

OFFSHORE WIND INDUSTRY SUPPLY CHAIN INTEGRATION: LEARNINGS FROM OTHER INDUSTRIES

This article attempts to present the process behind the identification of the supply chains involved in the offshore wind industry (OWI), their differentiation, and the need to redefine the strategies followed by each of them. After those fundamental points are explained, this article will provide a set of suggestions taken from interviews carried out with some key players in the industry.

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The offshore wind industry (OWI) has been called an immature sector that needs to be industrialised in order to become more competitive. In the OWI, there is a widespread belief that to reach this goal, it needs to observe practices from already industrialised sectors, such as the automotive industry, and apply them in its own competitive environment. This assumption has resulted in a set of decisions that has delayed the industrialisation of the OWI. In order to know where to look for appropriate industrialisation paths to emulate, the OWI must be split into its corresponding supply chains and then find an appropriate strategy for each one.

Manufacturing environments

According to the field of operations management, every manufacturing industry will fall into one of the following five process classifications: continuous, line, batch, jobbing and project. These processes are characterised by a varied level of flows and task complexities. Repeated tasks and continuous flows are characteristics of continuous and line manufacturing processes, such as the production of cars, mobile phones or gasoline. These processes are defined by high volumes, low varieties, and continuous production of goods. Moving up the line of complexity, one finds the batch manufacturing process, which is also used for high volume production, but contrary to continuous and line production settings, batch manufacturing is used to produce goods in lots. The next level up in complexity and uniqueness is the jobbing process, which is used to manufacture “one-off” products, such as special tools, custom-made furniture,

or pieces necessary to repair a machine for a specific customer. Finally, at the top of the complexity chain is the project manufacturing process, which deals with highly customized, technically complex products that are often developed over a large period of time and involve a considerable number of interdependent activities.

Different supply chains

Academic research in the field of supply chain management advocates that in order to become efficient and competitive, industries need greater material and information integration among the different supply chain actors (Frohlich & Westbrook, 2001). Figure 1 depicts the most common supply chain, in which the material flows from the raw material suppliers upward to the manufacturer, from there to distributors, and finally to the customers. On the other hand, information flows downstream from the customers to the raw material suppliers.

Ideally, if a company owned the entirety of the network, it could establish an efficient flow of materials from their source to the manufacturing process. Then, it could share logistics and storage capacity and finally deliver the product to the sales point when needed, even sharing inventories among the various selling points. Of course, for this to happen, the sales information would have to flow from the stores to the main storage facilities, which would then allow the manufacturing facility to plan the production schedule as well as the acquisition and reception of raw material. Information systems may be integrated throughout all the echelons, logistical

CONTINUOUS/LINE/BATCH SUPPLY CHAIN

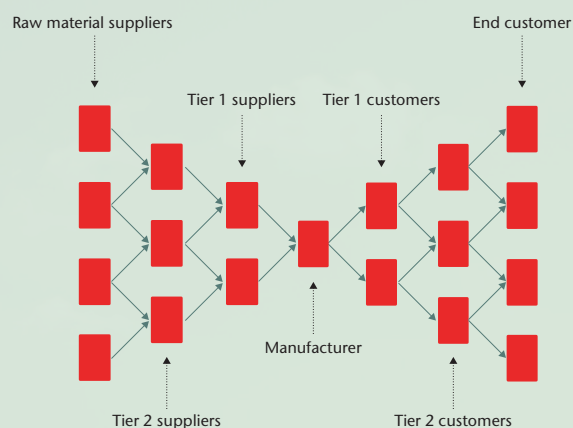


Figure 1. Source: Ivan Martinez-Neri

resources can be coordinated, and employees may be free to communicate among the business units and make decisions without any legal implications. That is what would ideally happen, but in reality, very few companies own the whole supply chain and comprehensively integrate its functions in that way.

In the actual competitive market, all the echelons in the chain are separate legal entities that typically compete amongst each other. Retail stores may be unwilling to share their sales information and wholesalers might buy whatever quantity of product they want whenever they find it convenient, rather than when the demand fits the productive capacity and supply of raw materials. Also, manufacturers might create a competitive setting among first-tier suppliers, which will not be willing to cooperate among themselves.

Supply chain integration (SCI), a topic within the field of supply chain management, advocates for the integration of information and material flow within all the organizations and individuals involved in the supply chain. This can be done through integrated information systems between the different companies, appropriate management of relationships among trading partners, coordination of activities, and sharing of logistical planning and produc-

PROJECT MANUFACTURING VALUE NETWORK

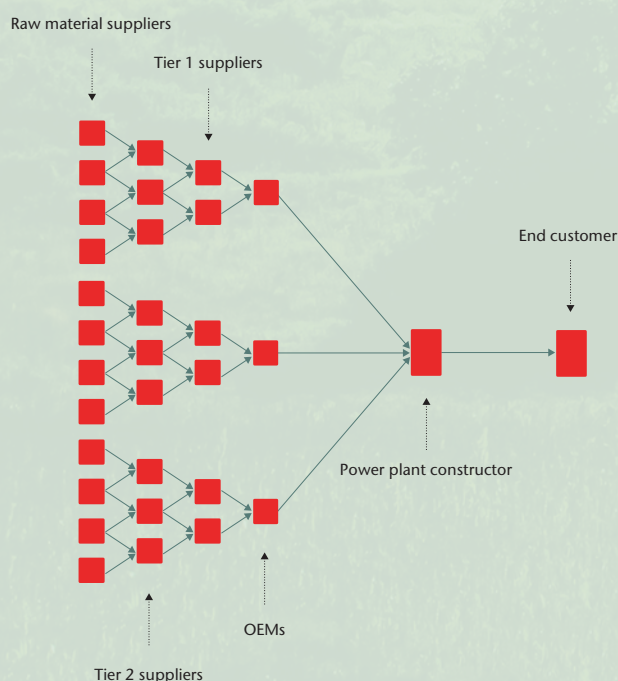


Figure 2. Source: Ivan Martinez-Neri

DANSK RESUMÉ

DILForientering vil i de næste fire numre bringe en serie af ph.d.-projekter, der repræsenterer, hvad studerende lige nu forsker i inden for supply chain-området. Denne artikel giver bl.a. et indblik i processen bag det at identificere de forskellige forsyningskæder, der indgår i offshore wind industry, og behovet for at redefinere strategierne for hver af dem.

