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CASE STUDY

Open Access



The matrix as a transitory form: the evolution of FMC technologies 2001–2016

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Abstract

Introduction: The matrix structure is sometimes presented as an inevitable “end point” for organizations that must adapt to an increasingly complex business environment. However, observations of the structure of firms do not always confirm this view.

Case description: The paper describes the evolution of FMC Subsea, a large division of the global technology firm FMC Technologies (now TechnipFMC).

Discussion and evaluation: During the 2001–2016 time period, the firm’s organizational structure underwent three significant changes. The firm was originally organized by geography. In 2011, it introduced global product units, which resulted in dual reporting lines (i.e., a matrix structure) for some regional managers. However, in 2015, it separated the product lines from the regional units, thereby eliminating the need for dual reporting.

Conclusion: This example suggests that the matrix structure may sometimes be a transitory form that eventually gives way to a simpler—yet still multidimensional—structure.

Keywords: Multinational firms, Matrix structures, Multidimensional organizational models, Complexity, Simplification

Introduction

According to one consulting firm, 95% of Fortune top 50 and 90% of FTSE top 50 companies have adopted the matrix structure (Thompson 2013). In the academic literature, the key assumption is that the matrix, as a complex organizational form, is a response to an ever more complex business environment:

“An increase in environmental complexity and uncertainty drives the need for the matrix and its complexity. The introduction of a matrix structure thus follows the Law of Requisite Variety (Ashby 1956): Complexity in the environment must be matched with complexity in the organization’s design” (Burton et al. 2015, p. 37)

International firms, in particular, face a complex business environment. They need to balance pressures for adaptation to local customer requirements with pressures for global integration, manage cultural differences, and handle differences in regulatory regimes across the countries in which they operate. Indeed, the literature on international management posits that while firms in the early stages of internationalization

may adopt a product or geographical structure, they will eventually switch to the matrix when they become global—or “transnational”—firms (Bartlett and Ghoshal 2000; Stopford and Wells 1972).

Despite the ubiquity of the concept, there are few systematic studies that can confirm these assumptions. What we know from the few studies that have been conducted is that the adoption rate is far lower than the 95% figure cited above, at least when considering firms outside the USA and the UK. For example, in a study conducted among 82 German multinationals, only 42 of the firms were categorized as having a matrix structure (Wolf and Egelhoff 2013). However, even this figure may be too high, because it was based on a very broad definition of “matrix”: Only 15 out of the 82 firms had the typical matrix structure associated with international firms, where a regional manager reports to both a global product manager and to the head of a regional unit. In an unpublished study performed by a consulting firm in Norway, only 2 out of 16 large international firms were characterized as having a matrix structure, and for the two cases that were identified, only a small subset of managers were “in the matrix,” that is, only a subset of managers reported to two or more bosses (Deloitte 2013).

Scholars have also begun to question the validity of Ashby’s Law of Requisite Variety, referred to above (Poulis and Poulis 2016). A key limitation of Ashby’s law is that it fails to distinguish between *necessary* complexity (i.e., internal complexity required to adapt to a complex external environment) and *unnecessary* complexity (e.g., internal complexity caused by suboptimal organization design decisions) (Worren 2012). We know from the practitioner literature that many firms have been attempting to simplify their internal structures, even though the business environment does not show any sign of becoming less complex (Ashkenas 2007).

Hence, the question I raise in this paper is whether it is necessarily true that organizations in complex business environments gravitate toward the matrix form. Since organizational structures evolve over time, I discuss how the structure of one particular organization has evolved in the 15-year period from 2001 to 2016. The organization that I use as a case is a division of the global technology firm FMC Technologies (now TechnipFMC). I describe the organizational model adopted by this firm at the start of the period, in 2001, and discuss why it was adjusted in 2011 and again in 2015. The case illustrates how the organizational model of a complex firm is re-designed in response to internal and external changes. It also shows how the matrix structure may be simplified by introducing an alternative (multidimensional) model that does not require a dual reporting structure.

