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*Why Small Enterprises Can (Still) Operate at the Top of the Pyramid? Evidences and Interstices' Theory in the Automotive Industry**

by Vincent Frigant

The paper questions the widely accepted vision of an automotive supply chain with a very pyramidal structure that works to mega suppliers' benefit. Mobilizing an original survey of 750 French SMEs, we show that SMEs can still operate at the very top of the pyramid and that the different tiers remain porous. The first section explains why the modularization of the automotive industry has led to a pyramidalization of supply chains, enabling the emergence of mega suppliers. The second section shows how some SMEs are still able to rise to the top tier of the supply chain, a process explained in the third section. Using the notion of interstices initially formulated by Penrose, an explanation is provided as to why mega suppliers leave certain market spaces unoccupied, with SMEs subsequently filling in the gaps. The ensuing analytical grid then leads to a conclusion that will highlight two main managerial and political implications.

Introduction

Carmakers have been strongly engaged for 30 years in a trend toward vertical disintegration. One effect has been a significant reshuffling of supply chain architectures and, in parallel, the structure of the companies that operate within the supply chains in question. In terms of the former remark, what we have been witnessing is a long-standing imitation of the Japanese model that is characterized by its pyramidal structure (Cusumano 1989; Fujimoto 1999; Lamming 1993). Modularization has played a key role in the Western world's accelerated implementation of this supply pyramid (Fine 1998; McAlinden, Smith, and Swiecki 1999; Sturgeon and Florida 2001; Veloso and Kumar 2002), which can be described in the following terms:

> The supply base of today's carmakers is structured like a pyramid. On top of the pyramid is the carmaker. Below the carmakers are a small number of Tier 1 suppliers that sell parts directly to carmakers. Tier 1 suppliers in turn purchase materials from Tier 2 suppliers, who purchase from Tier 3 suppliers, and so on down the supply chain. (Klier and Rubenstein 2008, p. 109)

This reorganization impacts directly the nature of the firms involved in the automotive

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industry. More precisely, the modular revolution has led to the emergence of mega suppliers (Donovan 1999) who have captured most of the pyramid's first tier (Frigant 2009). In this view, the only firms capable of satisfying carmakers' demands today are large companies. The current supply chain narrative leaves no room for SMEs in the pyramid's first tier, relegating them to the second tier and often lower (Klier and Rubenstein 2008; MacDuffie 2013).

The question then becomes whether SMEs have disappeared from the top of the supply chain pyramid. At a time when people were just becoming aware of modularity's effects, Herrigel (2004, p. 49) explained that "[t]here are also a very large number of problems with the image of a completely modular automotive industry and hence obstacles to the emergence of the highly concentrated and vertically integrated component industry outlined by Sturgeon, Florida and others (. . .) it is possible to think that there continues to be a very robust space for independent small and medium-sized component production in these industries." Fifteen years later, is his prediction true?

The debate at this level is whether modularity—as a process (MacDuffie 2013)—has ultimately made it impossible for SMEs to rise to the top of the pyramid, in contrast to the hopes expressed by Herrigel and in line with predictions by Sturgeon and Florida (2001) or Donovan (1999). Similarly, it is worth exploring whether the deep crisis that the automotive industry experienced in Europe in 2008/2009 contributed to SMEs' elimination from the top of the pyramid. If the answer to both questions is negative, the focus would then turn to explaining why the modularization of the automotive industry still leaves spaces for independent SMEs.

The answers will come in three stages. The paper's first section will explain how modularity is supposed to stop SMEs from having any direct contact with carmakers. The second will use an unprecedented survey of 750 SMEs in France to show that some SMEs are still able to operate in tier 1. It also demonstrates that certain number of companies in this category operate simultaneously in several tiers. The third section looks for mechanisms explaining SMEs' presence at the top of the pyramid. In an environment marked by the strong expansion of mega suppliers, the interpretation being offered is rooted in the notion of interstices originally formulated by E. Penrose (1959). The debate pitting Herrigel and Sturgeon, Florida, Donovan, etc. against the ideas discussed in the paper's first section suggests a need to think in terms of spaces that mega suppliers have not occupied. The analytical grid that Penrose proposed offers a useful tool for nourishing reflection along these lines and, in the conclusion, we explain that this study raises two issues from a managerial point of view.

Why Modularity Should Have Excluded SMEs from the Top of the Pyramid

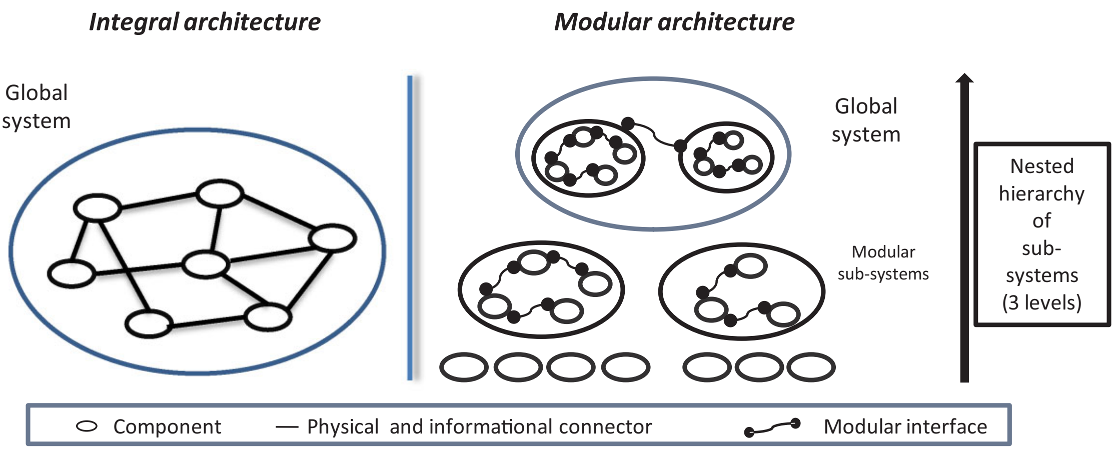
Since the mid-1990s, many researchers have highlighted the organizational consequences of the rise of modularity. Ulrich (1995), Sanchez and Mahoney (1996), and Baldwin and Clark (2000) have asserted that modularity as a design principle has opened the door to a number of organizational transformations. Modularity conveys a mirroring effect, construed as technological and organizational phenomena that are mutually responsive (Colfer and Baldwin 2010).

The Singular Manifestations of the Mirroring Hypothesis in the Automotive Industry

Modularity has been traditionally defined based on the notion of product architecture, or according to Ulrich (1995, p. 420): "(1) the arrangement of functional elements; (2) the mapping from functional elements to physical components; (3) the specification of the interfaces among interacting physical components."

