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Competition and cooperation in a metal engineering production system

di

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Abstract

In the discussion on the prospects for growth of the manufacturing system in Italy one still unsolved problem stands out: the small size of the firms. There is a great concern regarding not only sectors facing strong competition from countries with a low labour cost, but even sectors with a good position in the world market, as the engineering firms in the province of Modena. As a matter of fact, in the mechanical-engineering sector there is a large number of small firms and only very few firms belong to "groups" (and instances of foreign groups are rare): small size of independent companies is considered a sign of weakness that could be a mark of their inability to operate on international markets and thus to face the challenges of globalization. The paper investigates the systemic characteristic of the mechanical-engineering production system in Modena and the strength of many short chains of linkages within the network of companies operating at local level for the global markets. Our focus is the dynamics of change of the system. The literature on industrial districts has frequently emphasized how the firms that operate in the district are in competition with one another, when it is a question of firms specializing in the same stage of the production process; whereas they cooperate in the case of firms operating in different stages in the same production filière. This particular pattern of competition and cooperation among firms specializing in a stage could be one of the distinguishing marks of the system ("equilibrium" factors, as Brusco, 1989 and 1999, calls them). This explanation supposes that the firms can be either in competition or cooperating, we find forms of competition, for certain activities, among firms that cooperate for other activities. The data on the presence of competitors among the supplirs or the clients give an idea of how extensive this phenomenon is in the Modena engineering system.

In this paper we show that the weak points of Modena's mechanica-engineering industry lie not so much in the size of the firm as in the mechanisms that fuel and regenerate the competences needed to sustain the development of the network of firms. This line of research opens new question in the analysis of market systems and network of competences that are addressed in the last part of the paper.

Key words: local production system, mechanical-engineering firms, cooperation, competition, market system

JEL classification: L16, L25, L20, L60

Weak points or strong points in a local productive system?

In the discussion on the prospects for growth of the engineering firms in the province of Modena one still unsolved problem stands out: the small size of the firms[1]. The data are unequivocal: more than 60% of the firms employ less than 20 persons and the sales of these firms are destined in the majority for the local market (provincial or, at most, regional). In the engineering sector, moreover, very few firms belong to groups (and instances of foreign groups are rare): these, too, are therefore signs of weakness that, in the debate o small size and their operating mainly in the local market could be a mark of their inability to operate on international markets and thus to face the challenges of globalization.

In this paper we propose to show how this analysis may be misleading and the weak points of Modena's engineering industry may lie not so much in the size of the firm as in the mechanisms that fuel and regenerate the competences needed to sustain the development of the firms. Our argument will be underpinned with the data from the research project *Struttura e dinamica del cambiamento nelle relazioni tra le imprese metalmeccaniche nella provincia di Modena* (Structure and dynamics of change in the relations among the engineering firms in the province of Modena) and with the analysis developed around the "Officina Emilia" project. Before illustrating the salient points of the research, of which we have concluded a first stage of data analysis, let us take a step backwards in time and space.

Nearly thirty years have gone by since the publication of Sebastiano Brusco's essay on the engineering industry at Bergamo[2], one of the most original contributions in the literature of industrial economics. In that essay Brusco reveals the basic error, in methodology and analysis, that vitiates the debate on the prospects of growth in Italian manufacturing industry: a debate that then, as often now, sees in the small size of the firm an intrinsic limit to the opportunities for development by Italian industry — for, could not the large firm enjoy advantages from economies of scale (in production and distribution, or in drawing on external financial resources) and thus be more efficient than the small firm?

Brusco, in that essay, warned us that the size of the firm in terms of employees is not a sufficient indicator for assessing the efficiency of firms; and this for two reasons. Firstly, at parity of type of product, firms of different sizes could have within

themselves a different composition of the production stages: we therefore need to classify firms not only with respect to their size in terms of employees and production volume (generally measured by a raw indicator such as the firm's turnover) but also with respect to the level of vertical integration — of which statistics offer no adequate representation. Secondly, if the process can (technically and economically) be broken down into stages, the economies of scale of the stage, rather than those relating to the process as a whole, will be the analytical referent to assess the efficiency of the firm specializing in a particular production stage — a theoretical argument that resumes the discussion on the Smithian theorem of the division of labour put forward by Stigler in 1951. Any analysis of efficiency must then take account of these two dimensions: what the firm produces and how it produces.

The publication of that essay in 1975 provoked a whole series of studies that attempted to reply to a question implicit in the analytical formulation put forward by Brusco: what is the mechanism of coordination of the decisions (in terms of amounts to be produced and prices of products) that enables firms specializing in one or a few stages in the production process to produce efficiently, not only a individual firm level but also at "system" level? In this way, attention shifts from the reference to a notion of efficiency of the firm operating in an impersonal market of perfect competition to the notion of efficiency of the system of firms that interact, not only by trading goods and services among themselves, but also by exchanging, through multiple channels, information on technology, on the final markets for products, and on the markets providing raw materials and semi-finished items.

The analysis of the nature and forms of those interrelations, of the institutions that foster that transmission of information, of the peculiarities of the innovative processes that can be implemented within a system of firms with those characteristics — such analysis has, for two decades now, been a fertile ground for discussion on local production systems and industrial districts: a debate to which the analysis of the productive system of engineering at Modena can valuably contribute. In fact, if we go further in depth in the analysis of the data enquiring what the firms produce and how they produce it (thus following Brusco's indications thus) a very different world is revealed to us: we dicover that there is a huge number of different products, many cases of specialized operations and processes, together with the presence of artists in "made-to-measure" production. These factors are by no means a weakness of the

system, but rather its particular strength, to be exploited and preserved in the globalization of the markets, where competition is no longer merely between firms but between territories endowed with knowledge and innovative abilities. Hence, the challenge to be faced seems to be not so much the one confronting the individual firm (in order to increase its size in terms of employees), but rather that of the territory in which the firm operates, and thus one of the institutions that in this territory must contribute to exploiting and sustaining the networks of competences that criss-cross the firms and the social system and encourage innovative processes. And among these institutions are undoubtedly those of high eduaction and research. But the challenge can only be faced if the whole system of education and training (from basic to technical and professional training) is able to seize the opportunities (and appreciate the needs) for change.

The data collected in the empirical survey enable us to perform a first reflection on certain topics of this research perspective, two of which will be presented in this essay: the internal linkages within the system of engineering firms and the connections beween that system and other local productive systems that are of importance not only for the regional but also for the national economy. For, in the province of Modena, metal engineering production features as a system of firms that nourishes the innovative processes in other manufacturing systems — of strategic importance for the economy of the province — that weigh very large also in the national economy, such as the specialist production of motors, of food items, of biomedical devices, and of ceramic tiles.

Engineering firms: products, sectors of use and vertical integration

Why study the relations among the engineering firms? Theoretical aspects and implications for development policies.

The rich tissue of mechanical competences diffused in the province of Modena has been a crucial factor for the development of the local productive systems — not only in mechanics but also in ceramics and the biomedical field — whose products are largely destined for markets in and outside Europe. How these competences have filtered down in the social structure is amply documented in the studies on the post-World War II period, contained in various papers[3]. Analysis of the changes ongoing in this last decade is, however, lacking, for there are few data and the knowledge

available is fragmentary and often inconsistent in itself[4].

The research project entitled “Struttura industriale e dinamica dei cambiamenti nelle relazioni tra le imprese metalmeccaniche – METALnet” aims to assess to what extent the specializations present in the area have altered, whether the reliance on subcontracting outside the area has changed, for which products and from which areas; in addition, to what extent the geographical, but also the technological, area has expanded to which the Modena subcontractors offer production stages and components. Evaluation of these changes would be useful for an appropriate interpretation of the prospects for growth of the economy of the province of Modena, where the metal engineering production system plays a sustaining role.

The research project has three main goals.