Background

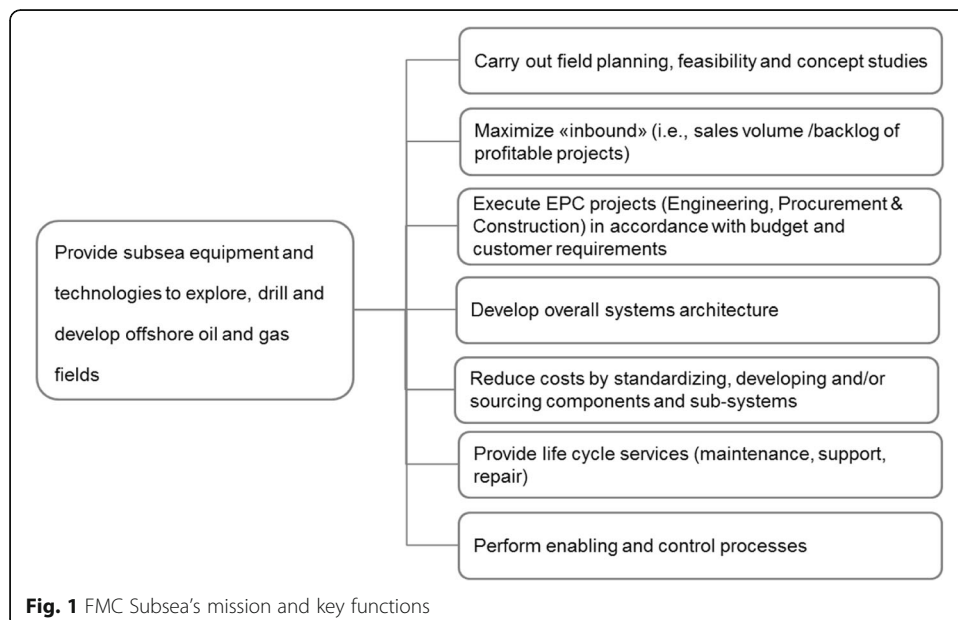
The organization that I describe in this paper is FMC Subsea, a division of FMC Technologies, a US technology firm, which merged with the French engineering firm Technip after this study was completed (in 2017). FMC Subsea was the largest division of FMC Technologies before the merger, representing about 66% of total revenues, and operated in a relatively autonomous fashion. The division headquarters were located outside the USA, and the division had its own staff functions, separate from the corporate headquarters. The head of the division, Tore Halvorsen (executive vice president) initiated the organization’s changes that are described in this article.

FMC Subsea is a supplier to oil companies around the world that develop oil fields. FMC Subsea designs, installs, and services *subsea trees*—the main part of subsea oilfield installations—as well as *manifolds* and *control systems*. The primary function of a subsea tree is to control the flow of oil or gas out of a well on the seabed (i.e., a subsea well). The fluid from the well goes through a flow line to a production facility (oil platform) and eventually to a refinery or distribution center. When the first offshore oil platforms were constructed, most of the equipment and processing facilities were placed on the platform itself. Over time, subsea installations have become more advanced and now perform many of the functions that were previously performed on the platform. FMC Subsea is the market leader and has the largest installed base of subsea trees (around 2000) of all companies operating in this market.

The subsea trees (and other associated components/modules) are typically developed to customer specifications in large EPC (engineering, procurement, and construction) projects. These projects typically have a \$200–300 million budget, a 3–4-year time span, produce 10,000 engineering documents, and involve 200 or more engineers in multiple locations. Although FMC is primarily a project-based firm, it has also established a business that services installed valve trees. The service business accounted for around 25% of revenues in 2016.

When describing an organization, it is helpful to identify its overall mission and the main functions that it performs (Warren 2016). FMC Subsea’s mission is *to provide subsea equipment and technologies to explore, drill, and develop offshore oil and gas fields*. This mission may be decomposed into six more detailed functions, as shown in Fig. 1. In the following, I will refer to these functions in describing how organizational changes have affected the allocation of accountabilities in the organization.

