DEVELOPING INNOVATION IN SMALL-MEDIUM SUPPLIERS: EVIDENCE FROM THE ITALIAN CAR INDUSTRY

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Abstract

Small-medium firms represent more than 90% of Italian firms, 50% of Italian production and 2/3 of employment and they need support in innovation process especially in known technology. The small-medium firm, in fact, operates chiefly in medium to low technology sectors, but cannot for this reason reject innovation. Suppliers are often too small to make the necessary investments in training, computer systems, research and development to make an effective partnership with final producers.
Within this scenario the behaviour of the small-medium car suppliers is quite different, vertical disintegration, reorganisation of the supply base and the development of buyer-supplier relationships have undoubtedly changed the role of suppliers in the carmaker's strategies.

Keywords: Small medium firms, innovation, car industry

JEL: L2, O32, L62

1 Introduction

This paper analyses the innovation patterns of 25 small-medium car suppliers of the district of Turin. All the firms were face-to-face interviewed using an unstructured questionnaire. The research was performed in 1998.
The paper is part of a wider research of the technological needs of the small-medium Italian firms, promoted and funded by the Ministry of the University, Scientific and Technological Research and co-ordinated by the Centre of Studies of the Italian Manufacturers' Federation.
During the selection of the firms, significant relevance was assigned to car suppliers to evaluate the product and process innovation processes of small-medium firms conditioned by a large final buyer. One of the quickest ways to learn is to develop imitative capacities to exploit existing technologies and, in particular, those tested by large final producers such as car manufacturers (Gadde and Hakansson, 1994).
Three aspects will be investigated:

- although the sample is not significant, this has not excluded the possibility of testing the role of small-medium firms in the new automotive supply chain;
- secondly, some remarks about the innovation capabilities expressed by the firms will be made. The aim is to point out the sources of innovation, as well as the factors determining innovation: technology transfer, the role of sub-suppliers, the relationships with external research institutes, the obstacles to innovation and so on;
- finally, the paper analyses the impact of the strategies adopted by the car manufacturers to support the product and process innovation processes of their small-medium suppliers.

2 The role of small car suppliers in the reorganisation of the supply base

In recent years car suppliers have been influenced by a profound and on-going reorganisational process (Lamming 1993), which particularly involves small firms that were once used to working as suppliers of production capacity and are now ever more involved in decisional activities for the final product (Bonaccorsi, 1997).
The active involvement of suppliers in the car industry took place step by step: logistic integration, just in time and product development have been added to deverticalisation in production (Lamming, 1993).
At present, for American and European carmakers, the buyer-supplier relationship continues to be extremely tense due to the radical strategic changes made by final producers. In general, the Japanese model is progressively being introduced, where:

- internal production is less than 30% of the total value of the product. For the most part Japanese carmakers have maintained control of the production of the engines, the powertrain, the chassis and the body;
- the number of direct suppliers is limited to a few hundred, many of which are responsible for the assembly of modules of components. Using direct contact with primary suppliers, the Japanese tiering structure makes the control of sub-suppliers easier;
- long term contracts allow cost reduction planning and stabilisation of profits;
- the components developed by suppliers are a large part of the total value of the project (up to 70%).

The only aspect not yet pursued by Western firms regards the financial control between suppliers and buyers through crossover share investments (keiretsu) or associative ties (kyoryokukai). In the United States and in Europe increasing competitivity among assemblers

have transformed growth strategies from the acquisition of suppliers to the take-over of competitors, moving resources from vertical to horizontal integration (Calabrese, 1997).
Purchasing tactics in the automotive sector may therefore be synthesised into three consequential strategic tendencies: marked vertical disintegration, the reorganisation of the supply chain and the development of the buyer-supplier relationship.

2.1 Vertical disintegration

Vertical disintegration has undoubtedly contributed to the growth in the role of suppliers in the final enterprise's strategies (Lamming, 1993). Nowadays, the choice of outsourcing dodge hierarchy or market trade-off, where purchasing (buy) is preferred to internal production (make) if economies of scale or co-ordination costs are modest (Williamson 1975). In car industry, outsourcing is not focused only on minor added value components, but interests specific production processes which call for increasingly complex technology in order to improve efficiency, optimise investments and processes, increase flexibility margins and lower the break-even point.
Moreover, rigidity in the use of the work force, diseconomies of size, growing specialisation for limited phases of the processes, the increasing complexity of the products, the tendency to eliminate warehouses, the propensity to reduce the incidence of fixed costs and investment rigidity, all foster vertical disintegration.
The suppliers involvement therefore represents a source of flexibility and permit carmakers to meet unexpected changes in demand more quickly (Wells and Rawlinson, 1994).
Thus design deverticalisation is added to production deverticalisation to identify a unique responsibility for each component. The data in table 1 relative to the process of vertical disintegration in Fiat Auto are remarkable.
Common product development requires more co-operation. All the communication channels between the final producer and the suppliers have to be multiplied and intensified.