Firstly, to acquire knowledge of the structural data relating to the engineering sector as a whole: for, only in this way can the qualitative analysis of the networks of relations that underpin the innovative processes be given due weight. This qualitative analysis can be performed on a limited nucleus of firms that will be representative of types of firms identified in the structural survey.

The second objective is to devise a methodology that will give theoretical and empirical support to a view of the firm as an agent capable, through interaction with other agents, of modifying the environment in which it operates. In this research perspective the firm is considered in its multiple relations (technical, commercial, personal) involving persons who work inside it at various levels.

The third aim is toformulate a modelling of the way in which the networks of competences that fuel the innovative processes emerge and change. These networks are a decisive factor of competitiveness in the systems of firms. In this, the empirical survey is an indispensable tool for defining the important elements of the model. It enables us to split up the set of engineering firms into five dimensions, viz: type of product, tecnology, relations with competing firms, with firms supplying products and services used in firm activities, and with firms to whom they sell their own products and services. Once an appropriate partition of the set of firms has been effected, a survey will be performed aiming to identify the typology of the networks of competences that characterize the system of engineering firms of the province of Modena. The survey from which the networks of competences active in a sample of firms of each type (through a snowball sampling technique) will be reconstructed

empirically, will enable us to generalize the types of networks of competences to the entire population of firms, and hence the multiple forms through which the innovative processes in the system of firms under survey fuel themselves.

The results of the empirical survey

In the period March-May 2001 the interviews were performed with a sample of 331 firms with more than 5 employees: the willingness of nearly 50% of the firms of the sample to supply the data required in the questionnaire enabled us to obtain results highly significant[5] in the analysis of the engineering firms in the province of Modena, by class of size.

From the empirical survey, we can estimate that, in 2000, in the province of Modena 1,309 engineering firms were active, with more than 5 employees, giving an overall employment of 41,746. It is this population of firms on which our attention is focused; in particular, our elaborations must refer to two types of firm. We have called "final firm" ("imprese in conto proprio") those firms whose activity is performed autonomously (though the design may be partly or even entirely specified by the client): and subcontracting firms ("imprese conto terzi") those firms performing production to specifications from the client, with design by themselves or by the client[6].

From the data on the number of firms or of employees of the two types of firm (reported in Table 1 and Graph 1) it emerges that a little over 60% of the firms work in subcontracting and account for almost 37% of the overall employment. The subcontracting firms are mostly smaller than the final firms (their average size is 20 employees, as against 49 for the final firms) and have an average turnover of about one quarter of the final firms.

Table 1 Graph 1

What do the engineering firms of the province of Modena produce? More than 40% of the turnover of the final firms (graph 2a) derives from the sale of single pieces: these products, indeed, account for three quarters of the turnover of the final firms in the 6-9 employee class, and are a sizeable though declining share of the turnover also in the final firms in the classes of 10-19 and 20-49. If we break down the turnover with respect to production as per catalogue (graph 3), it emerges that over 10% of the turnover of the final firms stems from production of items not as per

catalogue, performed to the client's design: these firms specialize in the production of a very wide range of items for a very large number of customers; they operate mainly on local markets for clients who, in turn, operate on national and international markets. These firms, then, seem to be able to find a market for their own products and do not depend on their clients.

Graph 2 Graph 3

The near nine hundred products of the final firms are destined for a small number of sectors: suffice it to think that 48.1% of the turnover stems from sales to the food industry and the hospital services sector, which account respectively for 26.5% and 21.6%. There are five other sectors accounting overall for 27.2% of the turnover: machinery for the ceramic tile industry (8.5%), excavators and building site machines (5.4%), car sales (5.1%), machines of general employment (4.3%), vehicle maintenance and repair (3.9%)[7].

Though to a lesser extent, the production of single pieces and prototypes accounts for a large share of the turnover also in subcontracting firms (about 20%). In general, the more than 1,400 items of the engineering firms that work in subcontracting are destined for about fifteen sectors, the foremost of these (with 14.3% of the subcontracting turnover) being the electric lamp and safety systems industry, featuring the specialization of certain firms subcontracting production for Beghelli. Other sectors are the production of machine tools (13.7%), ceramic tiles (10.7%), mining equipment (4.9%), domestic appliances (4.1%). About ten sectors account for between 1.8% and 4%: vehicle repair and maintenance, railway and tram rolling stock, aircraft, bicycles, automatic feed machines (Campogalliano produces weighing scales), services for dry cleaning.

Let us now look at the mean percentage of turnover in five geographic markets, by type of firm and class of size. The final firms export over 56% of their sales (more than half of this outside the EU), with regard to the sales in the domestic market, 19% are sold in the region and over 25% to customers in other regions of Italy. The subcontracting firms, instead, export a scant 12% of their sales (here, too, the sales destined to extra-EU markets reach more than half of the exports, though only just). In the domestic market the provincial and regional market prevails, accounting for almost 67% of sales (44.5% being in the province of Modena).

The province of Modena is the main market for the firms with less than 10

employees (whether final firms or subcontracting firms) and remains the main one also for subcontracting firms in the 10-19 employee class.

These data show certain basic distinguishing characteristics of the two types of engineering firms and we wish to underline how these differences are reflected in many aspects of analysis on the connections inside and outside the system of engineering firms.

Level of vertical integration of the firms

The variety of productive specializations of the engineering firms goes hand-in-hand with a variety of choices regarding which stages to perform in-house and which to decentralize. From the elaborations preliminary to the analysis of the level of vertical integration of the firms (graph 4) it emerges, firstly, that while more than 90% of the final firms perform planning and designing activities, these are performed by only one third of the subcontracting firms. A large part of the administrative services (highlighted in a blue square) are performed in 85% of the final firms (though one out of four of these firms does no market analysis). Overall, the administrative services are less present in the subcontracting firms (and, in particular, one out of four of these does no analytic or warehouse accounting).

Graph 4 and Graph 5

Graph 5 shows to what extent each stage is performed in-house, by other firms or by firms of the group. Among the administrative services, making up the pay packets is essentially done by specialist firms (though 15.7% of the final firms do it in-house). About 20% of the final firms decentralize planning and design, whereas more than 50% of the subcontracting firms do not perform this stage in-house.

The stages of assembly of mechanical parts, final installation, checking and testing, technical service to customers and transport of goods produced — that involve about 80% of the final firms — are largely carried out in-house in the “impresa conto proprio” and, to a lesser extent, in the subcontracting firm. The assembly of electrical and electronic components, in which some 80% of the final firms are involved, but less than 30% of the subcontracting firms, is performed in-house only by half of the final firms, whereas it is carried out in-house by a large proportion of the subcontractors.

There are then certain transformation stages — present in less than 30% of the

final firms — that are not carried out in-house but commissioned out: dye-founding, casting and sintering, “deformazione a caldo”; in the case of chemical and heat treatments and surface treatments, few final firms perform these stages in-house. Among the subcontractors, the foundry stages are largely performed inside the firm.

Although belonging to groups is a fairly restricted penomenon, the elaborations presented in graph 5 show how the final firms receive from the firms of the group above all administrative services, but also planning and designing services, transport and certain special stages (“deformazione a freddo” and, to a very small extent, founding and stamping); in the case of the subcontracting firms (less of which belong to groups than do the final firms), they receive from the firms of the group, in larger amount, also planning and design, technical assistance and transport services.

The economies of scale and the team work[8] come into play when we are required to account for the high percentage of cases in which there are external stages: founding, casting and sintering, deformazione a caldo, chemical and heat treatments, surface treatments, but also painting, are production stages in which there are significant economies of scale that justify their use for a great range of users in the system. These stages do not convey strategic information on the product and can thus be exploited enabling all the firms in the system to draw on them, according to their specific needs, in terms of quantity and frequency of production flows.

We must now identify a series of indicators that will describe how the organization of the production process runs through the tissue of production and commercial relations of the system of firms. To this end, we note, first, who are the suppliers of the engineering firms and, subsequntly, who are the clients of these firms.