The divisional headquarters of FMC Subsea are located in Kongsberg, Norway. Revenues were \$3.2 billion in 2011. The number of employees worldwide was 7000 in 2011 but has since then been reduced to around 5000 due to the downturn in the industry.



The data presented here are based on interviews with four key executives, including the EVP (i.e., leader) of the division, who also provided feedback on a draft version of this article. I also made use of various documents, such as organization charts, annual reports, and the internal company magazine. In addition, some information was drawn from a doctoral dissertation about the industry (Bjørnstad 2009) and the official company history book (Daling and Erlandsen 1999).

Three phases in the evolution of FMC Subsea's organization

FMC Technologies was originally not an oil services company (FMC stands for "Food Machinery and Chemicals") but became one as a result of several acquisitions. FMC Subsea has its origins in the oil division of a Norwegian defense contractor (Kongsberg). This division was sold to Siemens in 1987 and was then acquired by FMC in 1993. The engineering division that eventually became FMC Subsea was a national player during its first years of existence, with Statoil (the Norwegian oil company) as its main customer. However, around 1980, the head of the oil division established a new strategic goal, which was "To become the major European supplier of subsea production systems with a significant world wide market share." For a few years, the international activities were mainly in the form of exports, and as late as 1997, revenues from international activities only represented 25% of total revenues (Daling and Erlandsen 1999). As a result of the acquisition by FMC, however, the international ambitions were further increased, with the goal of becoming a "world leader." Ten years later, in 2007, the proportion of revenues from international operations exceeded 75%.

Phase 1: 2001–2010 The main customers of FMC Subsea are the large oil companies, which are today international companies that grew from a dominant national position (e.g., Chevron in the USA, Statoil in Norway, Petrobras in Brazil). As FMC Subsea increased its international deliveries and established offices abroad, it became clear that customer requirements varied somewhat from one region to the next, and in some countries, there was even a legal requirement to include "local content" as part of a contract (i.e., a certain proportion of the scope of a project would have to be delivered by local resources). Hence, it was natural at this point to establish a geographical organization. The main focus was on meeting local customer needs. FMC Subsea chose to divide the organization into four main units, each with the responsibility for a particular region (see Table 1 and Fig. 2).

Unlike many other project-based firms during this time period, FMC Subsea was an early adopter of the so-called industrialization approach.¹ One limitation of having a project based organization is that it can lead to the development of many components that are unique to each project (Nobeoka and Cusumano 1994). FMC realized that one has to balance project focus with standardization of components in order to reduce costs and manage engineering resources efficiently. Hence, the firm introduced so-called *product teams* as early as 1996 (referred to as *Product lines* in Fig. 2 and later called *product delivery teams*). The product teams were responsible for the standardization and re-use of components, methods, and tools across projects. However, the four regional units were highly autonomous, and there was limited

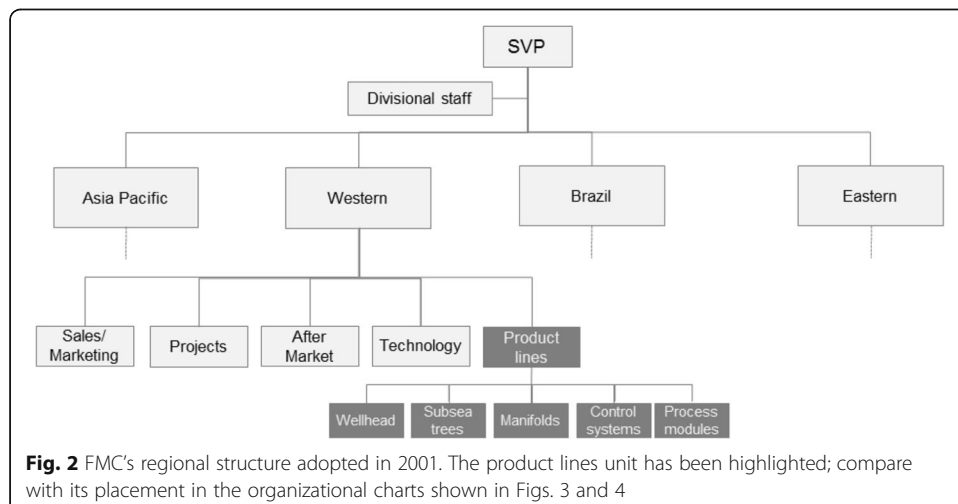
Table 1 Allocation of accountabilities in the 2001 organizational model