Table 1 - Vertical disintegration in Fiat Auto (%)

	1982	**1987**	**1992**	**1996**	**1998**
Production	50	52	65	70	70
Product development	30	30	45	59	70

Source: Fiat Auto

2.2 Reorganisation of the supply base

In stable market conditions the final producer's advantage comes from increasing the number of suppliers that do not prove large technological differences; relations are standardised and the great number of suppliers encourages price competition. On the contrary, the identification of specific know-how within each component concentrates the attention only on the suppliers able to guarantee high standard and continuity in quality.
The supplier evaluation mechanism traditionally based on price is integrated with other criteria: technological know-how, reliability and quality, consignment precision and the ability to develop new products. Productive capacity is no longer a sufficient requisite, design capability must also be implemented (Clark and Fujimoto, 1991). Optimum efficiency is not

longer expressed in terms of productive processes, since a correctly design definition allows greater optimisation of the cost of the new component (Bonaccorsi and Lipparini, 1994).
In parallel the product is simplified, with a reduction in the number of product lines per model and the implementation of modules.
The sum of these factors causes an inevitable reduction in the number of direct suppliers, potentially few firms per product unit. In 1992 alone the suppliers of European and American producers ranged from the 700 at Fiat Auto to 2,000 at General Motors, while the number of Japanese suppliers was well below 200 (Toyota 196, Nissan 195, Honda 155) (Wells and Rawlinson, 1994). Currently the direct suppliers to Fiat Auto have been further reduced to 340 and those of General Motors to less than a thousand, with further concentration of purchases on the main suppliers. In fact 90% of the total supplies to Fiat Auto comes from 130 firms, and in the case of the last compact model as much as 80% of the supply value comes from only 64 firms.
This has caused profound changes in the supply base.

- Firstly, a layered system of primary and secondary suppliers is set-up on the basis of the supplier capability to satisfy the new carmaker's needs. Many of the excluded firms from the primary level are downgraded to the role of sub-suppliers. This is not necessarily a negative situation for these firms. We shall see shortly how the sub-suppliers of our sample have registered on average the highest rate of turnover growth in the period 1992-96.
- Secondly, tier-one suppliers are classified on product complexity: suppliers of modules, of complex components, of single and standardised parts. Each typology requires a different purchasing approach. From researches carried out by Kamath and Liker (1994) we can see that among tier-one suppliers of Japanese carmakers only a dozen of these has a total partnership relationship; whereas the intensity of the linkage of the remaining suppliers is proportional to the importance of the supplies. According to Kamath and Liker primary suppliers can be grouped in partner, mature, immature and contractual. This is, perhaps, the most relevant and comprehensive taxonomy for car suppliers that are often generically identified by the term of components. In reality components stand for those suppliers of non-generic products designed exclusively to be incorporated into the final product. Closely linked to car industry many other firms operate. They produce dies and equipment, design and engineering studies, prototypes, etc., which can engage in similar supply relations with the carmaker.

After all, tiering simplifies the communications process in that final producers limit their contacts to the direct suppliers which co-ordinate the other tiers. Classification renders communication efficient in that it denotes the correct attitude to adopt with each supplier.

2.3 Development of the buyer-supplier relationship

The change from contractual relationship towards partnership induces the progressive integration of buyers and suppliers which becomes evident in the institution of specific co-ordination mechanisms (co-design, self-certification, self-qualification, just in time, etc.) and the widespread use of information technology (Lamming, 1993). In this way, intense co-operative activities are initiated between final producers and their suppliers, which are embodied in the sharing of operative and financial advantages, and in the formulation of specific and long-term links (Camuffo and Volpato, 1997).
However, the sum of these transformations could be ineffectual were they not accompanied by the research for cultural integration to encourage the overcoming of resistance and barriers (Sandell, 1994). Above all, there is the need to speed up the unlearning of consolidated practises such as: short term view on single supply operation, contingency tactics, reluctance

to abandon (buyer) and take on (supplier) specific know-how of the production process, reciprocal lack of trust, and so on. Secondly, partnership must be seen as a common path of reciprocal learning, leading to change and the overcoming of inevitable incomprehensions and difficulties. In particular, it must be evident that the consequences of the assumption of specific choices do not only affect the buyer but involve the other partners as well.
Just in time and co-design are the most important co-ordination mechanisms in production and process deverticalisation and wouldn't work if they were not self-regulated by delegation measures like self-certification and self-qualification.
In the first case, the supplier guarantees the consignment of the components and certifies their conformity to predefined standards, in this way acceptance checks and quality control within the car manufacturer's plant are eliminated. In the second case, the supplier guarantees that the new component conforms to all product specifications. By the use of self-qualification, checking and testing are delegated to the supplier who personally guarantees the product and process qualifications and the certification of the production equipment.
The buyer-supplier relationship is a path, which may require a small supplier to participate in specific support programmes organised by the buyer. These are aimed at reducing the costs of non quality, encouraging the process of growth and reciprocal adaptation, explaining the final producer's organisational culture and focusing the supplier's attention on innovation potenciality. A key factor in this context regards the joint management of human resources through common training programmes and the transfer of the buyer's personnel to the supplier to compensate for outsourcing.

