversial from an environmental point-of-view.

On the other side, the offshore wind energy sector is rapidly developing in the North Sea. The UK, Denmark, and Germany have the most extensive development in terms of installed capacity or farms in varying stages of development (EWEA, 2009a). In the next ten years, the European Wind Energy Association expects the offshore capacity to quadruple in Europe (EWEA, 2009b). Currently the industry is still in an early stage, and projects still face a considerable amount of risk and uncertainty. The financial capital required to enter this business is large, and hence this industry is populated by developers who are backed by large utilities and consortiums of banks, utilities, and other conglomerates such as General Electric and Siemens.

The wind energy industry has the support of governments across the North Sea, and is seen as part of the solution in switching to a new "green" energy economy. Subsidies and favourable regulatory status have propelled the creation of offshore wind farms (Snyder and Kaiser, 2009), possibly to the detriment of other ocean users (Mee, 2006). There are also continued concerns about the environmental impact of wind farms on the adjacent ecosystem throughout its lifecycle, particularly on adjacent marine life and migrating birds (RICRMC, 2010).

It is against this backdrop in which agreements on an integrated wind energy-mariculture facility could be made. Prior beliefs held by firms going into the agreement process may play a large role in the success of those negotiations. In constructing the following generalizations about the viability of a collaborative agreement, the results of Mee (2006), Michler-Cieluch and Krause (2008), and Michler-Cieluch et al. (2009), are referenced. In general:

- Both groups have little interest in the joint-planning process, and have uncertain assessments of mutual gains from cooperation.
- In the case of deep-water offshore farms, the distance from shore does not foster cooperation. If these facilities were closer to shore it would make the economics more compelling for both groups.
- There are divergent interests in the resource system and perceptions of management problems (Michler-Cieluch and Kodeih, 2007).
- The lack of personnel with cross-sector experience makes it difficult for either group to envision how an integrated facility could work.
- No prior formal or informal relations between the two groups may hinder coordination (Grandori and Soda, 1995; Fukuyama, 1995).
- The relative net revenue disparity between operations is so large as to provide little incentive for a wind farm to engage in a collaborative project (Griffin and Krause, 2010).
- Doing business in the offshore area is environmentally and technically challenging. With a predilection towards risk, these groups may be in a unique position for collaboration where other investors and businesses would not be interested.

New industries face significant challenges in establishing themselves as legitimate. Stakeholders, policymakers, and others in the market will not be fully convinced of the viability of this concept until there is comprehensive organisational legitimacy (Yeow, 2006). As this is a new industry concept, it is not surprising that there could be significantly divergent interests and marked uncertainty regarding initial and subsequent viability. The experience in either industry is limited, and a collaborative effort has no precedent.

4.2 Modes of cooperation

Any analysis of likely management scenarios for an integrated wind energy-mariculture facility should include a discussion of the relevant government policy. In the North Sea area, this concept is ahead of the current regulatory system in place. So far, no systematic regulations exist addressing this multi-use concept in the context of industry support. While current legislation may preclude concurrent economic activity within offshore wind farms, that likely stands as a *de facto* law absent any regulatory consideration on the matter. Given the strong push for spatial efficiency and multi-use concepts in the maritime waters in the EU and elsewhere (Krause et al., 2003; Lutges and Holzfuss, 2006), it is likely that more comprehensive regulatory frameworks will develop shortly. There are three likely avenues under which an integrated mariculture-wind energy facility may be organized. These are not exhaustive, or mutually exclusive from each other, but rather provide a straightforward method for categorizing potential outcomes.

4.2.1 Sole owner

At one polar extreme, a multiple use business plan could be enacted by a sole company without any cooperation. In all likelihood, this fits better from the direction of the wind energy producer, who would have easier access to the financial resources needed. The aforementioned complexity of drafting and following a contract with an outside firm may make this an appealing choice. Governance structures that have better transaction cost economizing properties are preferable from an economic point of view, and transaction cost economics suggests that full vertical integration completely resolves issues related to hold-ups and misaligned incentives (Williamson, 1981; Williamson, 1979; Johnson and Houston, 2000).

Considering that the area occupied by wind turbines is roughly 1-3% of the total area of an offshore wind farm (Mee, 2006), the potential for further net revenue via mariculture may be alluring to a wind energy firm. Economies of scope, i.e. simultaneously producing two products with a lower average cost than if undertaken separately, may provide the financial catalyst. Current research is assessing the economic merits of a joint mariculture-wind energy facility and will help illuminate the viability of such a venture from multiple perspectives (Griffin and Krause, 2010).

As an economic decision, undertaking this as a sole firm partly rests on the ability of the wind energy producer to culture products at a similar or lower average cost than if they had negotiated a contract or formed a joint venture with a firm who specializes in mariculture. A major impediment to this scenario is the lack of technical capacity and experience to extend the scope of production into offshore mariculture. Thus, while a sole ownership approach may initially appear promising, the degree of risk involved in operating two very different businesses at the same location is high. The degree to which personnel with specialized knowledge could be brought in to oversee and conduct these operations would likely dictate the relative risk of internalizing both productive activities.