Functions	Organizational units					
	Regional level					Global level
	Sales/ marketing	Projects/ engineering	Product lines	Technology	After market	Divisional staff
Carry out field planning, feasibility, and concept studies		•				
Maximize “inbound” (i.e., sales volume/backlog of profitable projects)	•					
Execute EPC projects in accordance with budget and customer requirements		•				
Reduce costs by standardizing, developing, and/or sourcing components and sub-systems			•			
Develop new technologies				•		
Provide life cycle services (maintenance, support, repair)					•	
Perform enabling and control processes						•

EPC engineering, procurement, and construction

standardization and limited resource sharing *across* regions during this time period. One manager expressed it in his way: “We had the same processes in each region, but multiplied by 4.”

Phase 2: 2011–2016 FMC Subsea achieved strong growth during the 2001–2010 period and established itself as the technology and market leader. However, there was growing dissatisfaction with its organizational model. The leadership team discovered that it was difficult to achieve potential synergies across the regions, despite efforts at informal coordination. The four regional units defined products (e.g., part numbers) and work processes differently, making it difficult to transfer a piece of work across the regions and allocate capacity in an optimal manner. The regional units also made procurement decisions without coordinating with each other, which resulted in different



suppliers providing the same product or service, when one could have consolidated the delivery into a larger contract. It was also difficult to transfer people across regional units, due both to the incentive structure and to discrepancies in how roles and responsibilities were defined. During this period, the customers—oil companies—had become more internationally oriented. They had consolidated their procurement activities and some had also expressed that they wanted to meet “precisely the same FMC” in every region in which they operated. In sum, there was a general perception that the regions needed to coordinate more effectively and in many cases standardize and consolidate their activities in order to exploit potential synergies and present “one face” toward the customer.

In a relatively large re-organization that was undertaken in 2011, two key structural changes were made. First, technology development activities were consolidated in a new, global unit (see Fig. 3). Secondly, another global unit—*product lines*—was also established. The team leaders in the regional product line teams would now report both to the manager of the regional product line unit and to a manager in the global product line unit. In other words, this change introduces an additional dimension (or grouping criterion): While the key units in the previous model had been the regional units (i.e., a geographical organization), the new organization contained a product unit at the same hierarchical level as the regional units (as well as the technology unit, which is functionally grouped and thus may be considered a third dimension).² In addition to these structural changes, several other changes were made in order to harmonize products and processes. As an example, all four regions adopted an identical work breakdown structure (i.e., the same manner of defining the structure of the product and the manufacturing processes). The new organizational model also led to the re-definition of the “resource model” of some units (Worren 2012). Previously, the product lines had been defined as profit centers. In the new model introduced in 2011, product lines were defined as cost centers. This was partly done to simplify the internal transfer pricing scheme: The previous transfer pricing scheme was viewed as complicated as it required the calculation or attribution of profits at a unit level. But the shift to a cost center status also underlined that the main customer responsibility laid with the regional sales teams and projects; the product line teams were considered as internal suppliers to the projects and were measured primarily based on cost reductions achieved through standardization.

