Relationships as Mechanisms for the Co-Ordination of Capabilities in the Portuguese Industry of Moulds

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Abstract
New perspectives arose of recently about the division of work in industry and the co-ordinating mechanisms thereof (Langlois and Robertson, 1995). This paper looks at the co-ordination of activities and division of work in industry from the industrial networks perspective. Both the notion of relationships between firms, seen as co-ordinating mechanisms (Axelsson and Easton, 1992) and joint learning devices (Håkansson, 1993) , and the notion of firms as sets of direct and indirect capabilities (Loasby, 1998a, 1998b) are used in order to characterise and contrast the trajectories (development paths) of four firms from the Portuguese industry of moulds for plastic injection.

1. Introduction
The division of work in industry and the dynamics of the mechanisms for the co-ordination of activities were recently brought back to discussion, with relation to their role on firms' access to, and development of, capabilities over time. If one looks at capabilities and activities as issues that go well beyond the individual firm, then, it becomes apparent that, for instance, the costs which may be conducive to vertical integration "... may go beyond those that arise in the course of defending against opportunism" (Langlois, 1998, p. 195). This paper addresses the theme of activities and capabilities from what the authors believe to be a novel point of view, by resorting to the theoretical framework of industrial networks.

Section 2 briefly reviews the approaches to the division of work in industry which emphasise the co-ordination and the development of capabilities. The approach of Langlois and Robertson (1995), which takes the firm and the market as sole activity co-ordination mechanisms, is contrasted to those of Richardson (1972) and Loasby (1998 a, 1998 b). By considering the notions of complementarity and similarity of activities, the relationships between firms arise as another activity co-ordination mechanism. If one looks at firms as sets of direct and indirect capabilities, as Loasby does, then the interdependencies between both these kinds of capabilities (and their dynamics) also emerge as relevant to explain the diversity of paths of development found in firms operating in the same industries. In fact, the notion that relationships between firms are a co-ordination mechanism underlies the network approach to the analysis of the dynamics of industrial systems (Axelsson and Easton, 1992). The connectnedness of relationships, which is crucial to the concept of network, not only

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supports Loasby's stance of non-aggregation of indirect capabilities, but also leads us to stress as relevant for the analysis of the trajectories of development of focal actors, the existence of relationships which are specific to each actor (as actors differ in their capabilities, their intent and the sets of relationships in which each one is embedded).

Section 3 presents the empirical context for this study, the industry of moulds for plastic injection at Marinha Grande (MG), in Portugal, and provides as brief description of the trajectory of four firms which differ from each other in several dimensions. Finally, in section 4, the major conclusions of the study are drawn, which seem to support the need to adopt a perspective of the dynamics among co-ordinating mechanisms in the industry, whence it should be recognised that firms positions and their trajectories are contingent on their relationships with specific counterparts and on the ways they seek to deal with the variety they confront at that level.

2. The division of work in industry and the mechanisms for co-ordination of capabilities

In the context of the 'Evolutionist Theory of Capabilities', proposed by Langlois and Robertson (1995), it is stressed that firms hold capabilities, which include both tacit and codified (explicit) knowledge. The dynamics of codification, diffusion and access to capabilities can help explain the rationale of an industrial sector in terms of division of work between firms and markets. Firms are seen as having core capabilities (mostly tacit and idiosyncratic), and ancillary capabilities (contestable and common to other firms). These, contrary to the former, are easy to transfer or imitate. As both learning and diffusion of capabilities take time, lags are to be expected, at any point in time, between the capabilities of the firm and those of the market. Given that part of the required capabilities are idiosyncratic and tacit, only obtainable through long learning processes, firms are confronted with "Dynamic Transaction Costs" (DTC) and may opt to integrate ancillary capabilities. DTC are defined as "the costs of persuading, negotiating, co-ordinating and teaching outside suppliers", or otherwise as "the costs of not having the capabilities you need when you need them" (Langlois and Robertson, 1995, p.35). DTC are especially relevant when there is a high degree of dependency between sequential production activities.