2.4 An empirical test for small-medium firms

In 1996, the 25 car suppliers analysed in this paper employed on average 120 employees and had an annual turnover of 16 million of Euros. According to the categories for employees adopted by the European Union, 4 firms must be considered small (less than 50 emp.), 16 small-medium (from 50 to 150 emp.) and 5 medium firms (from 150 to 250 emp.) (Table 2).

Table 2: Distribution of the sample by employees and turnover (1996)

Employee size	**<50**	**from 51 to 150**	**from 151 to 250**	**Total**
Number of firms	4	16	5	25
Turnover size (mil. Euros)	**<7**	**From 7 to 21**	**From 21 to 40**	**Total**
Number of firms	3	16	6	25

Source: Ceris-CNR

Balance sheets show a more than satisfactory financial situation. On average ROE is equal to 13.3, ROI is 8.4 and ROS 7.1. Export is 31,5% of turnover.
The statistical insignificance, together with the quantitative and territorial limits of the sample analysed in this study do not exclude, however, the possibility of carrying out an empirical test of the role of small-medium suppliers in the reorganisation of the car filiere.
Firstly, the firms in the sample have amply benefited from the deverticalisation process in the car sector. In fact, from 1992 to 1996 turnover has increased by +93 % and employment by +33. There is a positive, but very weak, correlation between size and growth in turnover (0.23), an evidence that even small firms have been able to benefit amply from the deverticalisation process. Correlation is still weak but negative (-0.17) between growth in

turnover and the classification of firms according to product complexity. Sub-suppliers' turnover has increased on average by 121% and that of mature suppliers by only 58%.
As regards the hierarchy between direct and indirect suppliers it does not constitute rigid demarcation. In fact, within our sample 11 firms stated they were exclusively tier-one suppliers, 6 firms sub-suppliers and the remaining 8 both direct suppliers for the final carmaker and other suppliers. In many cases the intermediate situation constitutes a trial period during which the car manufacturer makes a definitive decision about the supplier: whether to continue or interrupt the direct relationship.
Kamath and Liker's taxonomy, based on the importance of supply, seems more adaptable to the firms in our sample. The exclusively sub-supplier category remains unaltered (6 firms), while the remaining suppliers emphasise consolidated (4 firms) or immature relationships (15 firms). According to Kemath and Liker the characteristics of an immature supplier are: limited design responsibility, simple component characteristics, design specifics supplied by the buyer, minimal supplier influence, involvement only after style approval, average technological competence, and constantly checked self-certification and self-qualification. Obviously consolidated relations with suppliers imply greater responsibility in each of these aspects. How it was be expected there is a strong correlation between the buyer-supplier relationship and size (+ 0.77).
The car suppliers constitute a non-homogeneous industrial group as regards the type of supply (components, dies and equipment, engineering, prototypes, etc.) and as regards the production process (drop and/or cold forming, precision metalworking, plastics pressing, electronic components, etc.). Usually, firms carry out more than one type of activity, in some cases verticalised, as in the production of dies and cold forming, in other cases diversified as in the cold forming and plastic pressing.
These last remarks induced us to assess the industrial organisation and the strategies adopted to compete in the market place.
The prevailing strategy adopted to respond to the deverticalisation process has been, although it seems a contradiction, verticalisation. In 60% of the firms interviewed it has been possible to note the introduction of new phases in the production cycle, both by purchasing new equipment, and by the take-over of other firms. The verticalisation process may initially occur upstream with the construction and design of dies, or downstream with the implementation of the process phases of assembly, soldering, painting and surface treatments. The suppliers' verticalisation process has mainly interested the immature car suppliers rather than the mature ones. In some ways it is a coherent strategy, as this category of firms tries to supply the final manufacturer with a more complete product, thus increasing the complexity of the production cycle.
Flexibility is the most referred motivation that pushes these firms to verticalise the production cycle. Car manufacturers to reduce to the minimum the supplier firms' response time consistently adopt just in time and simultaneous engineering. If the external technological competence is easily attainable and the economic margins exist, verticalisation allows the suppliers to manage the complete control of the process more directly and to satisfy unexpected change in purchase request more quickly. Furthermore, the following advantages were mentioned: cost reduction, operating costs control and quality improvement.
Minor importance is assigned to final market diversification (20% of the sample), only a residual part of production is directed at other sectors, which are essentially white goods. In general, hot forming, plastic pressing, tube bending, etc. have be added to cold forming.
The ever more strategic role of suppliers is additionally confirmed in the globalisation process. Carmakers' strategy is that of preserving the uniformity and qualitative standards of the components independently of the production location. Thus the principal suppliers are called on to collaborate closely in the carrying out of the carmakers' global programmes, and to ensure the availability of the supplies required in the various production plants.