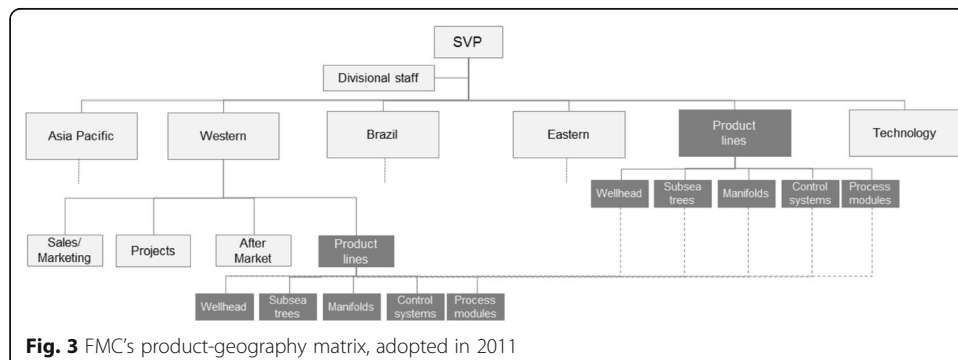
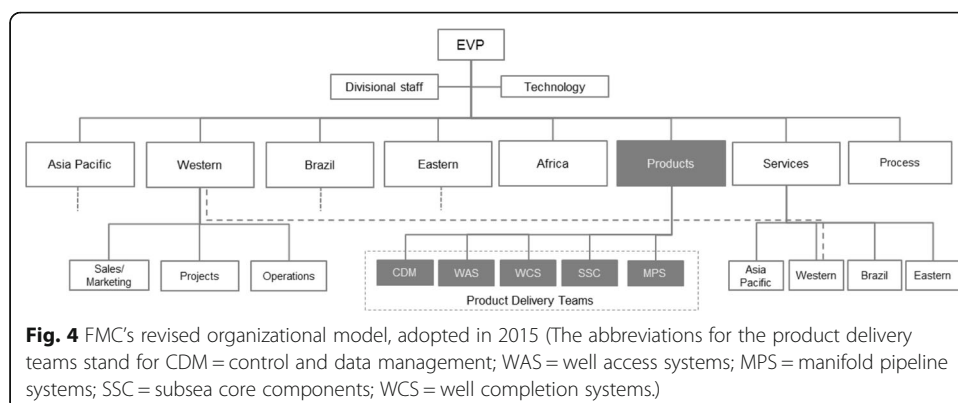


Fig. 3 FMC’s product-geography matrix, adopted in 2011

Phase 3: 2015 and onwards After 4 years operating with a (partial) matrix structure, a new review of the organization was conducted in 2015. Four main conclusions were drawn based on this review. The first was that there were, in the words of Tore Halvorsen (EVP), “too many arrows” on the organization chart, meaning that there were too many interfaces between the main units and that it was difficult to coordinate and reach agreement when facing key decisions. He also noted that it was difficult for people to relate to two bosses. Another conclusion was that the context had changed: It gradually became easier to transfer resources organizationally and physically and to distribute tasks across sites and regional units. Historically, customer representatives had expected that they should be able to meet with engineers from the product line units in person. The previous organizational model was thus based on the assumption that the members of the product lines would have to be closely connected to the regional units. It was discovered that this became less important for customers and that engineers could contribute to a project without being physically present on the main site. The third conclusion was that the service business, which had achieved significant growth, relied on processes and procedures that were partly incompatible with those in the rest of the organization. The regional units had a long planning horizon and ordered parts based on a prognosis of demand. In contrast, the service business had to respond within hours when an installed unit experienced a component failure. There was also a greater need for efficiency in resource utilization and a larger potential for standardizing work tasks in the service business, compared to the tasks performed in engineering projects. Finally, FMC Subsea had experienced a significant drop in demand for its products due to the general downturn (caused by a reduction in the oil price). This intensified the need to reduce complexity and lower costs.

Consequently, the new organizational model introduced in 2015 was aimed at simplifying the organization in several different ways. The product lines (now called “Products”) were fully separated from the regional units (see Table 3 and Fig. 4). Among the staff of approximately 500 people, about 350 were transferred to the new, global unit, while approximately 150 remained in the region. This meant that the team leaders, who in the previous model reported to two managers simultaneously in a matrix structure (Fig. 3), now returned to the situation before 2011 when they only reported to one manager (Fig. 2). The EVP stated: “You may say that we are leaving the matrix form, to some extent.”