Product architecture is described as being modular when (1) the overall product results from the assembly of different subassemblies (modules) that are functionally autonomous and independent, and when (2) the subassemblies are interconnected by previously defined interfaces whose role is crucial insofar as—once they have been defined—it becomes possible to modify the modules (and even to substitute them) without having to change the overall product architecture. Interfaces are considered "decoupled" in this case. Modules are kinds of simple building blocks (think of Lego) whose assembly lets the product be manufactured in multiple forms. Alongside of this, product architecture is said to be integrated when subassemblies are not autonomous and/or independent and/or when the interfaces are coupled, meaning when there is a need to

Figure 1
Integral and Modular Architecture



redesign the module's rules of interconnectivity to enable its integration into an overall product. Figure 1 offers a schematic representation of these two types of architecture. One significant point at this level, highlighted by Simon (1962), is that a modular product's design consists of building an embedded hierarchy of parts ranging from a global system to simple components and including modules (called modular subsystems in the figure).

From an organizational perspective, this kind of product design helps to increase the architect firm's vertical disintegration (Langlois 2002). This is firstly because modularity deepens the division of labor. It enables a separation of tasks (into design and/or production functions) that could not be dissociated in the past. This is because modular architecture is composed of several independent elements. Standalone working units can be given responsibility for specific modules without undermining the product's systemic integrity. Baldwin and Clark (2000) have shown, for instance, that this was IBM 360's explicit aim. Moreover, such divisions of labor also reach beyond the boundaries of the firm.

The explanation lies to the property of decoupled interfaces which simplify mechanisms of cognitive coordination. The *ex ante* establishment of rules of interconnectivity allows an independent firm to design, propose, and produce modules that can then be transplanted into the general architecture of the product. Once again, it is the example of computer products that is generally used to demonstrate how this property has enabled the emergence of many particularly innovative firms (Baldwin and Clark 2000; Sturgeon 2002). Similarly, due to outsourcing's permissive aspect, it is often viewed as a key source of efficiency for authors like Sanchez and Mahoney (1996), who assert that an efficient use of modularity requires vertically disintegrating the architecture of the firm and getting it to exploit its network of innovative suppliers. Outsourcing is all the more efficient if said suppliers specialize in the production of (a series of) particular module(s) where they can achieve economies of scale, scope, and substitution (Garud and Kumaraswamy 1995). Langlois (2003) has developed this argument and, broadening the perspective, asserted that modularity constitutes a key foundation in large Chandlerian firms' tendency to disintegrate vertically.

Yet alongside this first corpus, a series of studies on Complex Product Systems (Brusoni, Prencipe, and Pavitt 2001; Prencipe, Davies, and Hobday 2003) have developed along more critical lines, stressing the fact that for particularly complex products, the rise of modular principles is hampered by a large number of organizational limitations. One such constraint on outsourcing opportunities is the problem of knowledge absorption (Cohen and Levinthal 1990), relating in particular to different components' variable rhythms of technological progress. Because of the difficulty in anticipating all potential technical interactions between different "modules," cognitive coordination problems are ever-present and weigh heavily on contractual relationships. The "Legoland" that modularity promised remains a myth wherever products of a certain complexity are concerned (Pavitt 2003).

The car is one of these Complex Product Systems (Sako 2003; Takeishi and Fujimoto 2003). Contrary to some predictions (Donovan 1999; McAlinden, Smith, and Swiecki 1999; Sturgeon and Florida 2001), recent studies have confirmed that it maintains a strong integral dimension and that modularity is making little progress. This is largely due to technological reasons (involving the hierarchy of qualitative priorities attributed to a particular product, Gadde and Jellbo 2002); internal traditions affecting vehicle design (Batchelor 2006); habits affecting innovation management practices (Cabigiosu, Zirpoli, and Camuffo 2013; Zirpoli and Becker 2010); and also factors relating to the strategic control of the supply chain and the perceived risks of reduced absorption capacities (Frigant 2011).

Yet saying that the automotive remains an imperfectly modular product does not signify that certain principles of modularity have not penetrated this industry, nor that they have not had any effects. Meta-literature reviews focusing on modularity's organizational impact have shown that the relationship between technological and organizational modularity can be apprehended on different analytical levels. Colfer and Baldwin (2010) were of the opinion that the impact can be studied via within-firm groups, across-firm groups, and open collaborative groups. Campagnolo and Camuffo (2010) classified the articles they analyzed according to whether they focus on a functional or lifestyle perspective or a combination of the two.

In its strongest version, all of these levels can be considered deeply intertwined. The stricter version of the mirroring hypothesis describes a model in which the final product's modular decomposition must lead—by means of organizational isomorphism—to a largely disintegrated architect firm calling upon a vast network of suppliers forced to compete with one another on price/innovation criteria. It is the model described by Langlois (2003) and Sanchez and Mahoney (1996). Yet as both Colfer and Baldwin (2010) and Campagnolo and Camuffo (2010) have indicated, intermediary forms also exist. These are forms where modularity, in its design conception, has certain organizational impacts without ever achieving a so-called pure model. These are organizational forms in which some activities maintain a significant degree of vertical integration and where closed relationships between buyer and suppliers still exist. In short, literature seems to fully validate the idea that modularity has a range of effects.

The automotive industry comprises one such intermediary example. It has broken the modularity construct down along lines that are much more physical than functional, causing authors such as Volpato (2004) to prefer the term "macro-component" to "module." Moreover, actors' hopes of designing interfaces that remain stabilized between one model and the next were quickly abandoned (Sako 2003). However, the concept of interfaces—and the usefulness of determining them early on in the development process—is widely accepted nowadays. In turn, this has led to a partial revision in design methods (Cabigiosu, Zirpoli, and Camuffo 2013). Its current goal is to reduce time-to-market, increase reliability, and enable certain forms of carry-over (to achieve economies of substitution). The automotive product system was profoundly redesigned and turned into a nested hierarchy of susbsytems (AutoBusiness-SSBS 2004; Sako 2003). All in all, most researchers agree nowadays that the automotive has appropriated the concept of modularity in its own specific way and that even if we can no longer talk about modularity in Ulrich's (1995) sense of the term, several mechanisms exercising a modicum of organizational influence exist within this singular appropriation.

The Pyramidalization of the Auto Supply Chain

One of the areas where the concept's particular manifestation has impacted upon the branch's is industrial organization. Fujimoto (1999) has explained that the Japanese pyramid model was possible because carmakers (1) were buying aggregate components; (2) delegating much of the components' design to their suppliers much; (3) and tending toward mono-sourcing. Now, the modular concept was specifically designed for macro-components (seats, rear modules, cockpits, etc.) whose design would be delegated by carmakers to suppliers destined to become unique sources for a particular vehicle model. By so doing, manufacturers (with support from suppliers) were supposed to create an OEM market approximating the properties of the Japanese model. They were laying the foundations for a narrower supply pyramid, with large suppliers then rushing into this space, firms whose rapid internal and external growth would turn them into key supply chain actors. In other words, no more than 15 years ago, carmakers on one side of the market were making significant cuts in the number of suppliers with whom they worked directly (Veloso and Kumar 2002; Whitford and Enrietti 2005), whereas on the other, the emerging mega suppliers were structuring different automotive supply submarkets along oligopolistic lines (Donovan 1999; MacDuffie 2013; Sutherland 2005).