Globalisation not only concerns large suppliers of modules and systems, but also sub-suppliers.
The firms in the sample indicated a greater number of industrial initiatives abroad with respect to similar research carried out by the Chamber of Commerce in Turin (1997).
It is interesting to observe that some of these initiatives, especially those undertaken by the smaller Italian firms, were carried out by joint ventures or consortium between competitors. Three agreements of this nature were indicated involving seven firms of the sample. Especially in the case of South America or Eastern Europe, the presence of other car manufacturers is an opportunity to increase the number of buyers. Larger firms, on the other hand, tend to come to agreements with local producers in order to exercise complete control over the activities.
Joint ventures in production are not only aimed abroad, the first such experiences were carried out in South of Italy as well as in the district of Turin. Such agreements may have the objective of carrying out a joint production or merging the product development activities. In both cases the consortium becomes the exclusive interlocutor with the carmaker. These agreements tend to improve the relationship and the communications channels with the final buyer.

3 Innovation in small-medium car suppliers: capabilities and behavioural models

The innovation capabilities of small-medium car suppliers are strongly conditioned by the size and the technological characteristics of the product. Small-medium car suppliers have a tendency to operate in a context of incremental innovation. The analysis refers to a mature sector in which the innovation process proceeds over time along a logistic curve. For these firms innovation is often not a structured activity, innovation is infinitesimal, on a daily basis, and interests all aspects of the company: how a die is made, how the layout of the workshop is defined and the pieces are manipulated. Innovation is a continuous improvement of the production process, which at a certain point allows the generation of something new. Each employee contributes even minimally to improve market competitiveness of the firm.
Therefore, as far as our sample is concerned, high innovative capabilities could not have been hypothesised beforehand. Product innovation regards minimal changes for quality improvement, reduction of production costs and new market requests.
The considerations about process innovation differ to some extent in that periodically new equipment are introduced which determine a significant innovative leap and define new production standards. In the ’70s the initial diffusion of numerically controlled machine tools was observed, in the ’80s the introduction of flexible automation and robots, and now the principal progress could regard information technology and hydroforming.
Currently technological evolution has reached a consolidation phase. For example, all the cold forming firms of the sample use transfer presses. The purchase of highly sophisticated numerical controls or the introduction of robots for various uses can readily be accomplished even by very small firms.
Some firms of the sample showed a high production technology know-how. They are able to customise or completely manufacture some of their equipment. Such a solution is followed if there is a high level of accumulated knowledge or when the specific machinery cannot be found on the market. It is not by chance that the majority of patents deposited by the firms in the sample regard new process applications rather than new products.
Taking these concepts into consideration the sample can be classified according to CREST (Scientific and Technical Research Commitee) taxonomy. Four groups are identified by CREST:

- Research Performer firms (RP), SMEs with dedicated R&D structures and medium-long term programmes. No firm of the sample can be included in this category;
- Technological Competent firms (TC), SMEs with some qualified employees in R&DE and a good propensity to face innovation process. 7 firms of the sample are part of this group;
- Minimum Capabilities Firms (MC), SMEs with at least one qualified employee in R&DE to support transferral technologies. 9 firms of the sample can be included in this category;
- Low Technology firms (LT), these firms show a limited propensity to change the existing situation. 9 firms of the sample are assigned in this category.

Table 3 shows the variables used to define CREST tassonomy and some descriptive statistics.

Table 3: CREST tassonomy subdivision

Average	Technological Competent	Minimum Capabilities	Low Technology
R&D on turnover	4,1	1,2	0,8
N. patents	4,1	0,0	0,0
N. of researchers	2,3	1,3	0,7
Turnover (mil. Euros)	23.2	15.4	10.9
Employees	180	122	72
Export	39,9	18,2	20,6
N. of graduated	7,1	2,3	1,1