Who are the strategic suppliers?

In order to draw a picture of the network of vertical relations, the empirical survey made an in-depth collection of data on the characteristics of the suppliers of the firms, subsequently concentrating the analysis on those whom the firm considered to be strategic.

Firstly, the quantity of habitual suppliers varies with the variation of the size in different ways between the two types of firm (table 2). In confirmation of the thesis that the small-sized final firms (6-9 employees) mainly perform activities of planning, assembly and testing, we find that the mean number of habitual suppliers of these firms is 123, a figure much larger than the average. In the 10-19 employees’ class of

size, the mean number of habitual suppliers falls to 34 and then rises as the employees' class of size rises. In the case of subcontractors, on the contrary, the amount increases as the size increases, with the exception of the largest class, which is probably influenced by the strong specialization of the firms in that class. Only to a small extent are the habitual suppliers of the firm enterprises working mainly for engineering firms (table 3): on average, out of 86 habitual suppliers of the final firmsand 35 of subcontractors, respectively, only four and two work mainly for the commissioning firm.

On average, the final firms indicate as strategic about 14 suppliers, while the subcontractors indicate 5 (table 4).

Tables 2, 3, 4

Of the nine characteristics registered in order to get a profile of the strategic supplier of the final firms we find in first place the supply of a better quality: for nearly 70% of the final firms this is the main characteristic that defines their strategic supplier; 57.3% of the firms also note that "strategic" are the suppliers who have an availability of specific equipment and slightly less than 50% are also distinguished by reliability in delivery time and have enjoyed long acquaintance. The fact that the supplier may apply a lower price or may be able to develop new products is an important feature only for 35% of the firms; having ISO certification is a characteristic of strategic suppliers only for 30% of the firms; much lower is the percentage of firms that indicate among their strategic suppliers those providing a single component or a single production stage; lastly, only 6.2% of the firms indicate as strategic those suppliers who have a patent on the products purchased from them.

In the case of subcontractors, the characteristics that render a supplier strategic are different: the lower price, prompt delivery and long acquaintance become decisive factors. The picture is very differentiated by class of size and we have not the space to comment on this analysis here. Let us, instead, focus on which products and stages are offered by the strategic suppliers (graphes 6a and 6b). Of the thirty items in the table, we find that, for final firms, 50% of the strategic suppliers perform stages of metal carpentery, produce raw materials, parts of machines, and electric mchines (e.g. motors). Next, in decreasing order from 6.8% to 3.3%, come some further ten productions: from production of mechanical components to stages involving machine

tools. The strategic suppliers of the subcontracting firms are, for about 35%, suppliers of raw materials; much smaller is the percentage of strategic suppliers who perform production stages on machine tools (which, on the contrary, have much greater importance for final firms) and suppliers of commercial components.

Graph 6 a and 6b

To sum up, suppliers who offer machine parts and components (broadly speaking, from carpentery to components) are strategic suppliers for the *conto proprio* firms; while, raw materials sellers and producers of stages performed on machine tools are strategic suppliers for the subcontracting firms.

An intermesh of vertical relations, therefore, differentiated by the two types of firm but that, in both cases, has 70% of the strategic suppliers located in the region (graph 7) and a good 50% in the province itself; and the share of strategic suppliers of subcontracting firms located in the province of Bologna is significant at 15.3%. There are few strategic suppliers abroad.

Graph 7 and Graph 8

The relations with the strategic suppliers are of long standing — on average, 10 years, whether for the conto proprio or the subcontracting firms.

How do the firms exchange information with their strategic suppliers? For more than 60% of the firms — whether cont proprio or subcontractors (graph 8) — direct visits are a very frequent form of contact (often, mainly, always); the firms make great use of the telematic networks (the subcontractors less than the conto proprio) and more than 40% of the firms communicate with their strategic suppliers by e-mail. The important direct visits are accompanied by other forms of communication: mutual discussion and seeing the technology working are considered indispensable for full integration — in the production process performed inside the firm — of the stages that the firm purchases from outside; these elements are the easier the deeper is the reciprocal knowledge acquired through repeated interaction ongoing over many years.

The principal clients

These data show very tight bonds between the firms and their strategic suppliers. Let us now see what are the relations between the firms and their clients.

In particular, if we take the amount of turnover achieved with the three main

clients as an indicator of the degree of independence of the firm from its clients, we find that there are significant differences both as regards the comparison between conto proprio and subcontractors and as regards the size of the firm. Firstly, we see that the conto proprio firms (table 5) register on average 54.4% of their turnover with their top three customers, with the principal customer accounting for over 30%. Whereas the smallest firms (6-9 employees) achieve almost 90% of their turnover with their top three clients, it is the conto proprio firms with more than 10 employees who present a greater diversification of clients (though the concentration of sales to the top three clients is very high).

Table 5

As regards the subcontracting firms (table 6), 72% of the turnover is accounted for by the first three customers and for the small sized firms the share of turnover exceeds 90%, thus confirming the thesis that the smallest firms (regardless of the type of activity performed) are closely dependent on the demand of few (or very few) clients. Among the other classes, there are differences, though these do not appear to have a trend correlated with the size of the firm. With respect to the conto proprio firms — as well as beng more dependent on the top three customers — for the subcontractors the top client has greater importance, accounting for an average 50% of their total turnover.

Table 6

These differences do not necessarily mean that the subcontracting firms are unable to diversify their portfolio of customers: these firms base their activity on the working and production of components or semi-finished items with specific characteristics projected for, and in collaboration with, other firms. For, if we measure the importance of the relations with the commissioning firms with the average number of years in which the main client has been present among the top three clients, we shall see that the number is, on average, higher for the subcontracting firms (about 14 years, as against 9 in the case of clients of the conto proprio firms).

To a large extent, both the conto proprio firms and the subcontractors have long-standing relations with their principal customers and predict that the three top clients will be the same ones in the period 2002-2003; in particular, however, the conto proprio firms show a more marked tendency to have stable customers. Only the firms with over 99 employees (both conto proprio and subcontractors) foresee a different

composition of their more important clients in the next two years.

From an examination of the characteristics (size and location) of the clients of the Modena engineering firms it emerges that 70% of the total turnover of the conto proprio firms stems from sales to industrial firms (of all sizes, but with a preponderance of medium-sized firms), with a little over 20% from sales to commercial firms or agents (sales to whom are made mainly by firms with over 50 employees, whereas the clients of the smaller ones are predominantly industrial firms). As regards the subcontractors, the total turnover divides essentially into 60% (with differences of a few percentage points between the different classes) of sales to medium-sized industrial firms, 26% to small industrial firms and 13% to large firms. While around 36% of the conto proprio firms have their principal customers in Emilia-Romagna, almost 90% of the subcontractors have their main customer located in the region.

Within the region it is again the province of Modena that prevails (between 64 and 45% according to the importance of the client). In general, for the majority of the subcontracting firms, the main clients are located in the macro-area represented by the provinces of Modena, Bologna and Reggio Emilia. If we recall that for the subcontracting firms the top three customers account, on average, for 72% of the overall turnover, this analysis enables us to confirmthe hypothesis that Bologna and Reggio Emilia represent two important areas for identifying a local market that extends beyond the mere bounds of the province of Modena. The Modena-Bologna-Reggio Emilia area contains 55% of the firms with 63% of those employed in the engineering sector in Emilia-Romagna[9], and thus constitutes an important nucleus of firms rich in specializations and intense subcontracting relationships. A more complete definition of this “local market” would require systematic analyses, aiming at an in-depth study of which are the technical, productive and socio-economic relations by which it is characterized.

Subcontracting firms: their relations with the commissioning firms

In the case of the subcontracting firms, their relations with their clients enable us to study in-depth the matter of their independence. The analysis, presented at a recent conference[10], will be recalled in what follows with reference to the frequency of the collaboration — between subcontractors and commissioning firm — in the activities

of design and of research and development.