Mega suppliers' emergence clearly required changes in firms' perimeters. Ultimately, this meant SMEs being crowded out from the supply pyramid's top tiers. Three of the cumulative mechanisms triggered by this process led to radical transformations in the selection system that used to prevail. First, to become module suppliers, companies had to develop new competencies (in R&D, components integration, managing their own supply chains, etc.). To win the modularity race that everyone took part in around the turn of the century, suppliers engaged in more and more mergers and acquisitions in an attempt to build up the competencies they needed to design and produce modular subsystems (AutoBusiness-SSBS 2004). Alongside of this, carmakers encouraged follow sourcing, which is when a single module supplier is chosen to supply all of the carmaker factories manufacturing one and the same model. This was another element sparking a search for critical mass and limiting SMEs' ability to position themselves in the modules market. Lastly (and subsequently), module suppliers innovated using modules incorporating more and more technology and functionalities in an attempt to build barriers to entry impeding the arrival of new actors. They did this even as the trend toward greater concentration continued, creating a situation where first-tier suppliers' average size rose all the time (Frigant 2009; Klier and Rubenstein 2008).

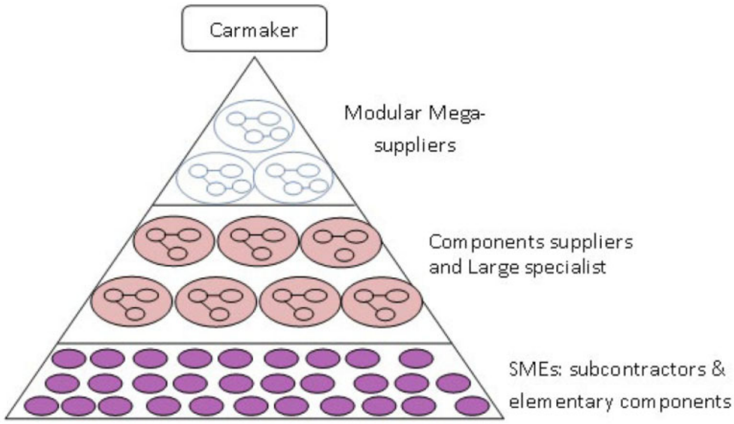
In brief, the modularization of the automotive had led to a transformation in the object of exchange, sparking changes in the supply chain's industrial organization. The trend culminated in the pyramidalization of the supply chain, with the mega suppliers who offered the most strategic components being the only parties entertaining direct relationships with manufacturers.

A stylized explanation is that supply chains were restructured into three levels. The first featured mega suppliers designing and producing modules, whereas the third was for SMEs who had been relegated to this level because they were being restricted to acting as subcontractors or suppliers of simple small parts. The second intermediate level, on the other hand, was more diversified, featuring actors who were relatively heterogeneous in size and made more or less complex products (see Figure 2).

This stylized representation is based on three implicit hypotheses: (1) the existence of a strict isomorphism between product architecture and organization, creating a situation where mega suppliers were the only ones with the ability to manufacture modular subsystems (because major competencies were needed, because carmakers would have to be followed abroad, and because mega suppliers were the only parties who could afford to commit the requisite material and immaterial resources); (2) modules became the only parts that the carmakers were buying, turning automobiles into a simple game of Lego; (3) carmakers were characterized by a constant single degree of vertical integration for all the vehicles they assembled and in all of the different factories where they were producing the same vehicles.

When these three conditions are true, we can suppose that the whole market of auto-parts can be supplied by modular mega suppliers. Yet given automobiles' imperfect modularity (Frigant 2011), it is doubtful that these conditions are entirely fulfilled. As the product architecture is not completely modular, the carmakers need to buy some elementary parts, to subcontract certain tasks, etc. The incomplete nested hierarchy creates spaces of market for small components that other kind of suppliers can deliver. As the degree of vertical integration is not unique, for some plants, some cars, it is necessary to buy some nonmodular parts. As the isomorphism hypothesis is a very debatable issue (Campagnolo and Camuffo 2010), some gaps appear in the image of the Figure 2. There are spaces in the market that SMEs can seize. In the third section, we will

Figure 2
Stylized Supply Chain of a Modular Carmaker



propose a more general explanation of these market spaces, thanks to the notion of interstice, but before that, we need to show that some SMEs operate at the top of the pyramid.

Where Are the French Auto SMEs along the Supply Chain?

There are two methods that can be used to verify whether SMEs are capable of accessing the supply pyramid's top tier. The first consists of asking carmakers for their list of suppliers (one alternative involves using databases like AutoBusiness's *Who Supplies Whom?*) and analyzing the distribution of companies used. The advantage of this method is that it enables an evaluation of the SMEs' position vis-a-vis mega suppliers. It has the shortcoming, however, of not revealing what has actually been happening beyond the first tier. In addition, listings of this kind can be difficult to obtain if only because carmakers consider them highly strategic. The second method consists of surveying a sample of SMEs in a given space and asking them if they are working for the automotive industry, what they are doing in this field, and at what tier of the pyramid they are operating. It is this latter method that was adopted by our survey of SMEs residing in France. It is an unprecedented effort on this kind of scale.

Data and Methodology

Funded by a public sector bank with responsibility for supporting French SMEs, the main purpose of this study is to assess the situation of SMEs working in the automotive industry following the 2008/2009 crisis. The questionnaire was comprised of 35 questions categorized under three headings. The first eight questions were meant to characterize the company, the extent to which it was part of the automotive industry, and the services that it provided. The second heading was composed of 11 questions relating to the company's' current situation and any state aid from which it might have benefited during the 2008/2009 crisis. Lastly, there were 16 questions pertaining to contract practices with prime contractors. The present paper only draws from the first category of questions. This is because of an intuition that the study needs to distinguish between SMEs depending on their position in the supply chain. It also explains the introduction of questions identifying the tier(s) where they have worked, enabling in turn the constitution of a database that would appear to be unprecedented in this field.

The questionnaire was drafted between December 2009 and April 2010 and submitted on three occasions to a control committee comprised of 15 persons representing automotive suppliers, carmakers, university experts in this field, and public sector organizations. Each question was tested using two key criteria; whether it comprehensible to an SME manager and how easy it was to respond. The question was mailed in May 2010 with responses expected by mid-June of that year. Potential respondents were given a reminder by telephone during this period, with the whole consultation process concluding on July 30, 2010.

One crucial aspect in the study is the sample that it constituted. Most of the time, "equivalent" studies build a sample using SIC codes that are directly linked to the automotive business (e.g., The French Group 29.3 Manufacturing of Automobile Equipment) and/or to lists of companies belonging to clusters or business networks that are involved in the automotive business (e.g., France's FIEV Association grouping the country's main automotive suppliers). It remains that this kind of method does not help in identifying those SMEs that operate furthest from the sector.