In the short term, a firm may face difficulties in accessing the capabilities it seeks. However, in the longer term, as other firms learn and/or capabilities become codified and spread more easily, it can be expected that a "tendency [arises] towards the generalised spread of capabilities that both breaks down the idiosyncrasy and reduces transaction costs" (Langlois and Robertson, 1995, p.43). In general, it is to be expected that "... the options for change at any given point are constrained by the nature of the environment at that point. Whether there is continuity, merger or disintegration is a function of the cost structure at that time which, in turn, depends on the existing distribution of capabilities and the degree of efficiency of markets" (op. cit., p. 45). Still, vertical disintegration may not happen when buying becomes better than doing because the firm, as a co-ordinating mechanism, may have developed routines which cause inertia.

The DTC mechanism helps to explain vertical integration, but the existence of alternatives in the market may not result in vertical disintegration. Besides, a one-way conversion of tacit into codified knowledge is assumed, which is rejected, for example, by Lundval (1996). Finally, if the discussion is essentially about "doing or buying" then the possibility of combining resources held by different firms in order to create what is to be traded is left in

the limelight (Araújo et al., 1999). Left out is also the possibility of those decisions to affect significantly the internal organisation of the firms due to complex interdependencies between activities (Dubois, 1994).

Still, other mechanisms may have to be considered in order to get a better understanding of the dynamics of the division of work in industrial systems. Planed co-ordination does not stop at the boundaries of the individual firm (Richardson, 1972). Complementary activities, which represent different phases in a sequential production process, require co-ordination. However, these activities do not have to be similar, i.e. they may be carried out based on diverse capabilities, defined as knowledge, experience and skills, all developed over time, which contribute to the singularity of each firm. Richardson considers that relationships between firms allow the co-ordination of dissimilar but closely complementary activities, as a co-ordination mechanism alternative to hierarchy (directed) co-ordination and market (spontaneous) co-ordination. The co-ordination of such activities cannot be solely left either to the firm, because they are based on dissimilar capabilities, or to the market, because they presuppose a qualitative and quantitative articulation of the plans of the firms involved.

Loasby (1998b) resorts, as does Richardson, to the distinction advanced by Ryle (1949) between "know what" and "know how", but he adds in the distinction between "knowing how to do something" and "knowing how to get something done" of Nelson and Winter (1982): "capabilities are know how, both direct and indirect, they represent the kind of knowledge ... which are crucial to the performance of a firm, an industry and an economy" (Loasby, 1998b, p.165). Firms are, thus, seen as sets of direct and indirect capabilities which have been derived from a particular pattern of experience and which are oriented towards a particular, if ill-defined, set of possibilities, see (Loasby, 1998a). Important differences may exist in the practices and extension to which firms seek to develop and use their indirect capabilities (op. cit., p.154). Within the structure of indirect capabilities of a firm, relationships with other firms may be stronger whenever the counterparts' capabilities are closely complementary and very dissimilar to those of the focal firm.

Firms may be willing to accept the costs of keeping those relationships because they perceive and wish to support the differences of knowledge associated to different activities. The ensuing costs are less than the benefits gained from developing new capabilities, methods and products (op. cit., p.157). Relationships can then have an important role in keeping diversity in industry by avoiding hierarchical control and in developing that diversity by stimulating specialisation. When a firm in the industry needs to access capabilities it does not control, created over a long and specific patterns of experience "... Some of those capabilities may be destroyed by the attempt to control them". On the contrary, keeping a diversity of capabilities may be worth the while, as "... substantial diversity may be a major capability for the industry as a whole, widening the range of activities which can be undertaken and increasing the possibilities of improving some relevant kinds of knowledge" (Loasby, 1998b, p.175). The benefits of diversity are particularly notorious in 'industrial districts', because there the geographical and psychological proximity of local firms allows them to access to learn with one another, including competitors[66].
Adding the relationship element to the Langlois and Robertson (1995) approach seems to better accommodate the possibility of different trajectories in industry, namely in terms of firms boundaries. Loasby (1991, p.41) notes, with relation to the external organisation of