4.2.2 Negotiated contract

Robinson (2008) found that, on average, alliances occur more in riskier industries than do internal projects, and hence alliances are used to organize activities that are riskier than a firm's average inside project. Expanding to an industry-level analysis, he found that alliance intensity across industries is positively associated with the risk difference between the two industries. This dynamic could play an important role in alliance formation versus single firm management of a multi-use facility. Negotiated contracts are another way an integrated facility might be managed and risk distributed. Contracts could take a variety of forms, such as a joint venture or a consortium or any form of subcontract. The key tenets here are that the outlined interdependence between firms must provide benefit to each party (Pareto-improving) and be perceived as fair by the participating entities. Continued cooperation between parties must be sustainable by the underlying incentive structure (Grandori and Soda, 1995). The potential of coordination can be large when firms coordinate core skills to form an alliance with unique capabilities that neither partner could efficiently provide alone. Michler-Cieluch and Krause (2008) showed that there is sufficient scope for such wind farm-mariculture cooperation in terms of operation and maintenance activities.
The process of drawing up a contract that delineates the lines of cooperation between firms is fraught with challenges. Hold-up hazards increase when complexity and uncertainty make writing and enforcing contracts difficult (Williamson, 1979), and when products require asset-specific investments, two conditions that hold in this case. Economic efficiency compels firms to engage in integrated organisational structures over simple contracts or sole ownership only when there are offsetting benefits to doing so (Johnson and Houston, 2000). These could fall under any of the previously outlined benefits from cooperation, such as reduced production costs, organisational efficiencies, or pooling risk – but these benefits are not guaranteed. Nielsen (2010) argues that all alliance contracts are necessarily incomplete because of the parties' inability to write an *a priori* comprehensive agreement that covers all future contingencies, and thus these contracts may enhance or prohibit desired outcomes. Therefore, in order to be successful, all stakeholders involved in such joint cooperation agreements must be informed and clear about their expectations, rights and the duties involved.
There is considerable research regarding the predictors of success in joint ventures and other alliances. Johnson and Houston (2000) find that only joint ventures between firms in related businesses are likely to generate operating synergies, and that combinations of dissimilar firms can reduce value by contributing to bureaucracy and lack-of-focus. Beamish (1994) finds that the good intentions and rational motives behind alliances are often not congruent with the strategic direction of either firm on its own, and can lead to poor performance and instability. In the case where firms with asymmetric resource endowments enter into a joint venture, Kumar (2007) finds that asymmetric wealth gains arise via the negative wealth transfer effects of resource appropriation by the firm with more valuable resources. Lastly, Michler-Cieluch et al. (2009a) suggest that initial collaborative research between sectors prior to the design and execution of a commercial agreement is mandatory.
In the case of the wind farm-mariculture topic, our interviews and survey work suggests that the stakeholders in a potential mariculture-wind energy facility may be amenable to some type of contracted agreement. There exists some interest in a prior joint research initiative and feasibility study, and respondents have suggested that they would be open to the idea of contracting out culturing activities at the site of an offshore wind farm. It does seem unlikely though at this point that a contracted solution could occur in the absence of some intervening third body (Michler-Cieluch, 2009a). However, an advisory or some other

external group helping to coordinate and mediate generally improves the chances of reaching a successful agreement (Noble, 2000).

4.2.3 Legislated

In the case where finding a market solution for multi-use in the offshore setting is not possible, a legislative prescription can still attain desired policy goals of spatial efficiency in the ocean area. The use of mandates, subsidies, tariffs, and other policy tools can change the incentives of the current economic environment to make the multi-use concept economically viable.

As there is a growing focus on coastal zone management and the efficient and equitable use of coastal resources in the EU, US, and elsewhere (Krause et al., 2003, Lutges and Holzfuss, 2006; RICRMC, 2010), policy makers may find policy instruments as a palatable solution for achieving policy goals. Mariculture can offer expanded employment opportunities to rural peripheral regions and displaced fishermen in the area of a wind energy facility, and potentially make wild harvest fisheries more productive if mariculture areas act as nurseries for wild fish (Mee, 2006). Indeed, multi-use layering of economic activities can maximize the value of offshore resources while reducing conflict between stakeholder groups. Promoting a multi-use concept would not be an uncommon step; regulators have already shown that they are comfortable with using legislation to spur growth in the offshore wind energy industry.

A clear, coherent, and stable regulatory framework is a bare minimum when firms make financial decisions in the inherently risky offshore marine environment. Managers need to be able to predict with some certainty the expected outcomes of changes in strategy, be it an internal decision or the decision to form an external alliance. Carroll et al. (1988) have found that fragmentation in the structure of State decision making is shown to lead to more elaborate and costly inter-organisational networks. The decision to actively foster cooperation on a multi-use concept should largely be dependent on market conditions, and the potential social benefits available from multi-use facilities.

5. Conclusion

The discussion thus far has attempted to frame the potential cooperation in a multi-use setting in the context of the broader social, political, and economic spheres, while also illuminating the perceptions and characteristics of the particular industries themselves. It appears clear that uncertainty and risk are large components of this discussion, and naturally were brought up by survey respondents. The likelihood and form of collaboration in the near future will be shaped by how well this risk and uncertainty is addressed.

It is apparent that the orchestration of a multi-use concept such as an integrating wind energy and mariculture will be difficult. First results indicate that practical multifunctional use of offshore areas requires technical and economic feasibility as a basic prerequisite to assure that both offshore wind farm operators and mariculturists will support a multi-use concept. This suggests that as more information emerges on the economic and technical viability of this, it will be clearer if this is a practical approach towards rationalizing marine stewardship in the offshore setting. Concurrent to this, it will fall to policy-makers to sanction the range of options for how such a facility might be managed. The discussion here is meant to enlighten the debate going forward on the relative merits of various management alternatives, while also illuminating the motivations for cooperation from a business standpoint.

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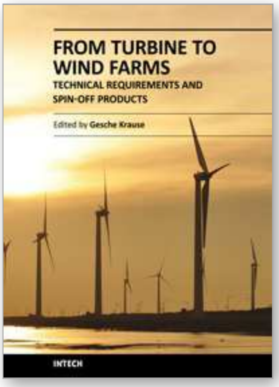

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