In a similar move, the service activities were removed from the regional units and consolidated in a global unit. Yet the managers in the service units are still located in the same regions, and they continue to participate in the regional leadership team meetings (illustrated with the dotted line in Fig. 4). Hence, with respect to the service unit, a partial matrix structure remains (for some senior managers). In order to reduce costs, FMC Subsea also initiated a general downsizing of staff and reduced the number of management layers as part of this re-organization. The number of management layers within a region was reduced from 8 to 3. As a consequence, the average span of control for managers increased from 5 to 12. A number of process improvements were also made in order to reduce costs. As an example of one such initiative, FMC was able to reduce the number of technical documents in one engineering process from 450 to 150; the managers that were interviewed were confident that this had been achieved without any reduction in the quality of the process.

As indicated in Fig. 4, the new Products unit is divided into several sub-units, called *product delivery teams*, each focusing on a particular component or sub-system. The product delivery teams play an important role in linking the local EPC projects with the global organization. The EPC project managers report to a project director, who in turn reports to the regional manager. The leaders of the product delivery teams, on the other hand, are now outside the regional structure and thus report to a manager with global responsibility. Whereas projects are measured on their ability to fulfill unique customer requirements in a specific region and deliver projects on time and on budget, product delivery teams are evaluated on their ability to minimize costs by leveraging common components across projects and across regions. They do this by providing a catalogue of standard components with fixed prices that are available to the projects. In addition, the product delivery teams serve as a resource pool for some technical resources that participate in the EPC projects. The key interdependencies between these units are shown in Fig. 5.

Discussion

The evolution of FMC Subsea during the 2001–2016 period illustrates that new organizational models are adopted to align the organization with new strategic

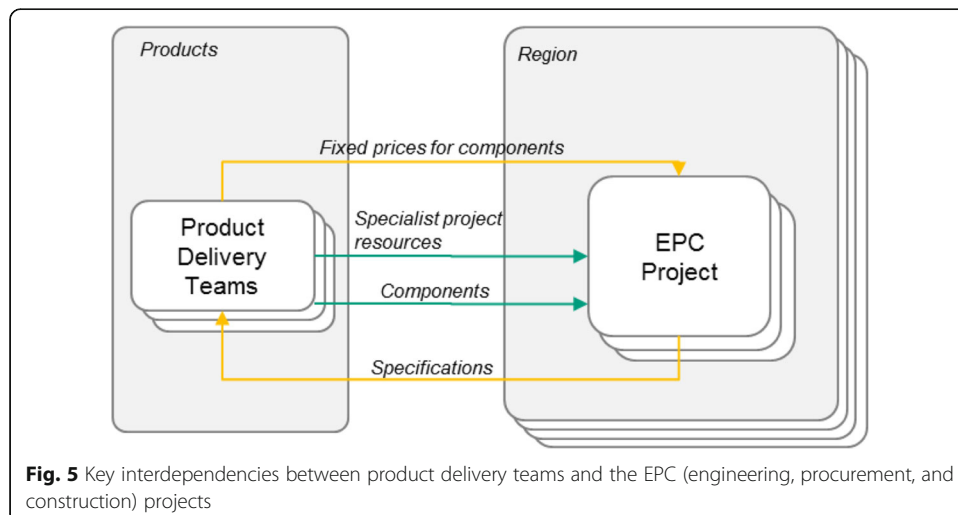


Fig. 5 Key interdependencies between product delivery teams and the EPC (engineering, procurement, and construction) projects

priorities and also to correct for deficiencies in the current model (Miles and Snow 1992). The initial challenge was to establish an organization that could serve international markets and adapt to local and regional customer requirements. Consequently, a regional structure was chosen. Another key priority was to balance the need to meet customer-specific requirements in projects with the ability to leverage common components and methods across projects. The solution, product teams, was conceived of in 1996 and remained a key element in all of the subsequent variations of the organizational model. When the second major change was initiated in 2011, the key challenge was to improve cost effectiveness and competitiveness. The lack of coordination and standardization across regions was seen as a key obstacle, and was addressed by consolidating activities and establishing new global units. Finally, in 2015, the need for cost effectiveness increased even further, as a result of the industry downturn. The key obstacle was now perceived to be the complexity of the organization, caused by unclear roles, conflicting unit mandates, and an excessive number of management layers, as well as by an increase in the number of technical documents generated in the engineering processes.