Table 7

The data are reported in table 7, where eight types of firm are: a little over half the firms that work in subcontracting provide no collaboration in design and are either never or only very sporadically involved in research and development (groups 1 and 2)[11]; more than one quarter of the firms do in some cases (sporadically or only for some clients) collaborate with the commissionng firm in projecting the stages or the products commissioned (group 3) and less frequently in research and development (group 4); there remain a little over 20% of the subcontracting firms that are more active in the design than the commissioner (groups 5, 6 and 7), and among these there is a nucleus of about 6% of all the subcontracting firms that always, or almost always, take part both in designing and in research and development (group 8). Of the eight types of firms thus identified with respect to the degrees of collaboration in design and in research and development, we shall consider the most important in numercal terms: groups 1 and 6, 7 and 8. In particular, we compare certain characteristics of group 1 and group 8, remembering that the firms of group 1 never collaborate either in the design or in the R & D, whereas those of group 8 always collaborate both in the design and in the R & D. The characteristics that we shall take into consideration — as summarized in table 8 — will enable us to trace out some working hypotheses in order to assess the strong and weak points of these types of firm.

Table 8

The overall picture might lead us to conclude that the firms that do not collaborrate either in the design or the R & D are potentially weaker than those that do collaborate. The analysis requires to be further developed, but there is a first result on the innovative ability of the different types of firms that we wish to submit for discussion.

Using the introduction of new products as an indicator of how innovative a firm is, we discover that the firms of group 1 are well placed: they introduce new products to a greater extent than the average, even if not as much as occurs in the firms of groups 6, 7 and 8. These are however products whose devising and design relies on abilities outside the firm. For that matter, this finding is consistent with what emerges from the datum that characterizes this group of firms: they never collaborate with the commissioner either in the design or in the R & D, but this does not imply that these

firms are not active in seeking the right links in order for themselves to introduce modifications in the products.

Those of group 1 are firms that predict growth (in number of employees and amount of turnover) even though conditioned by lack of specialized workers — a factor that is less constricting to the expansion of the firms of group 8.

Niche markets and client-competitor and supplier-competitor relations: an analysis of the competition

The vertical relations with suppliers and clients are also influenced by the vertical relations with competitors, and it sometimes happens that among the competitors there are some suppliers and some clients. Let us then consider some of the data relating to the competition in the conto prprio firms and the subcontracting firms, starting from the level of competition found in the empirical survey.

All told, among the engineering firms in the province of Modena that operate mainly as final firms, 19 out of 100 declared that they had no competitors (graph 9a); 44.3% of the conto proprio firms having 6-9 employees operate effectively in niche markets, as do one quarter of the firms in the 10-19 size class. Competition is, instead, very strong, or strong, above all in the conto proprio firms with over 50 employees.

Graph 9a and 9b

In assessing the level of competition among the subcontracting firms (graph 9b) the judgement of an “average” degree of competition indicated by firms of the 6-9 employee class has great weight. In general, the competition is strongest among the subcontractors, who note the absence of competitors only as regards the size classes of 10-19 and 20-49 employees. These results are heavily affected by the productive specialization of the firms and it will thus be necessary to analyse further in depth, considering the charactristics of the products of the firms.

Among the factors that represent a competitive advantage for the firm (graph 10), what stands out immediately is the tradition of reliability, a factor whose importance is seen as high or very high by 80% of the firms interviewed; immediately after this, with a percentage of around 70%, comes the ability to respond to the particular demands of client or commissioner. The capacity to offer qualitatively better products is an important factor on which firms (especially the conto proprio ones) seem to rely

in order to face up to competition. For the conto proprio firms a further factor that enables them to differentiate themselves with respect to their competitors is the ability to design, which, in contrast, carries little weight with the subcontracting firms. Greater speed in execution of orders, larger range pf products (or services) offered and endowment with specific equipment for particular production stages or needs of the commissioning firm — these are, instead, the elements of competitive advantage of the subcontracting firm.

Graph 10

In contrast, no special competitive advantages appear to stem from low production costs or low sales prices, the ability to promote sales or to apply more favourable conditions of payment.

Table 9

These considerations can be further investigated by looking at the average number of competitors declared by the Modena engineering firms. In this way we can evaluate the degree of competition perceived by the firms, through a quantitative datum (table 9). Although on average the number of competitors stated by the conto proprio firms is almost double the number of those stated by the subcontractors (respectively 25 and 15), there are notable differences between the two types of firm in the various classes of size.

For example, in the conto proprio firms of the 6-9 employee class, where the share of firms stating no competition is 44.3%, the average number of competitors is fairly low, whereas it is decidedly higher in the 10-19 and 50-99 classes.

In the case of the firms doing mainly subcontracting work, on the contrary, there do not seem to be sharp differences between the various classes of size in terms of numbers of competitors, but the competitive pressures are not all of the same amount.

As regards the competitors (tables 10a and 10b), for the conto proprio firms they are located in some cases in the provinces or in other parts of Emilia-Romagna, but mainly in other parts of Italy. For that matter, the conto proprio firms stated that they traded their own products for the most part outside the local market, and it was there that they encountered competition from other non-local firms. In contrast, the firms working mainly in subcontracting have the majority of their competitors inside the province, and only to a lesser extent in other provinces or regions of Italy. This datum is evident above all for the small firms, whereas the larger ones seem to show a more

heterogeneous distribution of the localization of their competitors[12].

Tables 10a and 10b

Since one of the objectives of this research is the analysis of the relations that are set up among the firms in a local productive system, the interviewees were asked to state the presence of competitors among their suppliers (for the conto proprio firms) or among their clients (for the subcontracting firms): our hypothesis is that these relations spark off one of the dynamics of change of the system of networks of competences that permeate the engineering system. In their contacts with suppliers or clients, the firms exchange not only goods and services but also flows of important information regarding: the technologies at various points in the production process where their speciality comes into play; the characteristics of the clients and the distribution channels; the characteristics of the other firms with the same specialization. From analysis of the data (table 11) it emerges that one third of the conto proprio firms (and among these none of the class of 6-9 employees) have suppliers who are their competitors as regards certain products or stages; the relation of competition manifests itself within the same sector and in the same geographic area for the majority of the firms, except for the 20-49 class, for which the firms operate instead in different geographic areas.

Tables 11 and table 12

Among the firms involved mainly in subcontracting (table 12), the percentage of firms having competitors among their own customers is a little higher (36%), but there are considerable differences between the classes of size: indeed, in the class with over 99 eployees all the firms state that they have this particular type of relation with their own customers, whereas in the 50-99 class the proportion falls to 50%, though remaining above the average. Moreover, as regards the larger firms, the clients are competitors both in the same sector and geographic area and in the same sector but in different geographic areas; in the other size classes, on the contrary, the competition develops mainly within the same geographic area.

Considerations for further development of the analysis of the local productive system in engineering

To conclude the analysis presented in this essay, we propose not so much a synthesis of the principal findings, as a look at the problems that still remain to be

solved and, therefore, at the orientation for a new stage of research that, starting from the findings of the empirical survey, will further analyse the "networks of competition" and the ensemble of relations (technical, productive, social) in the context of which the competences emerge and exert their effect.

In much of the literature on corporate economics and industrial economics the concept of competence is applied at the level of the individual firm or person. It is our opinion, instead, that may of the competences are activated by relations that *cross the bounds* of the firm, and concern, in particular, the relations between the firm and other agents (who could be the commissioners, the subsuppliers or perhaps the final users), but also the non-firm entities such as the professional associations or associations of enterprises, the organizations that define the standards, the public agencies and the laboratories of the universities[13]. Generally speaking, it would be as well to refer to a set of *agents* who interact with each other in a recurring *pattern* of interactions. These interactions are organized and unfold around a family of artifacts that itself evolvs in time. Through their interactions the agents produce, purchase and sell, deliver, install, commission, use and perform maintenance on the artifacts that go to make up a certain family; they generate new attributions of functionality of these artifacts; developing new artifacts that have the functionality attributed to them. In addition, the agents construct new agents, and fuel new patterns of interaction among the agents, in order that these processes may continue to take place in time — even when the circumstances in which they occur change in response to the perturbations that arrive, both from within and from outside the market system. We shall call *competence* every one of th activities that make up the processes listed above, and shall call *network of competences* a particular subset of agents whose interactions realize one of those competences.