[66] The presence of rival firms in these districts is a potential source of knowledge "... because they do things a little differently – but in ways that are easy to understand" (Loasby, 1998[a], p.155).

each firm, its indirect capabilities structure, that "such capital, of course does not appear in the balance sheet...; and it certainly is not suitable for aggregation"[67], a perspective which is shared by the industrial networks approach. The latter gives a central role to relationships as a mechanism for the co-ordination and learning of the actors (Håkansson, 1993). The notion of connectivity is also central to this approach, implying that they are not amenable to addition. The setting and the development of a relationship always involves two parties, diverse in capabilities and interests, in a lasting process which takes place in the context of other relationships, with which it may be connected, both at the level of the focal actor and of its counterpart (Håkansson and Snehota, 1995). The connectivity of relationships immediately suggests the interdependency between direct and indirect capabilities, briefly referred by Loasby, and the need for each firm to deal differently with each of its counterparts and with the diversity which ensues from these counterparts' specificity.

The direct or proprietary control of resources and activities in industrial networks is but one of the possibilities that each actor has to induce changes it considers paramount (Håkansson, 1992, p.140). The inducement of such changes is not limited to economic relationships between firms. It may also involve relationships with intermediate institutions, such as technological and research centres (Easton and Araujo, 1992). It may be expected that relationships, as they involve investments, result from and contribute to the gradual commitment of actors along their evolution paths. However, such paths or trajectories are not deterministic, both because actors can, with more or less difficulty, cease some relationships and seek to set others, and also because they can use and combine current relationships in many different ways (Araujo and Easton, 1996)[68].

The study of the division of work in an industry and the ways how different specialities integrate will benefit from the usage of a theoretical framework which allows to envisage firms' trajectories, namely in terms of extent of hierarchical control, focusing on the role of relationships for the co-ordination of, access to and creation of capabilities. This allows to consider, see Langlois and Robertson (1995): the role of the dissemination of knowledge on the alternatives allowed by the market; the access to other firms' capabilities and development of alternative capabilities, both allowed by the widening of the concept of indirect capabilities; and the co-evolution of direct and indirect capabilities of each firm in a context where each actor performs some role on the interconnection of relationships, see figure 1.

[67] Foss (1999, p.7), based on what Loasby wrote about the work of Marshall, suggests a link between the authors of Marshallian tradition and the industrial networks approach: "... underlying both the Marshallian vision and the network approach is a picture of the "market" or "industry" as much more than a collection of self-sufficient firms. That is to say, the industry/the network is more than a sum of the capabilities of firms".

[68] "...Economic actors can always find novel ways if using knowledge gained in some relationships to implement or force changes in other relationships... (Araújo and Easton, p. cit., p.377).