Source: Ceris-CNR

3.1 Behavioural models

In the last section some of the principal strategic tendencies which have characterised the car filiere were described and a partial empirical test was carried out.
In particular, tiering between direct and indirect suppliers, the bias towards the verticalisation of the production process, diversification, globalisation and definition of joint ventures or consortium with other competitors have been analysed. To these two other organisational-strategic variables are added.
On the basis of the questionnaire, other variables were added: the adoption of advanced forms of organisational structure, as in interfunctional teamwork or full management autonomy, dependence on other industrial or financial firms, the relationships with raw materials and machinery suppliers which encouraged innovation transfer, the presence of a product development department, investment in information technologies, the set-up of small R&D units, application for governments grants and the introduction of agreements with external research institutes.
Table 4 shows the absolute and relative frequencies over the total sample. Regarding the strategic-organisational aspects: 16% of the sample may be considered to be a mature supplier by the car manufacturer, 64% of the firms are immature suppliers and 20% sub-suppliers. 32% of the sample are already or are about to invest abroad, 20% operate in diversified markets, 60% of the sample have shown a tendency to verticalise the production cycle and 44% of the sample is involved in joint-ventures in production with competitors. Furthermore, 20% of the sample has adopted advanced organisational forms and another 20% is part of an industrial or financial group.

As regards the variables most linked to innovation the most important factors are: the presence of a product development department (72%), government grants to encourage process and product innovation (68%), collaboration with materials (40%) and machinery suppliers (36%), contact with external research institutes (36%).
Lower values were recorded by investment in information technology (28% of the sample) and the setting-up of R&D laboratories (28%). Finally, 4 companies (16%) have already defined, or are defining, joint ventures or consortium with other competitors in order to set-up a product development department together. In these last three cases the results have to be weighted with the financial and organisational impact. The setting-up of a R&D laboratory or a consortium require a greater commitment for a small-medium firm than for collaboration with suppliers.
The subdivision of the sample based on innovation capability allows us to detect further precise behaviour models (tab. 4).
One of the main criteria adopted to classify the car suppliers according to Kamath and Liker's taxonomy is the firm's innovation capability. Thus, the mature suppliers demonstrate a greater innovation capability than the sample average, and the firms with low innovation capability are mostly sub-suppliers. Nevertheless, this does not imply that firms qualified as immature cannot reveal a high propensity to innovate (4 firms out of 15), nor that all sub-suppliers must register only low values (4 firms out of 6).

Table 4: Small-medium car suppliers and innovation – subdivision by innovation capability

	Number of firms				Percentage values			
	TC	**MC**	**LT**	**Total**	**TC**	**MC**	**LT**	**Total**
Total	7	9	9	25	100	100	100	100
Mature supplier	3	1	0	4	42.9	11.1	0	16
Immature suppliers	4	6	5	15	57.1	66.7	55.6	60
Sub-suppliers	0	2	4	6	0	22.2	44.4	24
Globalisation	3	4	1	8	42.9	44.4	11.1	32
Diversification	4	1	0	5	57.1	11.1	0	20
Verticalisation	6	6	3	15	85.7	66.7	33.3	60
Evolved organisation	4	1	0	5	57.1	11.1	0	20
Group dependence	1	1	3	5	14.3	11.1	33.3	20
Joint-venture in R&DE	1	0	3	4	14.3	0	33.3	16
Joint-venture in production	4	4	3	11	57.1	44.4	33.3	44
Materials suppliers	4	5	1	10	57.1	55.6	11.1	40
Machinery suppliers	5	3	1	9	71.4	33.3	11.1	36
Product development department	7	8	3	18	100	88.9	33.3	72
Information technology	4	2	1	7	57.1	22.2	11.1	28
R&D laboratories	5	2	0	7	71.4	22.2	0	28
Government grants	6	7	4	17	85.7	77.8	44.4	68
External research	3	5	1	9	42.9	55.6	11.1	36

Source: Ceris-CNR

For each CREST group can be observed that:
– Technological Competent: all these firms have an internal product development department that can operate in co-design with the final carmaker. The production cycle is verticalised in 85% of cases and the same percentage is registered for requests for state

aids. High values are also indicated for collaboration with machinery suppliers and the presence of R&D laboratories.
- Minimum Capabilities: most of the principal characteristics are quite similar to those of the higher category. To these are added collaboration with suppliers of materials and external research bodies.
- Low Technology: the only distinctive element is the request of state aids. Low frequency (33%) is registered by verticalisation, R&DE consortium, joint ventures in production and to the presence of an internal product development department.

The analysis of the single variables gives further remarks. The most uniform strategic-organisational or innovative factors among the various groups are: joint ventures in production, and the request for government grants. In these cases evident differences exist, but they cannot be deemed to be distinctive factors.
The TC and MC SMEs show the same propensity to globalisation, verticalisation of the production process, presence of an internal product development department, collaborative relationships with suppliers of materials and with external research bodies.
Furthermore, some distinctive aspects are highlighted:
- production diversification strategies is pursued exclusively by TC, as are the adoption of advanced forms of organisation, collaboration with machinery suppliers, the implementation of investments in information technology and the set-up of R&D laboratories;
- dependence on industrial groups and the formation of joint ventures in product development are mentioned prevalently by LT firms.