Toward this end, we compiled a survey sample from an exhaustive list of companies residing in France and operating in sectors that the automotive industry uses intensively.[1] Subsequently, this sample was filtered to only include companies with fewer than 5,000 employees and revenues below €1.5 billion.[2] The sample included 8,740 companies, with 1,340 having responded, a response rate of 15.3 percent. After examining these responses, we added the following supplementary criteria: the company must have derived at least 5 percent of its revenues from the automotive industry,[3] and the questionnaire must be sufficiently thorough to be analyzable. Finally, we obtain 750 answers.

Table 1 shows that our database does not cover all of the economic sectors required to produce a modern automotive. Indeed, the survey methodology does not allow us to cover certain sectors due to our inability to identify relevant companies. In addition, in certain cases, we did not receive any responses. One example here was *technical textiles*, where none of the companies we wanted to survey replied. It remains that the crucial sectors were all represented. *Metallic product manufacturers* are best represented in our database—an unsurprising outcome given this sector's importance to the automotive business. Another major sector is *automotives* themselves (referring here to manufacturing of automotive equipment). Then came two sectors (combined for our purposes): *IT, electronic and optical product manufacturers* (especially the latter two); and *electrical equipment suppliers*. Lastly, note the small number responses from *engineering companies*. This can be explained by the fact that very few small actors operate in this particular field in the French economy.

All in all, the sample is not entirely representative of the companies mobilized by

Table 1
Suppliers' Sector of Origin

Sector (Aggregate Level)	Percentage of Suppliers
Automotive (Equipments)	17.1
Manufacturing of IT-Related and Electronic Products/Optics or Electric Equipment	12.8
Capital Goods	6.3
Engineering	0.8
Manufacturing of Metallic Products	56.8
Metallurgy	2.7
Manufacturing of Rubber and Plastic Products	2.5
Manufacturing of Other Mineral Nonmetallic Products	0.9
Number of Suppliers = 750	100

[1]The selection of sectors studied here is based on research undertaken by the French National Statistics Institute (INSEE), which books automotive industry purchases on a sectorial basis. Thirty-three sectors have been selected (according to four-digit French classification NAF rev.2, 2008).

[2]This threshold refers to a specific category of SMEs: ETIs (enterprises of intermediary size). The French Statistical Office defines ETIs as "[a]n intermediate-sized enterprise (ETI) is a company with between 250 and 4999 employees, and a turnover which does not exceed 1.5 billion Euros or a balance sheet total which does not exceed 2 billion Euros. A company with fewer than 250 employees but a turnover greater than 50 million Euros and a balance sheet exceeding 43 billion Euros is also considered to be of intermediate size."

[3]Since the work was done using data organized by cross-sections, the threshold was kept to reduce the risk of the sample containing companies that only worked in the automotive sector the year that the survey was done.

Table 2
A Few Descriptive Sample Findings (2009)

	Number	Total	Mean	Median	Standard Deviation
Sales (€000s)	747	7,081,773	9,480.3	1,600	34,082.4
Employees	749	39,432	52.6	15	133.9
Total Sales/Auto Sales (Percent)[a]	716	—	77.7 percent	100 percent	35.7

[a]Twenty percent of suppliers do less than 30 percent of sales in automotive sector; 6 percent ∈ [31,60]; 7 percent ∈ [61,90]; 67 percent > 90 percent.

carmakers and automotive equipment suppliers. However, it does provide a good basis for further study. When we compared our data with figures provided by French automotive industry associations, they estimate the number of suppliers residing in France at something like 4,000. Thus, our database represents 18.7 percent of suppliers identified by actors in this branch (18.1 percent in revenue terms).

Companies belonging to the sample generate average revenues of €9.48 million with a median figure of around €1.60 million. Globally, therefore, these are relatively small companies, as confirmed by the average number of staff members as of December 2009: 52.6 employees. This average is lowered by the fact that 36 percent of the sample companies have fewer than 10 employees. At the other extreme, 5 percent have more than 250 employees (with the largest having 1,430 staff members) (see also Table 4 later in this article). Note that the following tables will indicate the thresholds we used (250; 1,500) (Table 2).

Our survey method contained one risk, namely that we would select companies with little relationship to the automotive. The breakdown of the revenues generated by our sample companies by their target customers offers some reassurance along these lines, however. On average, 77.7 percent of sales were in the automotive sector, whether this involved firms working on tier 1, 2, and 3 (and beyond) or spare parts markets.

Without being perfect, the database constitutes an original tool for studying the current situations of French SMEs working in the automotive sector. Notably, it allows us to show that these companies are not in fact really being excluded from the top of the supply pyramid.

Findings: SMEs Can Be First-Tier Suppliers and Multitier Suppliers

A key issue of the questionnaire lies to the identification of the suppliers' tier in the supply chain. In a first step, SMEs had to break total revenues down between "automotive" and "nonautomotive." Then, for "automotive," revenues had to be broken down by counterparts' level of intervention in the supply chain. We asked companies to specify what percentage of their turnover was done directly with carmakers, teaching us which SMEs worked in tier 1. Similarly, SMEs specified turnover by subcontractors/suppliers who themselves worked in tier 1, providing our list of tier 2 companies. Lastly, there was the "tier 3 and beyond" category for companies subcontracting on behalf of carmakers' suppliers. We also envisioned the case of companies manufacturing spare parts. By construction, the sum total of this breakdown had to be 100 percent of the automotive revenues of the companies involved.[4]

This method cannot avoid the necessity of a subsequent choice because an SME can operate on several tiers simultaneously. Indeed, we can consider: (1) the main tier where these SMEs operate; (2) the highest tier that they mention. For instance, consider an SME who achieves 30 percent of its revenues on tier 1, 60 percent on tier 2, and 10 percent on tier 3. With the first method, we take into account where the SME does the highest percentage of revenues: there-

[4]We eliminated any questionnaires that did not verify this rule. The questionnaire included the definition of the idea of tiers (1, 2, 3 and beyond, spare parts) so that respondents would not be confused.

Table 3
Suppliers' Position in the Pyramid (Number of Firms = 715)

	Tier 1	Tier 2	Tier 3 and More	Spare Parts	Total
Main Tier (Percent)	25.9	47.8	21.7	4.6	100
Higher Tier (Percent)	35.5	45.5	16.1	2.9	100

Table 4
Main Tiers in 2009 by Supplier Size

Number of Employees	Number of Suppliers	Tier 1	Tier 2	Tier 3	Spare Parts	Total
[250; 1500]	40	70.0 Percent	30.0 Percent	0.0 Percent	0.0 Percent	100 Percent
[50; 249]	96	35.4 Percent	52.1 Percent	7.3 Percent	5.2 Percent	100 Percent
[10; 49]	334	21.0 Percent	52.1 Percent	22.5 Percent	4.5 Percent	100 Percent
<10	245	21.6 Percent	43.3 Percent	29.8 Percent	5.3 Percent	100 Percent
Total	715	185	342	155	33	—

fore, its *main tier* is 2 (60 percent). With the second method, we take into account the *highest tier* that a company mentions: its highest tier is 1 (30 percent).