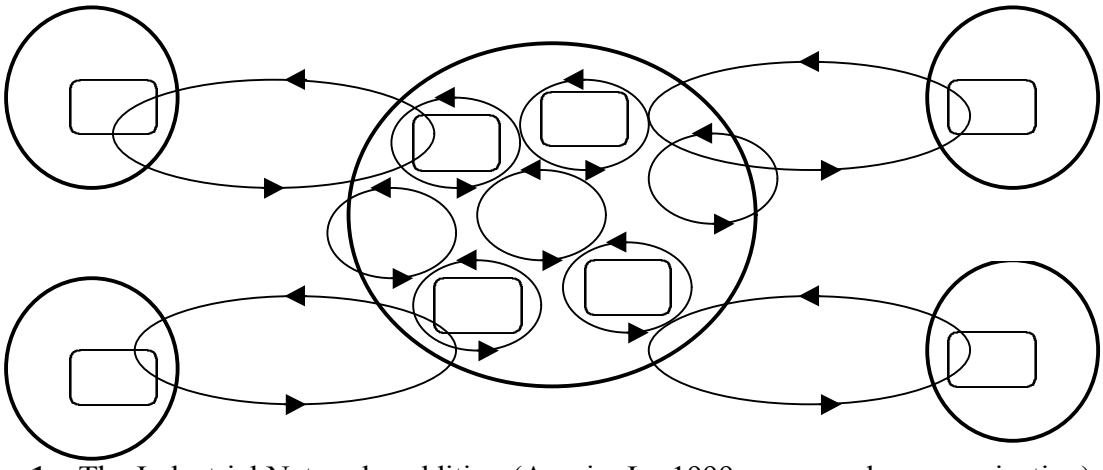

Figure 1 – The Industrial Networks addition (Araujo, L., 1999, personnal communication)

3. The Trajectory of four Firms of Industry of Moulds for Plastics

An empirical research was carried out on the district of Marinha Grande (MG), in Portugal, where a large number of firms producing moulds for plastic injection are concentrated. Four firms were selected for in-depth study, which could be considered as "polar cases" (Eisenhardt, 1991). This research lasted from 1995 to 1998, and it involved interviewing administrators of local firms, along with other people, given the authors' interest in collecting a variety of perceptions, perspectives and experience about the trajectories of the focal firms for a better understanding of those trajectories. Between 1 and 4 interviews were made with people from each focal firm. Each interview lasted over two hours, was tape-recorded and subsequently transcribed.

Each mould is, in general, a unique piece of engineering. As one of the informants stated: "[During fabrication] problems may always arise in building the mould and something estimated to take 20 hours may take 40 hours or more. The timely control of the development of the work is crucial to guarantee credibility [with customers], to ensure delivery times, in short, to fulfil the trust the customer puts on ourselves when he buys from us".

Moulds are (often) very complex tools, to be installed on machines for the injection of plastics to produce pieces of plastic (be it parts for other industries or goods for final use), hence called 'pieces', very diverse in numbers, context of utilisation, technical characteristics and dimensions. The process for the production of a mould can be initiated by a query from a client to a supplier, whereas the client indicates the characteristics of the pieces he wishes to produce and the injection machine he intends to use. The supplier proposes a provisional technical solution, a delivery time and a price. The project or final conception of the mould will require the specification of several aspects, including the procedures and machining solutions and the characteristics of the steels to be used. Steels, with the adequate characteristics and dimensions for that mould have to be acquired, the various parts of the mould are machined and subject to thermic treatments. Rectification is often necessary to correct distortions that result from the thermic treatments. Finally, the moulding surfaces are finished having in mind the characteristics intended for the surfaces of the plastic products, which will be produced. Next, the mould is assembled, including some standard parts, and a

primary evaluation of the quality of the previous steps is carried out. Finally, the mould is mounted and tested on injection machine(s), having in mind the injection equipment that the client will use, together with several other functional and contextual parameters of utilisation. Sometimes the mould requires further corrections in order to be able to produce the plastic pieces with the desired characteristics and rates of throughput. Besides, the client may ask for changes in the pieces to be produced and thus the mould will be subject to further operations. This may happen either immediately after the client receives the sample pieces produced or later on, after he started producing. Both corrections and alterations of moulds may have considerable impact on the stream of internal activities of a supplier of moulds. The situation can become rather complicated when several moulds are being built at the same time, in varying stages of development, using different technical solutions, but impacting on each other. All mould building activities or parts thereof can involve several firms: full cycle producers and final customers, engineering and/or commercialisation firms, other producers, and some firms for specific and specialised fabrication activities, etc.