The fact that such factors are manifested at the extremes of the scale of qualitative criteria is not devoid of useful considerations. For example, the adoption of organisational forms different from the functional or paternalistic structure in TC and MC firms confirms that organisational innovation is fundamental as much as that of product or process.
The setting-up of joint venture in R&DE among the LT firms points out the admission of a fundamental activity, which cannot be pursued by themself. In the same way the greater incidence of dependence on a group in the LT firms points out the risk that, especially if the holding company is foreign, the innovative process of the firm could be reduced.

3.2 Buyer-supplier relationship in innovation

It is now widely acknowledged that co-operative relations with suppliers can be considered a means for final producers to scan the technological knowledge basis of related industries and to keep its progress under control. Although co-operative supply relations can be implemented for a variety of strategic and operational goals (Ellram, 1991; Monczka and Trent, 1991; Imrie and Morris, 1992), it is agreed that the improvement of the product development process and access to innovative technology are of paramount importance (Hakansson and Erikkson, 1993; Hoyte, Cooper, Jones, 1994; Mendez and Pearson, 1994; Morgan and Garnsey, 1994).
The incidence of a big company on the innovative processes of small-medium firms tends to complete the suggestions and support of a technical nature, for the individuation of the best technological choices within a comprehensive strategic set-up which contemplates processes of outsourcing, productive globalisation agreements between firms etc (Gadde and Hakansson, 1994).
The active involvement of suppliers in the process chain of the carmaker radically depends on the intrinsic characteristics of the supplier. One of the tasks of the carmaker is the qualitative growth of the supply base through specific programmes which are not limited to cost reduction and quality improvement, but also involve the suppliers as a whole, starting

from the weakest aspects like product and process innovation processes. In this way the car manufacturer carries out a pro-active role investing managerial resources in the growth of the suppliers, in the conviction that most improvements derive from continuous reciprocal learning processes (Bonaccorsi, 1997).
The supplier of a system or a module is already an undisputed technological leader and therefore is not in need of any support. But in the case of small to medium firms the situation is radically different.
One of the supplier categories observed by Kamath and Liker is that of the immature supplier which was, however, recognised as having some unexpressed potential so as to avoid sub-supply relations. Even if the innovative processes are perceived as competition factors, the technological content of the product is not high and is unlikely to be the result of internal development. In these cases the role of the carmaker may become fundamental and, as Camuffo and Volpato (1997) observe, drive such buyer-supplier relations towards those models inspired by Japanese partnerships.
The different position of strength between buyers and suppliers must be considered attentively, analysing the relative asymmetrical interdependencies (Grandori, 1995). In fact, it is in these asymmetrical situations that one of the parts (often the carmaker), by offering part of its own knowledge manages to obtain information about the supplier, while safeguarding and increasing its own position of power. In other words, the development and transparency policies undertaken towards the suppliers may assume significantly different meanings depending on the relationship between the parties and the value that the same parties wish to give to such initiatives. A support policy founded on periodical visits or on moving the buyer's technicians at the supplier undoubtedly represents a form of collaboration, of transparency and aid for the supplier. At the same time it may constitute an element of informative advantage for the buyer, who comes to know information about the supplier (for example about its cost structure) which the supplier may not be interested in revealing.
The development policies that buyers can offer their suppliers to encourage innovative processes of products and processes can be classified as indirect or direct depending on the level of involvement.
Among the indirect support measures are the proposals and information for the adoption of new technology, for the reduction of costs, for quality and logistics, for the management of sub-suppliers, to improve the final quality of the product. These initiatives have been so consolidated that in recent years they have been increased and made tangible in specific projects (for example Volkswagen's KVP, Fiat Auto's Guided growth plan, and Renault's Synergy 500). The direct support measures actions are: training at the buyer's location, visits from technicians, personnel temporarily based at the supplier to improve the processes, and technical/financial aid for new investments.
At the moment of the research, the firms in the sample benefited from the buyer (Table 5), and thus in particular from Fiat Auto, mainly from the indirect supports, as in suggestions for improvements to quality and logistics (74% of the sample) and information regarding the final quality of the product (70%). The support measures regarding technology which the firms interviewed declared of most benefit were suggestions for the adoption of new technology (61%) and visits from technicians sent to implement better procedures (65%).
As a matter of fact carmakers prefer the support measures of least involvement. Visits from technicians are limited to supervision of the production process and only rarely encourage the implementation of better procedures. Furthermore, there is strong non-homogeneity between the technicians which often come from commercial areas and not from technological-productive ones.
Training at the buyer's headquarters (52% of the sample) is a support activity that is considered essential but often the initiative originates from the suppliers and not the buyer, an important factor given that its cost cannot always be sustained by small-medium firms.