Consider the main tier: Table 3 shows that the most frequently mentioned tier is 2: 47.8 percent of all respondents' prime supply chain intervention is at this level, with 21.7 percent operating on tier 3 or further down and only 4.6 percent stating that their main link to the automotive business is their spare parts activity. It remains that the key finding for our analysis is that nearly 26 percent of all the SMEs that we surveyed are first tier suppliers.

Consider now the highest tier that SMEs declare. By construction, this should give us a higher number of firms situated toward the top of the pyramid. According to this second approach, 45.5 percent of SMEs operate at the level of tier 2, and 16.1 percent on tier 3 and below. Only 2.9 percent are attached to the supply chain exclusively because of their spare part market activities;[5] 35.5 percent work directly for the carmakers (tier 1).

This change in focus has only a slight effect on our snapshot. Although we can confirm that the SMEs that answered our survey are primary tier 2 suppliers, it remains that a significant number of these SMEs are also first tier suppliers. Clearly, *this does not mean that SMEs account for a lion's share of the market for outsourced components*. We cannot deny that mega suppliers account for the largest orders (in volume and value terms). Similarly, *we accept that a response bias exists and that the SMEs who respond to our survey are more likely to be ones who feel close to carmakers*. Nevertheless, even if we accept that these figures might be biased in magnitude terms, they still demonstrate that carmakers remain accessible to SMEs. The OEM market is not an exclusive hunting ground for mega suppliers. As such, these findings tend to support the hypothesis that the modularization of the automotive industry has not completely relegated SMEs to the bottom of the pyramid.

Note, however, that among this group of SMEs, there is a relatively clear relationship between size and the main tier where they intervene in the supply chain (Table 4). The large SMEs featuring in the sample do most of their automotive-related revenues either on tier

[5]By construction, these companies do not operate in tiers 1, 2, or 3 since they would have been ranked in one of the preceding tiers.

Table 5
Breakdown of Suppliers by Number of Tiers Where They Operate (2009)

One-Tier Suppliers		Multitier Suppliers	
(*N* = 432)	**60.59 Percent**	**(*N* = 281)**	**39.41 Percent**
First Tier Alone	12.9 Percent	2 Tiers	30.9 Percent
Second Tier Alone	30.4 Percent	3 Tiers	7.6 Percent
Third Tier Alone	14.7 Percent	4 Tiers	1.0 Percent
Spare Parts Alone	2.5 Percent		

1 (70 percent) or tier 2 (30 percent). This relationship between size and tier also applies to companies with between 50 and 249 employees because 35.4 percent of all respondents operate mainly on tier 1, 52.1 percent on tier 2, and 7.3 percent on tier 3 or beyond. Similarly, companies with 10–49 employees are mainly active on tier 2 (52.1 percent). Only 21.0 percent of them operate mainly on tier 1 and 22.5 percent on tier 3. This downward movement also applies to micro-enterprises since 43.3 percent are mainly tier 2 suppliers and 29.8 percent mainly tier 3 suppliers.

The classical pyramidal vision of the supply chain contains also the idea that a clear disjunction exists between the different tiers. The restructuring of the industrial architecture is said to have led to suppliers being clearly positioned at one and only one tier in the hierarchy. Variances between different lines in Table 3 suggest to the contrary that a number of multilevel companies do exist. To explore this possibility, we have listed companies according to whether they state their automotive revenues in terms of one or several tiers (Table 5).

Most companies are only operating at a single tier of the hierarchy (60.6 percent); 30.4 percent of all SMEs are second tier suppliers and nothing else, 14.7 and 12.9 percent of SMEs are tier 3 or tier 1 suppliers alone, and 2.5 percent of SMEs are spare part suppliers alone. These findings seem to support the hypothesis that suppliers' roles are split across the whole of the supply pyramid. However 39.4 percent of all SMEs operate at several tiers simultaneously in one and the same year. Because these figures are snapshot statistics, we suggest a different interpretation of the data, namely that companies' positioning in the hierarchy is less strict than might be assumed with analyses conducted in pyramid terms. A total of 30.9 percent of SMEs operate on two tiers simultaneously, and 7.6 percent operate on three tiers simultaneously. The example drawn here of SMEs operating on all three of the pyramid tiers (and who also supply spare parts) is, however, very rare and only accounts for 1 percent of all suppliers.

Table 6
Distribution of Combinations for Multitier Suppliers

Tiers Occupied Simultaneously	Percent
Tiers 1 and 2	31.0
Tiers 2 and 3	29.2
Tiers 1 and 2 and 3	10.7
Tiers 2 and Spare Parts	8.5
Tiers 1 and 2 and Spare Parts	6.0
Tier 1 and Spare Parts	5.3
Other Combinations (Four Possibilities)	9.3
Total (*N* = 281)	100

Table 6 shows that multitier companies' most frequently observed combinations are between neighboring tiers and combine two levels. Out of the 281 multitier SMEs, 31.0 percent operate simultaneously on tiers 1 and 2, with 29.2 percent operating simultaneously on tiers 2 and 3. Another frequent combination consists of supplementing one's direct involvement in the supply chain by the manufacturing of spare parts. This is the case for 8.5 percent of tier 2 suppliers and 5.3 percent of tier 1 suppliers. Six percent of multitier suppliers intervene on tiers 1 and 2 and also manufacture spare parts. Lastly, 10.7 percent of multitier companies (or 4.3 percent of all SMEs) operate on tiers 1, 2, and 3.

All in all, whereas a majority of SMEs taking part in the supply chain intervene on one single tier alone, it is important to avoid the conceptual trap that consists of considering that the pyramid in question has been structured once and for all. Crossover possibilities do exist between different tiers. Many suppliers are simultaneously present on several different supply chain tiers.

Relationship between the Tier Where an SME Operates and the Tasks It Performs

Although the survey provided few empirical explanations for SMEs' positioning in the pyramid (with its conclusion looking at this aspect in greater detail), two elements are worth emphasizing. First, the sector to which a company belongs seems to have played a role in its supply chain positioning (Table 7). This finding is not unexpected given that the sector amounts to a company's main activity. Moreover, it is logical that the closer an activity is to the automotive business, the higher a company operates in this pyramid. Thus, companies that make automotive supplies are more present at the top of the hierarchy that the others, with 52.5 percent operating in tier 1. Conversely, SMEs producing electronic and electric products appear to be positioned more in tier 2, although 27.2 percent of them operate exclusively in tier 1 and/or beyond. SMEs producing metal or metalwork products have much less of a presence in tier 1 and tend to operate towards the bottom of the pyramid (53.8 percent in tier 2 and/or beyond) with 16.1 percent working solely in tier 3.