All four firms studied (IB, TEC, SOM, and FAM) differ and can be contrasted according to some dimensions. Both IB and TEC showed a turnover of about 25 million Euros each in 1997. IB is presently one of the largest producers of moulds employing about 600 people. TEC only does engineering and commercialisation, so it only employs 40 and sub-contracts fabrication from several local firms, most of them full cycle producers. In that same year of 1997, SOM and FAM, both full cycle producers, had a turnover of 2.5 million Euros and employed 70 people each. SOM produces a wide range of moulds (in terms of both dimensions and tolerances) whilst FAM specialised in producing very small moulds with very strict dimensional tolerances.

3.1. The IB and TEC Cases

It is very interesting to compare these two firms, since they are very different in terms of scope, despite their similar turnovers. IB was founded in 1975, by two former directors of AHA[69], one of them from the commercial area and the other from the project area. Political turmoil in 1974/75 in Portugal resulted in a very substantial loss of orders, both for AHA and other local firms, especially from foreign clients. IB founders saw this as an opportunity to create a firm to intermediate, both in commercial and technical terms, with those actors. However, they soon found significant lags between the capabilities deemed necessary for the production of the orders they obtained abroad and those available with the producers that they could access. As they had very restricted access to the firms that did have the required capabilities, one of IB's partners (and subsequently other engineers) became deeply involved in co-operating with their other suppliers. Their involvement included the promotion of new work practices, "forcing" the acquisition of specific equipment required for the delivery times and quality demanded by their clients, in face of the technologic advances elsewhere. The somehow unexpected success of IB's intervention with its suppliers resulted in a growing volume of orders from the clients it gained. However, the growing commercial and technical intermediation by IB led to increasing problems, both because of their effort in co-ordinating production on a variety of suppliers and because of increasing difficulty in ensuring that those suppliers changed themselves fast and further enough. IB then opted to create some highly specialised firms and buy some local producers. This integration effort required a very extensive and intensive training programme, mostly indoors, especially following one of the

[69] The firm AHA was founded at Marinha Grande (MG) in the 1940s. It is considered the "school" or mother firm from which the whole industry of moulds of MG sprang. Most local firms were created by technical staff from AHA who, at some point in time, left this firm to create their own ventures.

acquisitions. IB had to set norms, procedures and standards in both their administrative and production areas. This was necessary to carry out a coherent and fast paced training programme and to ensure smooth and effective communication and co-ordination among the firms and operating units of the group.

Presently IB has about 40 clients, from a variety of industries; very diverse on the requirements they pose to the focal actor. The diversity of its portfolio of relationships has been mostly accommodated internally. Those of IB's firms which were formerly specialised in specific activities (like polishing or machining) gradually became, instead, specialised according to moulds size. They seldom sub-contract and often it is still not easy for them to access firms perceived as having the required capabilities for sub-contracting. Their order book exceeds their production capacity due, at least in part, to the deepening of their relationships with their "traditional" clients, together with their policy to reduce the number and diversity of their portfolio of relationships. Attempts to use concurrent engineering and to facilitate the participation of IB's engineers in the conception of moulds are believed to have led to an increasing depth of some relationships. Both policies involved closer articulation of activities and resources between IB's firms and their clients, but such developments occur only with some clients and with uneven degrees of success. Automotive industry clients deserve a special reference because the conception and the design of the final pieces result from progressive approximations and adjustments. This means that after moulds are first designed and produced the pieces produced are evaluated, often in real life situations, and therefore modified which requires operation on the moulds to have them changed, often at short notice and with significant implications on the production of other ongoing orders. Some of the problems that arise at later stages can be anticipated to a point with the help of simulation programmes and prototyping techniques both in the design and engineering of the plastic parts and on the conception of the moulds to produce them. The active participation of IB in the activities of the local Technological Centre can be related to these issues. IB has, for instance, promoted projects in the Centre to exploit the existing and new technologies, especially in machining and prototyping, as well as those whose impact for the industry seem highly uncertain.