Little significance is given to initiatives with greater co-responsibility as for example technical/financial aid in the implementation of new investments (17%) and the temporary collocation of the buyer's personnel with the supplier (13% of cases).
On average the firms interviewed have benefited from 4,5 supports by the buyer (tab. 5). The distribution of the sample according to the innovation capability evidences some disparity.
Firstly there seems to be a positive correlation between innovation capability and supports received: 6,2 different initiatives for the TC firms, 4,1 per for the MC firms, 2,3 for the LT firms. Unfortunately we cannot know if the innovative level expressed is the result of the final buyer's initiatives, or if, as it is more realistic to presume, the level of innovation capability is a discretional factor in the concentration of the suppliers' development policies.
The latter remark is in part confirmed by observing the distribution of the single support measures in the three groups of firms. Proposals regarding the quality of the final product and logistics are more or less addressed to all firms, while the initiatives which are more connected to technological innovation are highly focused to the firms with high innovation capability and, to a lesser extent, to the firms with medium innovation capability.

Table 5: Support initiatives undertaken by car manufacturers to encourage innovation in suppliers (% of total firms)

	Innovation capability			**Total**
DIRECT SUPPORT	**TC**	**MC**	**LT**	
• Training at buyer's headquarters	66%	50%	33%	52%
• Technician's visits	100%	50%	33%	65%
• Temporary collocation of buyer's personnel	33%	12%	0%	13%
• Technical/financial aid for new investments	16%	12%	16%	17%
INDIRECT SUPPORT				
• Suggestions for the adoption of new technology	83%	62%	16%	61%
• Suggestions for cost reduction	83%	37%	16%	48%
• Suggestions for improvement of quality and logistics	100%	62%	50%	74%
• Suggestions for the management of sub-suppliers	50%	50%	16%	48%
• Information about the finale quality of the product	83%	75%	50%	70%
AVERAGE SUPPORTS	6,2	4,1	2,3	4,5

Source: Ceris-CNR

3.3 An empirical analyses

Some of the variable reported in table 4 have be used to define a multinomial logit model where the ordered response variable is the innovation capabilities expressed by the Crest tassonomy. The aim is to investigate inter-firm differences in innovative behaviour.
Table 6 shows the list of the explanatory variables and how they were weighted. The variables - presence of the Product development department, R&D laboratories and investment in Information technologies - were omitted because included in the definition of the response variable. The variables Evolved organisation and Production joint venture were

excluded for multicollinearity, while Firm size and the number of Direct and Indirect supports were added.
As a matter of fact, the variables taken into account can be grouped in different questions: which industrial organization strategy (diversification, verticalisation, globalisation and dependence on industrial groups), which external channels (suppliers, buyers, joint-venture with competitors and external R&D institute), and are firm size or state aids important in determining innovation capabilities?
The limited number of observations does not permit to identify a precise explanatory model or to test a particular theoretical construction but to consider the relationship between the independent variables and the innovation capabilities of the firms. To this purpose to evaluate the influence of the variables we used a forward selection procedure with a high significance level to entry into the model (0.5).
Firm size, Diversification strategy and Co-operation with suppliers in R&DE are the only variable significant (Probability Chi-square < 0.05; Table 7) and have a positive influence (Table 8). Direct support of carmakers, Government grants and Verticalization strategy have a positive coefficient but are not significant. Globalisation strategy, Indirect support of carmakers, Relationship with external research bodies, Dependance on industrial groups and Joint venture in R&DE have a negative coefficient and are not significant.
Just a few comments on these results.
Small-mediun firms are not homogeneous under the 250 employees threshold. Among this sample, size significantly influences the degree to which firms rely on innovation capabilities. Small is beautiful, but is better not be too small.
Diversification and verticalisation positively affect the level of innovation, but the significance and high coefficient reported by Diversification induce to encourage more the accumulation of knowledge from different industrial frameworks than in the same line of business.
Co-operation with material and/or equipment suppliers in R&DE is the only significant external channel variable. In addition to the increasing of verticalisation, this is another clue of the tendency to strengthen the supply chain in the car industry.
As far as concern the firm of the sample, collaboration with materials suppliers is strongly conditioned by the type of the product. The principal material suppliers of the sample analysed are steel or chemical bigger firms often located abroad. Furthermore, the market situation for some materials presents the characteristics of high stability and low propensity to innovate. Regardless of this some interesting common projects were indicated, most of them on the foreign materials suppliers initiative. Usually, the task of the small-medium car supplier is the testing of the industrialisation of the new materials to support the reduction of weights, increase the mechanical resistance and monitor the consequences on the equipment.
As regards collaboration with machinery suppliers, the aspect which distinguishes the possibility of transferring innovation through this channel is the formation of stable relations over time. Only in this way is it possible to encourage a rapid and trusted passage of specific knowledge.
The logit model points out that carmaker supports are not a prerequisite for innovation. Both the Direct and Indirect support parameters are not significant. The positive sign of Direct supports confirms that the Italian carmaker pays much attention on the technology competent SMEs.
Finally the negative signs of the estimated parameters of External research center and Joint-venture in R&DE, although they are non significant, highlights the inclination of the most innovative firms of the sample to follow the innovative path individually.