A second piece of information relates to the actual tasks that the SMEs perform. In the questionnaire, we asked suppliers to describe the services they fulfill on behalf of the automotive industry. These are qualified by two elements. First is the characteristics of the elements provided (we do not consider here engineering companies or SMEs that only produce spare parts); a distinction is made between simple and complex parts (the latter defined as subassemblies derived from the assembly of different components). We then asked companies whether a research and/or development

Table 7
Tier(s) Occupied in 2009, by Suppliers' Sector of Origin

	Only Tier 1 (Percent)	Tier 1 + Another Tier(s) (Percent)	Tier 2 (Percent)	Tier 2 + Another Tiers (Percent)	Only Tier 3 (Percent)	Other (Percent)
Auto	22.5	40.0	10.0	7.5	8.3	11.7
IT, Electronics, Electric	16.3	10.9	39.1	9.8	16.3	7.6
Metallic Products + Mettalurgy	9.7	16.1	34.5	19.4	16.1	4.3
Other	11.5	29.5	29.5	7.7	15.4	6.4

Thanks to χ^2 test, we reject the hypothesis of independence ($\chi^2 = 94.03$; $p = .0000$).

activity was involved. Combining the two, we were able to construct Table 8.

We retain two essential ideas from the Table 8. The first is that, all things remaining equal, the more complex the service being provided, the greater the probability that the SME in question will be operating toward the top of the hierarchy. The first major distinction here is between complex and simple parts. The former tend to be made by suppliers positioned on the first tier. Adding R&D services increases the probability of becoming a tier 1 supplier, whether exclusively or partially.[6] Conversely, suppliers manufacturing simple parts without R&D activities tend to be situated toward the bottom of the pyramid.

The word "pyramid" is not being used by happenstance. Tables 4, 7, and 8 suggest that there is indeed a form of hierarchy within SMEs. The probability of rising up the rankings depends on the sector to which the company belongs, the parts that it is manufacturing (and whether SMEs are enhancing them through R&D), and lastly, size. Two things must be remembered at this level, however. First, some SMEs have continued to operate at tier 1 of the supply chain. Second, although it seems possible to identify determinants explaining this ability to rise up the hierarchy, the link is not entirely deterministic. Some SMEs producing very small simple parts made out of plastic or metal still make it to the top of the pyramid.[7]

Explaining the Presence of SMEs at the Top of the Pyramid: Interstices Exist in the Automotive Supply Chain

SMEs' presence in the pyramid's first tier might be explained by the fact that the three conditions outlined at the end of the first section have not been validated (isomorphism between modules/mega suppliers; perfectly modular cars, irrespective of the production location). What might remain here are products/services purchased by carmakers from SMEs who are more or less picking up whatever is left due to modularity's imperfections. With the ongoing modularization of the automobile (MacDuffie 2013), however, SMEs should inevitably lose opportunities to get to the top of the pyramid. This explanation, given by Sturgeon and Florida (2001) more than 10 years ago, has yet to be materialized, implying a need for more thinking about the dynamics driving automotive components markets. The hypothesis here is that mega suppliers refuse or are unable to cover carmakers' needs in their entirety. In a competitive environment whose mechanisms all seem to favor mega suppliers, saying that they are structurally incapable of capturing the whole of the market provides a possible explanation for the diversity of SMEs operating at the top tier, as revealed in this study. Choosing this approach renews the thinking of Edith Penrose, who was the first to theorize this situation thanks to her interstices notion, based on large firms' defection from certain markets.

Back to Penrose: The Three Sources of Interstices

In chapters X and XI of her book *The Theory of the Growth of the Firm*, Penrose (1959) tried to understand why large firms are incapable of covering the whole of a market. An initial way of answering was to say that SMEs possess structural advantages (optimum market size, flexibility, greater entrepreneurialism, etc.) enabling them to be more competitive in specific productive areas. At the same time, Penrose felt that a more general explanation should be found. It is while trying to define the "fundamental forces at work" (p. 222) that she developed the notion of interstices.

Penrose's idea was that when these large companies are in a growth phase, they neglect market spaces that she calls interstices, with SMEs filling the void: "The productive opportunities of small firms are thus composed of those interstices left open by the large firms which the

[6]"CC" (38 employees in 2009) is a good example of an SME who began its activity in 1993 as a pure subcontractor for Citroën producing door panels by hardboard thermoforming. In a second step, the SME developed RD activities. Nowadays, it designs and manufactures reinforcement parts for trunk (backseat lid, spare wheel cover, removable load floor) and interior (technical parts under carpet) from natural materials (wood and biomaterials). CC is mainly a second tier supplier but it also supplies directly some carmakers.
[7]Just two examples from our database: "AA" and "BB" are mainly first tier suppliers. "AA" manufactures thermoplastic seals for handbrake levers and gear boxes; "BB" produces valve guides, camshaft plug ends, and vacuum pump plug ends.

small firms see and believe they can take advantage of" (Penrose 1959, pp. 222–223).

What remains to analyze is why large companies—even once she posited their intrinsic superiority (in terms of their ability to fund investment, undertake R&D, achieve economies of scale, etc.)—are unable to occupy the whole of a market and, by so doing, crowd out the SMEs. Penrose's reasoning was rooted in her resource-based theory of the firm. In her view, the corporate accumulation of resources is discontinuous and happens at decreasing speed. Thus, in a growing market—such as the automotive subcontracting market, due to the interlinked effects of rising production volumes and growing outsourcing—mega suppliers were unable to expand as quickly as the overall market did.

Interstices derive from a general principle of market segments abandoned by large firms arbitrating between different productive opportunities and calculating their comparative advantages before choosing in which market segments they are best able to leverage their resources. Given the imperfect divisibility of resources, their growth is necessarily discontinuous and advances in a nonlinear manner. The end result is that for a certain level of resources, they will occupy markets with the highest relative profitability, leaving other markets (considered less profitable) to SMEs.

The initial mechanism explained why in a stabilized market, a stock of active SMEs can be observed. This was supplemented by a second mechanism justifying the ongoing entry of new actors, potentially SMEs, linked to market transformations caused by technological progress (Penrose 1959, pp. 223–224). At this level, interstices are created by the rate of innovation and introduction of new technological fields. It is true that large firms can occupy these areas, but SMEs can also get involved, in particular because the large firms have difficulties to manage radical innovations (Henderson and Clark 1990; March 1991).