TEC was created in 1968 by a former projects director from one of earlier firms at MG. This happened after TEC's founder helped an English client, from 1962 onwards, to solve problems of timely deliveries and adequate quality from some local fabricators. Like IB's founders, he had to induce significant changes on the work practices of those suppliers. Gradually, TEC involved fabricators on the process for mould production, often helping or inducing their early start-ups. Presently, it resorts to about 70 local producers to whom it sub-contracts a variety of orders obtained from a portfolio of about 35 clients.

TEC's portfolio of clients is diversified but they all place large orders, including numerous moulds which any one only producer would be unable to satisfy by himself. Some of TEC's clients are seen as particularly demanding in terms of delivery dates, quality and relationship procedures but others are equally demanding, for instance, in the need for a very careful evaluation of the conditions where the moulds will finally operate, both physically and organisationally. The relationships developed with Russian clients did require very significant adaptations from TEC and its suppliers regarding both the technical solutions to adopt (for moulds and technical and administrative procedures) and issues of mutual understanding in communication between all parties. The setting and development of TEC's relationships with very diverse clients took place simultaneously with the setting and development of relationships with a likewise diversity of suppliers. TEC's viability depends

critically on its ability to maintain its access to producers and to permanently manage how that access is done. This depends on several aspects, one of which is TEC's perceived unwillingness to integrate backwards which seemed never to have been necessary, anyway. Besides, TEC's attractiveness for its suppliers is understood to be based on the utility of those relationships, as they are seen to contribute to the sustainability and development of suppliers. Such utility derives from the demands TEC places on the capabilities of suppliers, the knowledge it transfers to them and its potential to facilitate their direct and indirect access to new clients. Sometimes the development of relationships with some clients required that TEC had to promote the development of specific capabilities by some suppliers and, in return, to assure them that a subsequent flow of orders would ensure the subsequent viability of those developments. Further, the fact that some orders often involve several moulds which have to be placed with different procedures (diverse in their capabilities) often demands exchange of information and experience among producers so that an even level of quality is achieved, as the client is the same.

The process for distribution of TEC's orders to its suppliers is based on an evaluation process by those who interact directly with them. A relevant consideration for that evaluation is the degree of priority that each supplier gives to the order, the supplier's pattern of behaviour relative to quoted prices and delivery times and the supplier's performance in previous orders. Another consideration is the present level of involvement with each supplier, both regarding the types of moulds presently placed with him (their similarity), compared to his perceived capabilities and involvement in orders from the same client. TEC avoids that suppliers be confronted at any point in time with producing very dissimilar moulds or too many moulds for the same client or, still too many moulds ordered through TEC itself. TEC believes that it is beneficial that its suppliers do work for other customers. This is supposed to help suppliers to better evaluate their relationships with TEC and also to give TEC indirect access to knowledge suppliers gain from their other relationships.

3.2. The FAM and SOM Cases

FAM and SOM were created in the early 80s and in the early 70s respectively, each of them by technicians from diverse mould production backgrounds. Both firms started producing a variety of moulds for a range of clients, some of which were engineering and commercialisation firms including IB and TEC. FAM's trajectory, and in particular its specialisation in very small moulds which demand very strict tolerances, developed in alignment to its dealing with very few clients and relationships. One of its initial and current clients needed moulds to produce small cosmetics casings, very special in terms of their surfaces finishing and movable parts. The capabilities that FAM had to develop in order to produce those moulds were later considered essential to gain another order from a German client who subsequently visited the MG district. FAM afterwards decided to invest in equipment deemed necessary to overcome technical problems it had confronted when it produced its first few orders for this new client. The German client's moulds produce tiny pieces for the electronic industry, where inter-changeability of components is essential and, therefore, tolerances are very, very strict. Besides, the production and assembly lines of the client operate simultaneously with three identical moulds and they supply components to other firms. Given the interdependencies among those firms, the focal actor must be highly available to make changes in answer to requests from this particular client if the relationship is to be kept. Sometimes the client has to launch new products at very short notice. Then, FAM has to create and produce prototypes of the moulds and start producing itself small batches of the final pieces, while the final moulds, in triplicate, are built and finished. Those

small batches are produced on FAM's premises in identical equipment to that of the customer.