4 Conclusions

In this work the procurement policies of the car sector have been analysed over a sample of small-medium suppliers. In particular, three consequential strategic trends have been observed: the marked vertical disintegration of the sector, the rationalisation of the supply base and the evolution of the buyer-supplier relationship. Furthermore, the product and process innovation processes have been analysed along with technological competence and the initiatives undertaken by the carmaker to increase the culture of innovation in the small-medium firms.

The paper has shown that the firms analysed, even the smallest ones, have amply benefited from deverticalisation both in terms of turnover and employment. Hierarchical policies between direct and indirect suppliers have not yet defined rigid demarcation, whereas taxonomies based on the extrinsic importance of supply and on the relation between suppliers and carmakers are more explanatory.

The strategy prevalently adopted to answer the process of deverticalisation effected by car manufactures has been the verticalisation of internal activities. Lesser relevance has been assigned to the diversification strategies of both the final market, and production specialisation.

A meaningful figure concerns the globalisation politics undertaken in collaboration with competitors. The agreements do not only concern the productive-commercial aspects, but also the setting-up of common product development department.

Product innovation, on the other hand, is minimal and mostly concerns changes needed to improve efficiency, quality, cost reduction and the customer satisfaction. In this context the development policies that the buyers could offer their suppliers to encourage the innovative processes of product and process can be separated into indirect and direct actions according to the degree of involvement. However, it may be expected that final producers' support to encourage innovation in suppliers, in general, has adopted support measures of least involvement for the car manufacturer and have been concentrated on the suppliers with the greatest innovation capabilities.

Finally, some evaluations have been made of the technological level of the product and process, and on the innovation capability expressed by the firms analysed.

Table 6: Multinomial logit model

	ORDERED RESPONSE VARIABLE	1	2	3
	Innovation capabilities Crest tassonomy	Low Technology	Minimum Capabilities	Technological Competent
	EXPLANATORY VARIABLES	0	1	2
	Size	Employees< 50	50> Employees< 150	Employees> 150
	Government grants	No	Yes	
Industrial organisation strategy	**Globalisation**	No	Yes	
	Diversification	No	Yes	
	Verticalisation	No	Yes	
	Subsidiary	No	Yes	
External channel	**Joint-venture in R&DE**	No	Yes	
	Co-operation with suppliers in R&DE	No	Material or Equipment suppliers	Material and/or Equipment suppliers
	External research centres	No	Yes	
	Number of Direct supports (max 4)			
	Number of Indirect supports (max 5)			

Table 7: Summary of forward selection procedure

Step	Variable Entered	Probability Chi-Square
1	Size	0.0022
2	Diversification	0.0051
3	Suppliers	0.0470
4	Subsidiary	0.2698
5	Joint-venture in R&DE	0.2620
6	Globalisation	0.3711
7	Government grants	0.3981
8	External research	0.6415
9	Indirect support	0.4676
10	Direct support	0.1843
11	Verticalisation	0.5796

Table 8: Analysis of maximum likelihood estimates

	Variable	Parameter Estimate	Standard Error	Probability Chi-Square
	INTERCP1	3.1160	3.2518	0.3380
	INTERCP2	11.9185	7.1953	0.0976
Positive Effects	Size	+8,4483	5.6704	0.1363
	Diversification	+8,2253	5.0109	0.1007
	Suppliers	+2,5054	1.8623	0.1785
	Direct support	+2,6126	2.3433	0.2649
	Government grants	+2,4074	2.3838	0.3125
	Verticalisation	+1,0548	2.0032	0.5985
Negative Effects	Globalisation	-1,6708	2.0692	0.4194
	Indirect support	-2,5889	2.3585	0.2723
	External research	-3,2669	3.6037	0.3646
	Subsidiary	-5,0264	4.2387	0.2357
	Joint-venture in R&DE	-9,5359	7.8855	0.2265

Measures of goodness of fit		**Association of predicted probabilities and observed responses**	
Number of observations	25	Concordant	80.6 %
Number of estimated parameters	11	Discordant	1.9 %
LR test statistic	20.9	Tied	15.5 %
p-value	0.0005		

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