The FMC Subsea case illustrates how the matrix may be a transitory form: It was an intermediate step between a regional model, introduced in 2001, and a multidimensional model without dual reporting for product units, introduced in 2015. One may consider *why* the matrix may be a transitory form in this manner. There are at least two possible explanations. It is well known that there are sometimes political reasons for choosing a matrix structure (Galbraith 2009). When the EVP initiated the changes that led to the re-organization in 2011, he wanted to find a solution that would gain acceptance in the leadership team. One can imagine that it was easier to get acceptance among the existing regional managers for a model that simply added a reporting line, compared to the alternative (i.e., the model introduced in 2015), which might have been interpreted as a “loss” of key resources and/or a reduced scope of responsibility for the regional managers. After 4 years, however, when it was clear that the matrix structure was a challenging model, the required consensus had emerged for going all the way and removing the product teams from the regional structure and transferring them to a global unit.

Another possible explanation is that the successful implementation of a new organizational model requires a certain *maturity level* (cf. Curtis et al. 2002). A new organizational model is not only a formal reporting structure, but also requires the re-definition of unit level goals and key performance indicators (KPIs) and adjustments in terms of individual roles and working relationships. One may speculate that the matrix structure that was introduced in 2011 provided a rather modest change from the pre-existing model, yet provided some benefits in terms of increasing coordination and knowledge sharing across the four regions. The experience from working in the matrix may then have conferred both individual and organizational learning that enabled the organization to take the next step and successfully adopt the organizational model that was introduced in 2015.

The model introduced in 2015 represents a simpler organizational model with respect to both the vertical and the horizontal features of the organization.³ Vertically, the 2015 contains considerably fewer management layers (a reduction from 8 to 3 management layers within the regional units). Horizontally, there were changes that

removed role conflicts or goal conflicts between the sub-units in the organization. The 2015 model led to the establishment of a dedicated After market (i.e., services) unit. In the previous model, the roles responsible for the service business had been organized within the regional units. FMC’s leaders came to the conclusion that the service business and the engineering business represented units with conflicting functions or goals. The solution was to separate the service business from engineering by creating a new After market unit.

The organizational model introduced in 2015 performs the same functions as before. But the creation of the After market unit and the removal of the matrix reporting structure made it possible to remove the overlapping accountabilities (cf. Table 2 versus Table 3). In the previous model, implemented in 2011, the team leaders within the geographical product lines reported to one manager in the regional unit and to another manager in the global product lines. The global product lines were accountable for enhancing standardization *across* regions, while the regional product units were accountable for ensuring delivery of components/modules at the request of the EPC projects (and the people within the regional product lines probably had their main focus on standardization *within* the region⁴). One senior executive stated: “People found it difficult having to ask one manager about what they should do, and another about when they should do it.”

The argument that the 2015 model leads to simplification rests on a key assumption: that one is able to implement the model as intended. One potential risk with this type of change is that the formal matrix simply becomes a “hidden matrix” that is equally hard to operate. This may happen if roles and responsibilities overlap at the sub-unit level. As mentioned above, the product delivery teams represent the linkage between the global and the regional organization as they formally report to a leader at the global level yet deliver components to projects organized regionally. It is likely that there will

Table 2 Allocation of accountabilities in the 2011 organizational model

Functions	Organizational units						
	Regional level				Global level		
	Sales and marketing	Projects	After market	Product lines	Product lines	Technology	Divisional staff
Carry out field planning, feasibility, and concept studies		•					
Maximize “inbound” (i.e., sales volume/backlog of profitable projects)	•						
Execute EPC projects in accordance with budget and customer requirements		•		•			
Reduce costs by standardizing, developing, and/or sourcing components and sub-systems				•	•		
Develop new technologies						•	
Provide life cycle services (maintenance, support, repair)		•					
Perform enabling and control processes							•

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Table 3 Allocation of accountabilities in the 2015 organizational model