The high priority that FAM accords its clients and, in particular, to its German client (from whom FAM derives 60% of its turnover) has consequences for the screening of new potential clients. FAM will not accept a new client, unless the pieces/moulds he requires are similar to those it already does to avoid disrupting its internal activities. Further, FAM will find out whether the procedures for the new (prospective) relationship will be similar to those in existence both in terms of formalities and in terms of processes for the conception and development of the pieces. A factor for this decision has to do with the demands for formal guarantees contracts and frequent interaction with the client's commercial department, seen as indicating price sensitiveness. Another factor concerns the potential "chaos" in production and consequent disruption in high priority relationships, which may result from the need to conceive/design pieces through an interactive gradual approximation process, too demanding on the producer's availability. By keeping only six relatively similar clients, FAM can absorb internally the variability that results from its portfolio of relationships, by mere adaptation of its internal activities and resources, seldom sub-contracting specific activities to other local firms. These occasional sub-contractors are mostly firms created by former FAM's staff, seen as having similar capabilities to those of their "mother-firm", from whom they learnt.

SOM, according to various informants, is "typical" amongst moulds firms at MG, inasmuch as it conceives and produces a wide range of moulds for a variety of clients. SOM's trajectory, until very recently, can be characterised by its efforts to be able to deal with very diverse clients. In 1997, it had 40 clients, very diverse in terms of the relevance they accorded to delivery times, prices, quality and size of moulds, mould development processes, degree of participation of SOM in those activities, regularity and size of orders, etc. Recently, especially since a turbulent period for the industry, in the early 1990s, the firms' managers sought to reduce that diversity and to deepen their capabilities in mould conception and production, in more specific areas. This diversity reduction process is closely associated to the perceived need to strengthen some relationships, and to access new clients, for more regular order sizes and frequencies and, in any case, more receptive to SOM's contribution for the conception of the pieces to be produced. Following some unsuccessful attempts, SOM has been gaining the acceptance of some clients for the desired deepening of relationships and has favoured those who order several moulds at a time. A large part of its orders comes now from firms in the automotive and domestic appliances industries. The moulds for both of these are similar in the sense that they will produce pieces with similar sizes and tolerance rates. However, the flow of orders from these clients is still irregular and this has been frustrating the intent to abandon the conception and production of less demanding moulds. Being "forced" to carry on taking the latter, SOM cannot strengthen its capabilities for producing the more demanding moulds. Besides, it cannot make itself enough available for the more demanding customers, be it for alterations at short notice, be it to pre-empt problems. SOM expects to improve its capabilities through its association to the local Technological Centre through a project for the study of plastics behaviour/materials resistance. It may thus gain access to knowledge held by other associates of the Centre, given the close links between knowledge about plastics and knowledge about components size, both of which are important for the conception of moulds and plastic pieces. The diversity of clients/product has also been partly and progressively absorbed through SOM's growing access to other local producers, with six of whom it has privileged relationships. Some of the orders accepted are sometimes sub-contracted to other producers, with the clients agreement,

some specific areas excepted. SOM may also, at times, involve other producers whenever problems arise during fabrication