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tion schedules among others. This kind of integration is what has allowed certain industries to become more competitive by forming clusters of integrated companies that are able to innovate and respond faster than if they were competing alone.

Most academic research carried out in SCI has used the production supply chain depicted in Figure 1 as a unit of analysis. Furthermore, that research has commonly used large-scale manufacturing environments, and the findings would only apply to some of the processes used to manufacture the components of an offshore wind farm, such as electrical devices, bearings, cables, etc. Taking the wind turbine generators (WTG) as a product it is observed that they are manufactured using low-scale line-production processes as evidenced by the fact that in 2014, only 361 of these machines were produced and installed around the world.

Now, if an offshore wind farm were taken as a deliverable, its value chain would look similar to the one depicted in Figure 2. In this construction project, materials and subsystems (WTGs, foundations, cables, etc.) flow to the site where they are "assembled" by the power-plant constructor and delivered to a final client, which can be a utility company, a pension fund, or an asset management company among others. This network is fundamentally different from the one presented in Figure 1, as it does not involve numerous suppliers, one large-scale manufacturing entity, and numerous distributors and final consumers. Instead, it has few providers of large subsystems, one constructor, and limited clients. Additionally, these kinds of projects are carried out over 3–5 years, have an expected lifespan of 25–30 years, and represent capital expenditures that amount to hundreds of millions of euros.

In summary, an offshore wind farm does not have one but three different supply chains: one that represents the components manufactured in large-scale line-production processes; a second involving low-scale processes for the WTGs, foundations, and cables; and the final network that represents the value chain of a project, which is used to deliver an offshore wind farm as a complete product.

Empirical findings

A literature review carried out by the author evidenced the fact that most published research in the SCI field is not specifically addressed to project manufacturing environments. Therefore, a set of explorative interviews was carried out with executives of six companies, each one representing an involved sector in the OWI: a wind farm developer, a substation provider; a foundation manufacturer; a sub-sea cable supplier; an installation vessel owner; and a wind turbine generator provider. As these companies participate in other industries as well, they were able to provide ideas on how to integrate the OWI following practices from those other sectors. The proposals fall mainly into two of the supply chain integrative practices: information sharing and collaboration.

It was highlighted that the sharing of information among the members of the supply chain network is neither open nor transpar-

ent. The constructor of the wind farm collects and coordinates all of the information in the projects, avoiding direct interaction between the providers of the different subsystems, even if considerable interfaces among those elements are expected. According to the participants in the interviews, this practice slows down the exchange and flow of information. One of the suggestions is, as practiced in other industries where large construction projects are developed, to allow the direct interaction and exchange of information between subsystem suppliers. Another of the interviewees suggested a central documentation system like those used in civil works such as the construction of highways. The substation supplier, which also provides electrical components that go inside the WTGs, commented that the OWI is the industry in which they find the most non-disclosure agreements of all the industries to which they supply electrical components; this hinders the complete development process according to them.

Additionally, the interviews revealed that the other industries in which the companies participate have high levels of collaboration, such as is the case in the utilities sector, which has joint R&D activities together with their competitors whereby the generated knowledge is shared as well as the incurred costs. The cable suppliers are part of a multi-industry forum in which they meet together with competitors, universities and clients to agree on standards and the solutions to common problems in the electrical industry. Additionally, this industry has highlighted the importance of standardizing the electrical components and interfaces in the OWI, which has been found to be a booster to increase competitiveness by means of a break-up of complex systems into discrete and manageable system interconnections (Langlois, 2002).

Another example of practices being used in other industries to integrate the supply chain and which could be implemented in the OWI would be to allow multiple companies to cluster together and offer a tender. As an example, it was mentioned that although a group of companies could make a proposal for the design, manufacture and installation of foundations, many constructors disintegrate the process into three different tenders, one for each one of those tasks; this is done in order to increase competition in prices but it has the effect of disintegrating processes within the industry.

Implications

For the academic researchers, the OWI represents a unique opportunity to study a stream of construction projects, that have similarities among them, such as the use of wind turbines to generate electricity, but that are still unique in the sense that they have to be customised to fit local regulations, demands of local content, the geographical characteristics of the offshore site, grid connection requirement, etc.

For the industry it represents an opportunity to look to other industries and learn from them. The large-scale line manufacturing processes could look to the automotive industry, the low-scale could look to industries which have a standard machine that is customized and for which less than one thousand units are manufactured per year, such as the aircraft-engines industry. For the construction of offshore wind farms, collaboration among providers of subsystems for big construction projects could be a good place to start. Offshore oil and gas, construction of power plants and in general major civil engineering projects could be used to benchmark the OWI. /

Bibliography

Frohlich, M. T., & Westbrook, R. (2001). Arcs of integration: an international study of supply chain strategies. *Journal of Operations Management*, 19(2), 185–200.

Langlois, R. N. (2002). Modularity in technology and organization. *Journal of Economic Behavior and Organization*, 49(1), 19–37.