Lastly, a third mechanism of a relatively different nature also explained SMEs' presence: We call it "artificial interstices." Penrose did not explicitly formulate this mechanism although she did detail its contours in Chapter X, where she wrote in depth about barriers to entry, notably stressing their role in generating interstices. By artificial barriers, she meant the strategic barriers that firms establish (Penrose 1959, p. 230). Restructuring her arguments

Table 8
Tier(s) Occupied in 2009, by Products Provided

	Only Tier 1 (Percent)	Tier 1 + Another Tier(s) (Percent)	Only Tier 2 (Percent)	Tier 2 + Another Tier(s) (Percent)	Tier 3 and Tier 3 + Another Tier(s) (Percent)	Total (Percent)
Simple Parts	10.8	16.0	35.1	17.7	20.3	100.0
Complex Parts	10.9	26.6	25.0	21.9	15.6	100.0
Simple Parts + R&D	12.1	31.2	29.1	17.7	9.9	100.0
Complex Part + R&D	21.2	36.4	24.2	11.1	7.1	100.0

Only spare part suppliers are excluded here. We do not consider engineering firms. Thanks to χ^2 test, we reject the hypothesis of independence ($\chi^2 = 38.88$; $p = .0001$).

might help us to update this third mechanism. Interstices can appear when a prime contractor intentionally calls upon SMEs instead of larger rivals. In a modularity context, this is redolent of the Intel Inside syndrome, which describes the reversal in market power that has been so beneficial to this module supplier and detrimental to the computer assembly companies that dominated for so long in this value chain. In the wake of modularity's rise, such risks were evoked very early on in automotive literature (Murray and Sako 2000), with carmakers reacting quickly by developing strategies to avoid the danger (Frigant 2011). A variant involves situations where prime contractors are being subjected to local regulation in their internationalization strategy. Thus, in regulated markets (by example defense or state-run utilities), counter-trade is a current practice. Even outside such markets, prime contractors who are internationalizing can be obliged to source a certain percentage of their inputs from local SMEs.

Whether one tracks Penrose's thinking closely or offers a broader reading thereof, her general thesis was that in a market experiencing a dynamic form of growth (in the sense of twinning quantitative growth with qualitative disruptions), interstices will appear and be rejuvenated in a way that allows SMEs to build up a lasting presence. The question then becomes whether such interstices can be identified inside the auto industry. Consideration should be given here, in turn, to the three kinds of interstices highlighted by Penrose.

Mega Suppliers' Trade-Off between Different Profit Opportunities

Penrose's main argument revolved around the idea that large firms are disinterested in some market segments because they do not see them as offering sufficient profit opportunities. This argument can be detected in the automotive industry through a study of the mega suppliers' productive trajectories over the past few years.

For this population, the transition to modularity has seemed like an opportunity to increase margins by specializing in the production of modules (Fourcade and Midler 2004). Given the principle of components' aggregation, the idea of offering a complete module automatically enables the vertical integration of several production phases, hence the aggregation of several stages of the value chain (see Figure 1). The initial effect is compounded by the rising power of the design function, given the fact that a leading aim for many carmakers has been to delegate more and more R&D. In turn, this has had two effects: higher R&D costs that can be (partially) funded by customers themselves, and innovation rents that can be captured by those suppliers who are capable of designing singularly innovative modules. This explains why innovation has become, more than ever, a strategy that mega suppliers use to differentiate themselves and tie in carmakers. Clearly, a strategy of this sort requires a redefinition of the scope of firms' internal competencies. From the late 1990s on, large suppliers engaged in major restructuring efforts to build up their technological and organizational competencies by focusing on complementary technologies allowing them to acquire sufficient resources to make the modules that they deemed important (AutoBusiness-SSBS 2004). As per Penrose's approach, this also caused the abandonment of certain market segments, illustrating real strategic shifts in market positioning. The outcomes of these processes would become a key element in the creation of market interstices for SMEs producing small parts (as thermoplastic seals, valves . . . as we noticed at the footnote 7).

This repositioning in the modules market combined with an acceleration in carmakers and mega suppliers' internationalization (Frigant 2009). During the 1990s, follow sourcing became a major constraint that manufacturers started forcing on everyone else, obliging suppliers to deploy resources that they would then be unable to mobilize elsewhere. A second key point should also be raised at this level, particularly in Europe, where market stagnation and, conversely, growth in the emerging markets induced suppliers to modify their geographic priorities. In recent years, China has become a priority for development. Using Penrose's terminology, we might say that China offers a profit opportunity reserve that should not be missed. In a framework defined by limited resources, mega suppliers emphasize emerging markets nowadays and no longer seek to fill in interstices on European markets. In turn, this leaves more room in the latter for national/European SMEs.

Market Transformations

The automotive industry is often presented as technologically stable. We might remember that it has been used as an exemplar for Dominant Design theory (Utterback 1994). However, a closer look reveals that it is also marked by recurring technological innovations (Beaume, Maniak, and Midler 2009; Newcomb and Spurr 1989). This divergence in interpretation can be explained by the fact that innovations are generally incremental in nature. Innovations usually affect elements that are peripheral to the global and/or emerging system for Premium models, before being disseminated across more common models. An innovation process of this sort leaves much room for SMEs.

When we consider radical innovations such as electric vehicles (hybrids, plug-in hybrids, battery electric vehicles), mega suppliers seem to play also a key role in particular via agreements and joint venture with carmakers (Vitali 2012). Yet alongside of this, mega suppliers refuse to invest certain areas that seem too distant from their core competencies. Indeed, many components have had to be invented or re-invented for specific automotive uses (Vitali 2012) meaning that, depending on their specific trajectory, mega suppliers will not necessarily develop all of the human and material resources that they require. Some of these will then be offered by large companies originating from other sectors although if—as per Penrose's first mechanism—such companies consider the profit opportunities insufficient, SMEs will also have a chance to enter the market[8] (Dodourova and Bevis 2012). Over time, there is a chance that this market will consolidate, with the SMEs in question becoming large firms or else taken over by other market firms. But taking a snapshot of the market such as it presents itself today, SMEs of this kind are bound to be present at any and all times.

Following on from this argument, we might say that whenever radical innovations occur (like electric vehicles today), carmakers generally react with highly heterogeneous outsourcing strategies. This diversity tends to persist, although it is generally stronger during emergence phases. Ford and Toyota have, for example, developed highly differentiated supply chains for the production of electric vehicles. Ford has entrusted most of its integration operations to the mega supplier Magna, whereas Toyota has more or less integrated the whole of its value chain (purchasing a few generic components from international electronics suppliers). These different strategies imply a variety of productive opportunities for mega suppliers who, because they face high fixed costs, are reluctant to penetrate this market, allowing SMEs to position themselves in its first tier. Given these variations in the degree of vertical integration, a particular SME serving a manufacturer from its tier 1 position might also work out of tier 2 with another manufacturer if the latter has structured its supply chain differently (example of Ford whose chain is de facto managed by Magna).

This phenomenon can also be witnessed, to a lesser extent, with traditional gasoline-driven vehicles. Gadde and Jellbo (2002) and Batchelor (2006) have shown that vehicles' modular breakdown varies from one manufacturer to another, reflecting interbrand variations in vertical integration practices (definition of core business). The end result is that even if some elements are purchased by carmaker *X* in the form of complete modules sourced from a particular mega supplier, another carmaker might decide to continue making this same element internally and call upon several suppliers to provide the necessary components.[9] These can be mega suppliers who have maintained their component branches—or else SMEs, if mega suppliers have abandoned the market segments in question to position themselves solely in the modules business.