We hold that it is necessary to work out a modelling of the way in which the networks of competences emerge and change, in which perspective the empirical survey will be an indispensable tool for defining the important elements of the model.

A systematic survey of the networks would seem to be in order, not only to provide indications for industrial and training policies (Russo *et al*., 2000) but also in a theoretical context. It must be borne in mind that the structure of these networks of competences may assume a fairly different form from what could be understood by the agents whose interactions aim to create it. In this sense we can say that the

structure of the networks of competences is an “emergent” phenomenon.

The absence of systematic empirical knowledge regarding the networks of competences is also the result of a deficiency of theory in this field. Suffice it to reflect that, up to now, the empirical studies that attempt to identify the competences of the firms starting from the mesh of social relations in which the firms operate have provided no precise indications of method to which to refer: the cases studied are, in general, very narrowly restricted both by the nature of the relations examined and as regards the sources of information used. An empirical survey of the networks of competences would thus be useful in order to learn how the structure of relations among the engineering firms works; it could be developed with reference to three problems around which to pursue in-depth the theoretical analysis, the empirical survey and the modelling: (a) the efficiency of the system, (b) the notion of competition relevant to the dynamic analysis of the system, and (c) the capacity for innovation. In spelling out the salient aspects of these problems, we shall indicate the lines along which to develop the research, in the form of questions.

The efficiency of the particular organization — locally hierarchic but globally heterarchic — of the activities of production and distribution, in the system of engineering firms

The METALnet investigation refers to companies operating in the province of Modena and producing several manufacturing products ranging from metal components and processes to machine tools, packaging machines, tractors: a wide aggregate coded as “metalworking activities” in the classification of economic activity usually adopted in industrial surveys (Ateco 1991, groups 27-35). Almost all of these production processes can be broken down into phases, most of which have very low minimum efficient size in terms of employees, but not necessarily in terms of value added or in terms of initial investment required to set up that specific stage of production. Strongly concentrated to a small range of industrial users, the output of the companies operating in this system is characterized by a multiplicity of products, manufactured by almost four thousands companies, many of them artists in “made-to-measure” products. A basic element characterizing this production system is the particular specialization of the firms in one or few stages of the entire process of production and distribution of the products. Four elements contribute to making this specialization efficient.

The first is the existence of a demand for stage products adjusted in terms of quantity (in order to reap possible advantages of scale) and variety of specializations in the components and semi-finished items (on which it may be necessary to rely in the course of production). How does the firm choose which specialization to undertake? To what extent is the choice affected by the history of the firm, by the personal background of the owner and by the persons who work in the firm? How does the specialization alter through time?

The second element is the flexibility of the firms specializing in identifying which is the time profle of the process of production and distribution of the products that optimizes — not only at stage level, but also at system level — the temporal integration of the specialized processes. The systemic perspective is not the result of an *ex ante* planning of the optimal time profile, but is the outcome of a multiplicity of processes of local adjustment (in which interaction occurs among several restricted groups of actors, sometimes two to two, in the vertical chain of supply). The time profile of the information flows (what to produce, how to produce, in what time to produce), of the flows of goods (purchase of raw materials and components, semi-finished items, OEM products) and the decision flows are thus important elements of the analysis of efficiency at system level. Which are the structures of incentives and priorities that govern these flows of information, artifacts and decisions? In what way and by whom are the structures of incentives and priorities decided and implemented? How are the various flows integrated with each other and how are they modified in time?

The third element to be considered in evaluating the efficiency of the organization of the system of engineering firms is that the interactions among the firms become denser within the firm and among the firms of the system in patterns of relations that generate networks of competences. The presence of a great number of these networks is a strong point in the productive system of Modena’s engineering. Which are the mechanisms from which the networks of competences stem? Which are the possible structures/forms of these networks? Do the networks of competences that emerge as a recurrent pattern of interaction among the firms of this system have the same form as those generated among productive units or departments of a vertically integrated firm?

The fourth element that we think peculiarly characterizes the efficiency of this

system of firms is the multiplicity of sectors (in terms of technical characteristics of the products, geographc and functional outlet markets) to which the “final” products of the system are destined. It is this multipìlicity that enables the firms of the engineering productive system to dispose of a wide range of basic competences that fuel a fruitful mutual influence in the diffusion of commercial productive technical knowledge in the processes of production and innovation. How does such a process of local contamination (personal interactions, formal interactions among the firms) come about? How are its effects generated at system level and, in particular, how do technological convergences and generative relations occur?

The particular forms of competition and cooperation among the firms

The literature on industrial districts has frequently emphasized how the firms that operate in the district are in competition with one another, when it is a question of firms specializing in the same stage of the production process; whereas they cooperate in the case of firms operating in different stages in the same production filière. This particular pattern of competition and cooperation among firms specializing in a stage could be one of the distinguishing marks of the system (“equilibrium” factors, as Brusco calls them)[14]. This explanation supposes that the firms can be either in competition or cooperating, but no intrinsic dimension of the dynamics of the system emerges, i.e. the operation of forms of competition, for certain activities, among firms that cooperate[15] for other activities. The data on the presence of competitors among the supplirs or the clients give an idea of how extensive this phenomenon is in the Modena engineering system.

In order to analyse in further depth the dynamics of change of the system, which may be set off by forms of competitive and cooperative interaction, it is necessary to refer to a theory of competition that features three leading aspects.

Firstly, the important comptition in such analysis is not the impersonal one mediated by price signals, in which everybody struggles against everybody: an interaction of this kind renders the market unable to generate relations. The notion to which we must refer is, instead, that of competition understood as a form of nteraction among actors who operate to bring ever-new products on to the market and to improve and at the same time change the existing products; and this can occur only on the basis of the ongoing, endogenous construction of mutual and recurring relations among firms that contribute to building a market system. Secondly, through such

competitive tension a social interaction is generated that fuels the capacity of the firm to identify the ways in which best to respond to the clients' demands. In most cases this is not achieved by offering the same product at lower prices but, rather, better, innovative products at equal prices. Lastly, the dynamics of the competitive process cause new artifacts and new markets to emerge — and also new actors.

Along these lines of theoretical investigation there are two themes relating to the interweave between cooperation and competition — that have emerged in the empirical survey of the system of engineering firms in Modena — that must be examined in greater depth.

The first concerns the dynamics of change in the system. In particular, through forms of vertical relations in te supply of goods and services, certain firms have acquired new competences that have enabled them to become competitors of the firms to which they formerly provided components, stages or semi-finished items. The dynamics of the system are therefore fuelled not only by the (horizontal) relations of competition, but also by those that may amerge from relationships that were formerly only vertical. Those vertical relations transmit, towards the commissioner, the flows of goods commissioned, but also, towards the subcontracting firm, the flows of information that feed the knowledge of the outlet markets, of the the characteristics of the final customers and the suppliers, and of the productive techniques available. In this process of transmission of information, as well as goods, some subcontracting firms may seize profit opportunities that arise out of operating (in "conto proprio") directly on the markets on which their ex-commissioners operate. In this case, the change in the organizational modalities of the firms is not exogenous but emerges as one of the opportunities within the relations among the firms of the system.