4. Analysis of the cases

All four cases described in section 3 seem to support the idea that both hierarchy and relationships are important on mechanisms of co-ordination of work in an industry. Also the contrasting the cases of IB and TEC suggest that there is no "natural law" governing the greater or lesser degree of vertical integration in the industry. Both firms opted for different solutions and apparently both were successful. The options they followed were apparently driven by their managers idiosyncrasies, their relationships, and relating "capabilities", articulated with their counterparts': Differences are therefore to be expected on the ways firms combine their direct and indirect capabilities, as Loasby (1998a) suggested. All the cases illustrate the importance of relationships as a mechanism for the co-ordination of capabilities in the moulds industry. Access, both to clients ant to suppliers, was never instantaneous and the development of the activities to be co-ordinated involve the creation of more or less complex and strict interdependencies contingent on, at least, both parties willingness for the intended relationship. The notion of indirect capabilities of a firm requires, in the least, knowledge about who can deliver timely, adequately and with credibility. Further, these capabilities go well beyond a mere set of routines developed to access an undifferentiated "mass" of actors. They require the knowledge of how to access to the capabilities of specific actors and an understanding of the potential and limitations of those capabilities. There are two other aspects deemed fundamental to understand the trajectory or development path of a firm, namely the capability to teach others how to do something and the capacity to access other actors in order to absorb knowledge either from them and/or farther away actors. The cases of TEC and IB are significantly contrasting in this respect, as they diverged so dramatically in terms of vertical integration. TEC is remarkable for its ability to make "mobile" knowledge otherwise specific to relationships held with and between a host of actors.

The four firms' trajectories also reflect the ways each one sought and seeks to deal with the diversity of solicitations faced. FAM and SOM differ strictly in terms of their degree of specialisation, but that difference cannot be understood without taking in consideration the roles of their relationships with specific clients and the evolution over time of their portfolio of clients. Besides, firms can mobilise, more or less widely, both other firms and relationships developed over time, for dealing with diversity and variability. These relationships give access and sometimes are a privileged means to ensure the development of capabilities. IB and FAM cases both involve a prevalence of internal "absorption" of the diversity of their portfolio of clients. On the contrary SOM, and especially TEC, show how relationships with other local actors can be used as crucial means to accommodate diversity. This means that, to a point, their counterparts can access solutions developed by other actors relative to problems specific to a piece of work. Thus, relationships allow access to a variety of solutions reached in the context of other relationships with third parties.

Some dimensions of the trajectory of the focal firms demonstrate the importance of the relationships in which they are embedded: to integrate v.s. to access diverse capabilities through relationships, to transfer and cross knowledge from several producers/clients, to contain the diversity of the portfolio of relationships within "manageable" limits (i.e. limits consistent with the held capabilities v.s. intended capabilities), to increase the degree of

participation in the development of plastic pieces[70], etc,. Therefore, the trajectory of each firm depends on its relationships with specific counterparts and on its options relative to the ways they seek to deal with diversity in their portfolio of relationships. The analysis of the cases also suggests that the creation of new knowledge and learning and diffusion of knowledge in an industrial sector does not only depend on the number of firms in the sector, but also on the kinds of interaction between the actors and the connectivity of the relationships involving each actor.

5. Conclusions

Adopting the industrial network perspective to look at the division of work in the moulds industry and at the mechanisms used to integrate diverse specialities allowed us to interpret the trajectory of each firm on the basis both of the roles of its relationships with specific counterparts and of the connectivity between these relationships.

Direct and indirect capabilities were found to co-evolve through time, each set of capabilities influencing the other one. The structure of indirect capabilities of each firm cannot be described or understood by merely listing the firm's access to other actors' capabilities. If it is kept in mind that each actor is embedded in relationships with specific counterparts, then it becomes apparent that the trajectory of each firm also reflects the role of those counterparts and the ways the firm deals with diversity on its portfolio of relationships. This study also supports the perspective that the potential for learning and diversity on an industrial sector depends not only on the number of firms and the existing capabilities, but also on the forms of interaction between actors and the connectivity between relationships involving each one. The existence of intermediate institutions, like technological centres, briefly referred in the cases, suggests that they can also be relevant at least for the processes of codification and diffusion of knowledge in an industrial system, in part due to their role in connecting actors with different capabilities and interests.

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[70] Von Hippel (1998) analyses and illustrates a quasi-contrary situation. The stabilisation of the internal activities of a supplier can be achieved by transferring to the user the realisation of specific activities.

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