Functions	Organizational units						
	Regional level		Global level			Forsys [external]	
	Sales and marketing	Projects	Operations	Products	Technology	Services	Process staff
Carry out field planning, feasibility, and concept studies							•
Maximize “inbound” (i.e., sales volume/backlog of profitable projects)	•						
Execute EPC projects in accordance with budget and customer requirements		•					
Manufacture product			•				
Reduce costs by standardizing, developing, and/or sourcing components and sub-systems				•			
Develop new technologies					•		
Provide life cycle services (maintenance, support, repair)						•	
Develop and market process technologies							•
Perform enabling and control processes							•

EPC engineering, procurement, and construction

be situations where it is necessary to make trade-offs, for example, between fully satisfying customer requirements in a project versus reaching cost reduction targets. However, based on my interviews, it seemed like FMC Subsea placed considerable emphasis on defining the sub-unit mandates and the resource model (Worren 2012). Whereas the projects are measured in terms of profit and loss (P&L), the product delivery teams now have what managers call a “quasi P/L”: They provide a binding component price to the projects. They are charged for an overrun but also receive the proceeds of a surplus. My interpretation is thus that the product delivery teams are *internal suppliers* to the EPC projects and that the leaders of the product delivery teams and the leaders of the EPC projects do not act as matrix managers with joint decision authority.⁵

The case illustrates that there is a need for more precise descriptions of the formal structure of organizations. In both the practitioner and the academic literature, one has a tendency to confound organizations that are multidimensional (i.e., with units defined based on more than one grouping criterion at the same hierarchical level) with matrix structures (i.e., organizations where some or all employees report to more than one manager). They imply rather large differences in terms of roles and authority relations (Worren 2012), and it becomes hard to describe changes in organizational models, such as those undertaken by FMC Subsea, if one does not make this distinction.

Conclusions

The evolution of FMC Subsea in the 2001–2016 time period shows that the matrix is not an inevitable “end state” for firms that face complex business environments. Instead, it may be a transitory form as firms evolve from a purely geographical (or product based) structure into a multidimensional structure.

Research has shown that many firms that adopt the matrix later abandon it (Burns and Wholey 1993). Early writers such as Davis and Lawrence (1978) anticipated that some organizations that adopted the matrix would find it to be an unworkable design and would return to an earlier structure. However, they did not anticipate the ability of managers to further improve the design. Their assumption was that firms that abandoned the matrix would revert back to a functional structure (p. 226), instead of designing simpler models that can fulfill the same functions as the matrix but at a lower cost due to lower complexity (Ackoff 1999; Worren 2012).

The case described here suggests an alternative option for managers who consider abandoning the matrix and returning to a unidimensional structure. By maintaining the multidimensional structure, but removing the dual reporting relationships, and introducing internal customer-supplier linkages between internal units, one may get some of the benefits of the matrix—but without the costs.

Endnotes

¹The term “industrialization” was coined by a consulting firm and refers to standardization and consolidation in existing firms. It is not synonymous with “industrialization” as defined in the academic literature.

²Following Worren (2012), I define a multidimensional organizational structure as an organization consisting of units reflecting more than one grouping criterion (or dimension) *at the same hierarchical level*. Hybrid organizations, on the other hand, are organizations that consist of units reflecting different grouping criteria (or dimensions) *at*

different hierarchical levels (e.g., they may have regional units at level 2, product units at level 3, and functional units at level 4).

³The relationship between organizational complexity and goal (or functional) conflict is discussed more extensively in Worren (2012, 2016).

⁴It seemed like the product team leaders had their main allegiance to the region in the 2011 model, despite the introduction of the matrix reporting line to the global product unit. Managers stated that the 2011 model led to standardization of some components globally, but also to the introduction of regional product lines that were not standardized.

⁵The differences between traditional matrix structures and multidimensional forms that do not require dual reporting are discussed in more detail in Ackoff (1999) and Worren (2012).

Abbreviations

EPC: Engineering, procurement, and construction

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The firm described in the article has only approved the release of the article itself and not the supporting data (e.g., interview transcripts or internal company documents).

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Competing interests

The author declares that he has no competing interests.

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