The second theme concerns the definition of niche markets as against the competitive markets. There are cases in which the action of small and medium firms in the engineering production system, specializing in niche products (e.g. special items produced in short runs), can be described in terms of competitive tension as against the operation of large "competing" firms, specializing in standard products (e.g; similar, not special, items in very long runs[16]). Although — from the point of view of the technical conditions of production, of the bargaining power to fix the price and the distribution channels for the products — the firms may differ greatly, there may be important forms of competitive interaction when the firm producing in

short runs sells to the same client of the firm producing in long runs. It needs to be emphasized that we do not think that long and short runs are interchangeable and competitive. As a rule, long runs refer to standard products, while short runs cncern custom-made items. In general, it does not happen that, for the same product, the customer is persuaded to substitute a standard item with a custom-made one. The point we wish to bring out is that by means of sale to the same customer a continuous comparison is generated on the technical opportunities and the conditions of efficiency that constitutes a reference for the action of the small firm specializing in the niche market, but which may become an important stimulus for improving the response to the client's demands, even for the large firm specializing in long production runs. It is not, then, a question of the type of conditioning usually dealt with in the literature, which ascribes technical, organizational and innovative superiority to the large firms.

What capacity to innovate has a system of firms with the features we have identified in our empirical survey?

The small size — in terms of employees and turnover — of the majority of the firms in the industrial districts is also a feature of the engineering productive system in the province of Modena. The smallness of the firm is still today seen as a cause that in the long term could have an intrinsically limiting effect on the generation of innovative processes. In order to be effective, it is claimed, these processes would be better activated by larger firms that are therefore capable of sustaining specialist activities in the research and development of new products.

On the contrary, the analysis of certain district areas, like the central part of Emilia-Romagna, would seem to show a peculiar innovative dynamic in the systems of firms of the districts (Russo 2000). This dynamic is characterized by generative relations and by networks of competences that, in the past, have activated innovative processes. The tools of theoretical and empirical analysis need therefore to be refined in order to assess whether these factors that fuel the innovative processes are permanent features of the particular system of firms of the districts or whether they are fuelled by forces that are not merely endogenous but also exogenous to the system of firms, such as the training system and the social institutions. How is the process that fuels generative relations and networks of competences capable of generating innovations activated?

As regards the questions posed in this section, the debate is ongoing and there are already some very interesting contributions developed by Seravalli (2001) and launched in two research projects complementary with each other. The first of these projects involves research groups from the universities of Modena and Reggio Emilia, Parma, and Venice: the topic is the analysis of the industrial districts as complex systems, and the intention in this research perspective is to focus the theoretical research on local development. The second project, called "Officina Emilia" (Emilia Workshop)[17] stems from the University of Modena and Reggio Emilia: an open workshop to develop a theoretical reflection on the themes of the maintenance of the networks of competences that generate technical innovations, an opportunity to invent and experiment how to fuel the social capital that has made this region a prosperous one.

NOTES

[1] This is a concern of the local institutions, as witnessed by the interventions in a recent conference on the findings of the METALnet research, but it is also a recurring topic in the debate on industrial policy at national level [Galli, Confindustria, June 2002].

[2] Brusco (1975).

[3] See Brusco (1989), Solinas (1994), Rinaldi (2000), Russo (1996, 2000), Rinaldi and Ruggeri (2001), Russo and Ruggeri (2001).

[4] For a review of these studies and a discussion of the methodological aspects of the surveys on the engineering industry performed in the 1990s, see Pirani and Russio (2001).

[5] The relative error is less than 5%. For the estimate of the weights and errors see Lalla (2001).

[6] 32% of the engineering firms in the province of Modena work exclusively in conto proprio, whereas 51% work exclusively in subcontracting. In general, there is a polarization that enables us to set at 50% of turnover the threshold that defines the "type of firm": a share of turnover lower than 50% identifies the firm as "conto propri proprio" while a share of over 50% characterizes the firm as "subcontractor".

[7] The sales to other sectors record markedly lower shares of turnover. In particular, the sales destined to the transport service sector, to industries, to manufacturing industries not otherwise classified, to the manufacture of machines for wood working and the manufacture of tractors range from 2 to 4% of the total conto proprio turnover.

[8] For the concept of team work used here see Bellandi (1994) and Seravalli (2001).

[9] Data from the 1991 census, elaborated in Russo and Pirani (2001), pp. 13-14.

[10] At the conference held by the Chamber of Commerce on 4 April 2002, the first results of the METALnet research were presented. In Russo and Pirani (2002) we presented the main results of the analysis that are summarized here.

[11] From a check of the individual replies collected in the empirical survey it emerges that the capacity for collaboration in research and development is not necessarily required in the planning — which explains the cases included in group 2. Our thanks to Renato Brescancin for helping to clarify this point.

[12] Note, however, that the small number of replies to this question may have lessened the significance of the result; these evaluations will therefore need to be treated in more depth in the subsequent stages of the survey.

[13] These ideas, developed in Lane *et al*. (1996), Lane and Maxfield (1997), have been applied to the analysis of the industrial districts in Russo (2000) and Lane (2002).

[14] See Brusco (1989 and 1999).

[15] See Brusco (1996).

[16] Thanks to Giovanni Bonifati for drawing attention to how this point, present in the analysis of competition proposed by Schumpeter, can be profitably studied also in the light of Georg Simmel's contribution in the analysis of conflict.

[17] For a synthesis of the activities performed in the context of the project "Officina Emilia – Laboratorio di storia delle competenze e della innovazione nella meccanica" see the website www.officinaemilia.unimo.it

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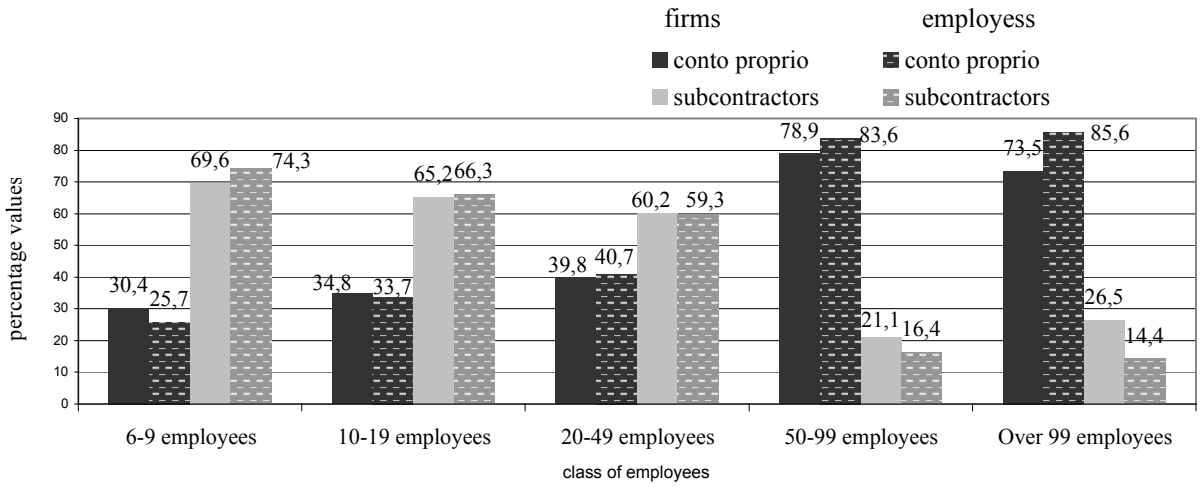
Tables and figures

Graph 1

Firms and employees by class of employees and type of firm (2000)

Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees

Source: our elaboration of data from interviews to the Unimec-Metalnet sample



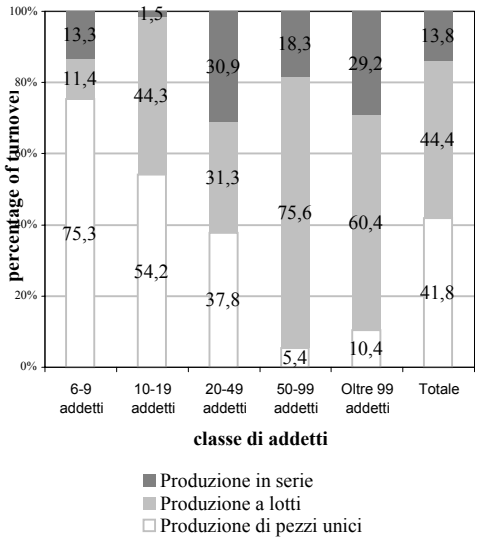
Graph 2

Percentage of turnover by type of production and class of employees

Values referring to the universe of the engineering firms of the province of Modena, with more than 5 employees

source: elaboration of data from interviews to the Unimec-Metalnet sample

2a conto proprio firms



2b subcontracting firms

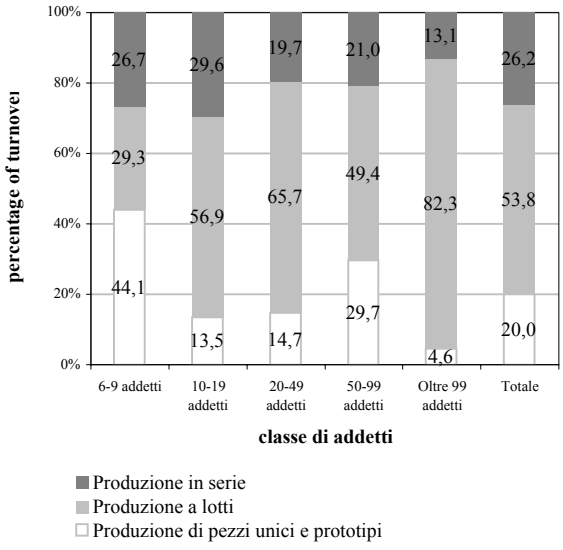
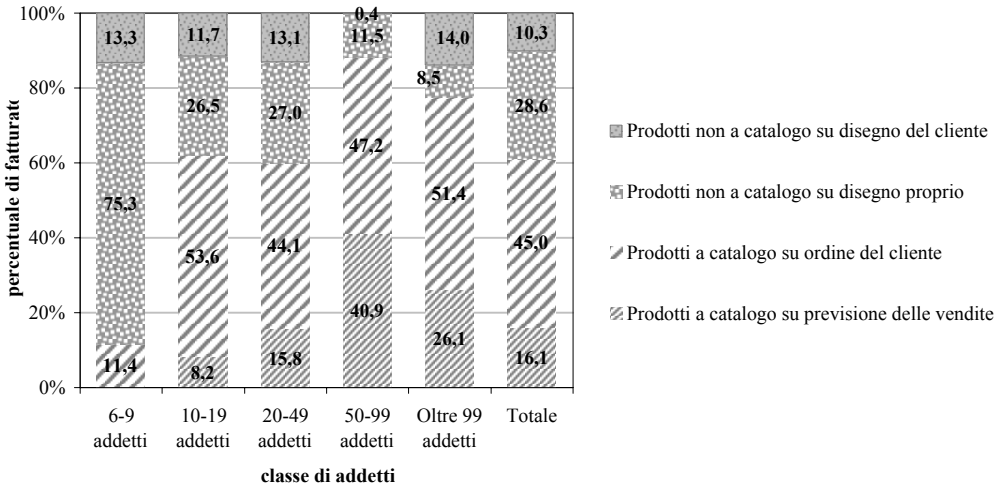


Grafico 3

Final firms:percentage by type of product and class of emplyees

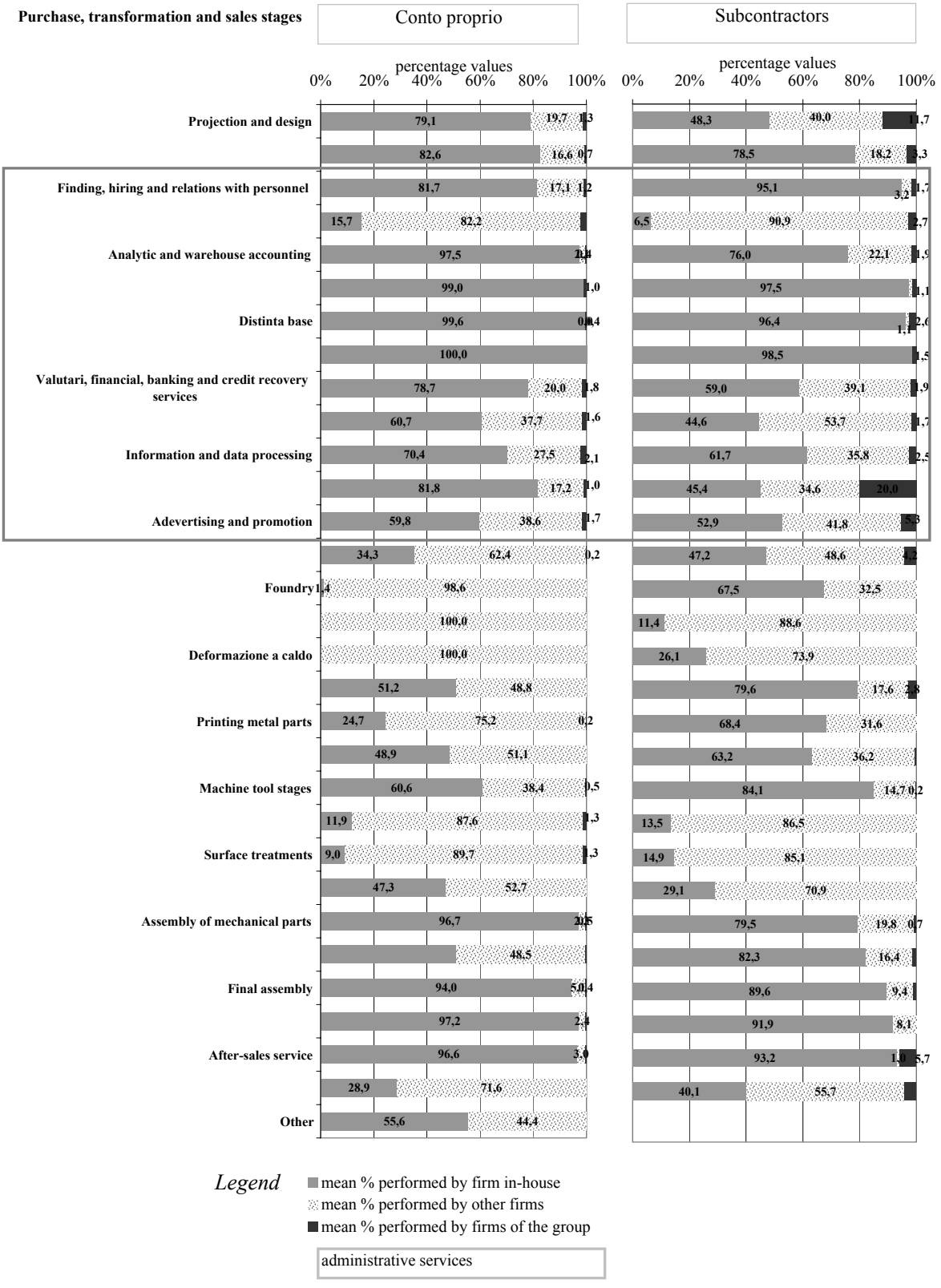
Values referring to the universe of the engineering firms of the province of Modena, with more than 5 employees

source: elaboration of data from interviews to the Unimec-Metalnet sample



Graph 4
Level of vertical integration in the engineering firms of the province of Modena (2000)
Percentage of conto proprio and subcontracting firms in which the stage indicated is performed
Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

Graph 5
Level of vertical integration in the engineering firms of the province of Modena (2000)
mean percentage of each stage of production, transformation and sales process performed in-house by the firms,
by firms of the group, or by other firms
Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