This heterogeneity is amplified when we consider the different plants that carmakers have been building worldwide models (Herrigel 2010; Jullien, Lung, and Midler 2013). For any carmaker *X*, not all plants feature the same degree of vertical integration, even if they produce similar or almost similar, hence the

[8]Dodourova and Bevis (2012) provide several examples of English SMEs who develop innovative products to the new segments emerging around the development of environmentally friendly cars.

[9]A German Premium car manufacturer considers that assembling an exhaust system module constitutes one of its core competencies and purchases most of its parts from the French mega supplier Faurecia—while also buying a few complementary parts enabling the production of a complete module from SMEs located nearby (interviews by the author). In the same way, "CC" (footnote 6) supplies the same parts to carmakers or mega suppliers according to the organization of the supply chain.

existence of elements purchased in small volumes that mega suppliers soon decide to abandon because they offer very few profit opportunities. This problem accentuates when manufacturers adapt vehicles locally to better fit host country consumers' demands. One example is a German carmaker's model that, despite its global positioning, has been extended to the Chinese market. Here, although the basic model shares many modules, due to the fact that no major supplier wants to build production capacities for this one model produced in one single plant, the company has to rely on local firms to get the components that it needs.

Artificial Barriers

Internationalization sometimes subjects manufacturers to local contents rules forcing them to incorporate a certain percentage of locally produced components. This creates two situations that are beneficial to SMEs.

The first is when the scale of final local production is insufficient to motivate mega suppliers to build plants locally. When transportation costs and customs tariffs are low, module imports become feasible. However, if these two conditions are not satisfied, the carmaker can transform its production process in order to call upon local SMEs. The second situation arises when major modules cannot be imported. In this case, the assembly process remains more or less identical but, to respect local contents rules, the manufacturer buys a maximum of simple components from (or subcontracts tasks to) domestic firms. Here again, if few carmakers maintain a presence in the country in question, large suppliers can be expected to predict that it offers few profit opportunities and drop out of these markets, to be replaced by local SMEs (Jullien, Lung, and Midler 2013). However, in the European example, it should be noted that this kind of configuration has little credibility, given the European Union's commercial policy and density of carmakers present in this region.

One situation that is often encountered in Europe involves carmakers who want to maintain, for some of their supplies, control over their supplier network. For some kinds of production, carmakers want to have suppliers who are small enough to be controlled strictly (qualitatively and quantitatively). This involves the creation of what Penrose called "protected areas" where the prime contractor artificially maintains a stock of dependent SMEs. This situation appears in two cases. First is when the carmaker wishes to explore some new technological areas (like life-on-board entertainment). A closed relationship with a small (and dependant) specialist is a good way to capture exclusive ideas and innovations (Nieto and Santamaria 2010). Second is when the carmaker wishes to preserve its market power (against mega suppliers): SMEs remain a good way to cut the procurement cost on certain generic components (Chanaron 2013).

Conclusions

The automotive supply chain has often been described using the metaphor of an Egyptian pyramid that is very pointy at the top (corresponding to the first tier where only a few fast-growing global mega suppliers operate). In this vision, the second tier is comprised of large regional suppliers and a few specialist SMEs. Beyond this, we are supposedly at a level that hosts a myriad of SMEs operating on a subcontracting basis.

Using French data, we have demonstrated that a number of SMEs have been able to rise to the very top of the pyramid. In addition, contrary to the overly stylized vision, the tiers' hierarchy is not as strict as scholars often suggest. Indeed, it might be more accurate to speak of it as a specific case or as a consequence of the fact that modularity (the main source of a pyramid's restructuring) has not yet produced all of its effects, as Sturgeon and Florida (2001) suggested. One view is that over time, forces of modularity transform the pyramid's shape, with mega suppliers ultimately eliminating SMEs from the top. We argue the opposite. Basically, the presence of SMEs can be explained by the presence of Penrosian interstices that have all the reasons in the world to (1) exist and (2) survive in the context of an automotive sector defined by imperfect modularity.

Our study raises two issues from a managerial point of view. First, if SMEs wish to seize the interstices, they need to develop competitive intelligence in order to understand where the interstices are. They need to reinforce their capabilities to understand the evolution of market and the strategies of mega suppliers and carmakers. But competitive intelligence is often costly and managers are more or less reluctant to engage expenditures on this field (Raymond, Julien, and Ramangalaby 2001; Tarraf and Molz 2006).

With this in mind, it seems advisable that public policy and/or business networks (clusters, industrial associations, etc.) gear their SME support actions around competitive intelligence. Using Penrose's analytical grid, three kinds of watch functions would have to be developed. The first involves monitoring changes in products and technologies to identify emerging markets. Analyzing carmakers and suppliers' product strategies makes it possible to at least partially anticipate technologies that are in the process of being developed, thereby identifying any interstices taking shape. In the automotive business, for instance, monitoring patents helps to identify which technologies are being developed by carmakers operating on a very upstream level (manufacturers today already register patents that they will only start using in vehicles in four or five years time). Simultaneously watching what suppliers are doing makes it possible to perceive possible new markets. Where this involves innovative SMEs, their less innovative counterparts can benefit from watching buyers' internationalization strategies.[10] Lastly, there is also a possibility of monitoring changes in the regulations affecting product definition (i.e., environmental regulations) or how markets operate (i.e., local contents ratios) to ascertain potential opportunities.

The second managerial implication involves changing some SME or management consultancy executives' mindset. Starting with the assumption that the first tier is reserved for mega suppliers, then logically, the former will no longer try to market to carmakers, with the latter discouraging them from doing this and offering instead strategic plans whose purpose is to get them to specialize as tier 2 or tier 3 suppliers. What this study has shown is that this kind of abnegation can sometimes be premature. Keeping sales staff who entertain good relations with manufacturers and continue to offer them some kind of service is not necessarily a waste of resources. Clearly, this raises questions about the equilibrium point between the cost for this kind of commercial investment and the possibility of slipping into an interstice. The present study hits its limits here, however.

The reason is its inability to answer the question about what kind of SME is most likely to find interstices to operate in. What has been revealed is that larger SMEs—and firms coming from specific sectors and/or offering complex products—have a greater chance of ascending the pyramid. But more variables would be needed (company age, proximity to manufacturers, R&D intensity, turnover, exports, etc.) for a statistical study providing a rigorous response to this question and identifying tier 1 SMEs' typical profiles. Still, by demonstrating that such SMEs do exist, the paper is laying the foundations for future studies of this kind. Otherwise, by providing an explanation grounded in market interstices, it can also claim to help select relevant variables that will be needed to conduct a study of this kind in the future.

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[10]For instance, one public sector French organization, realizing that a French airplane manufacturer wanted to build a factory in North Africa (and was trying to work with local companies to embed itself more deeply there), prospected French SMEs to try and get them to move to the country in question and act as its supplier.

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