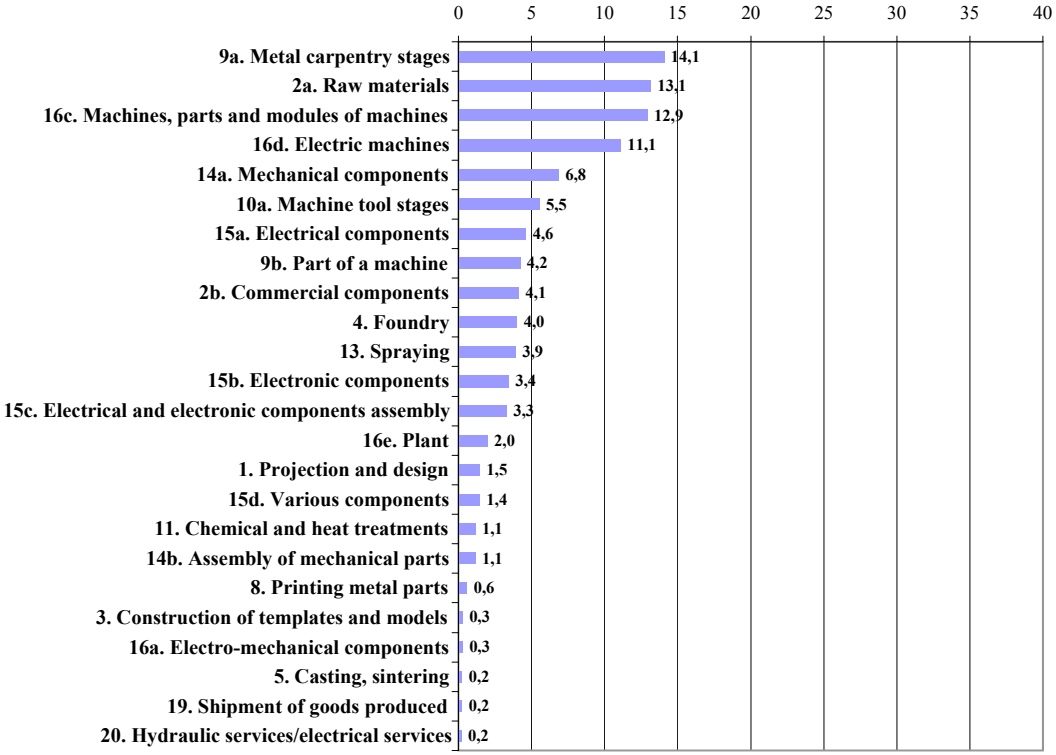


Graph 6

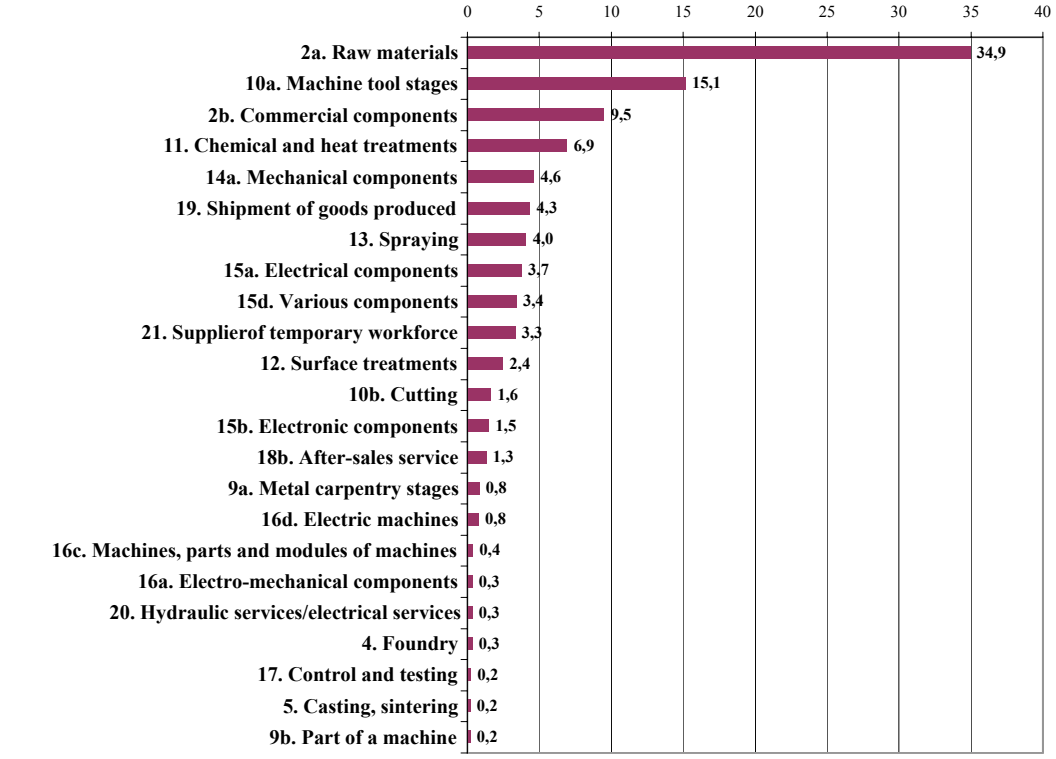
Distribution of components or stages purchased by the 5 main strategic supplier

Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

grapf 6a. Conto proprio firms



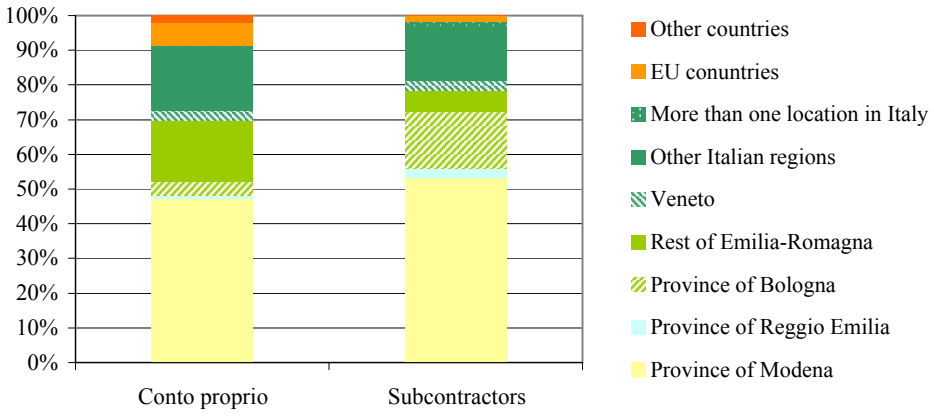
graph 6b. Subcontracting firms



Graph 7

Geographic localization of the first 5 strategic suppliers of the conto proprio and subcontracting firms, by class of employees

Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees
Source: our elaboration of data from interviews to the Unimec-Metalnet sample



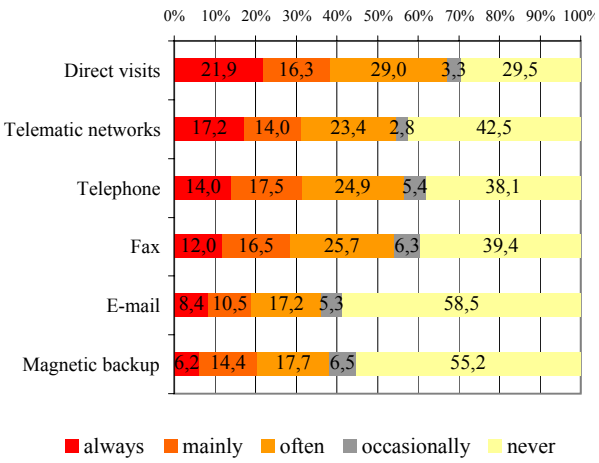
Graph 8

Ways in which conto proprio and subcontracting firms exchange information with strategic suppliers

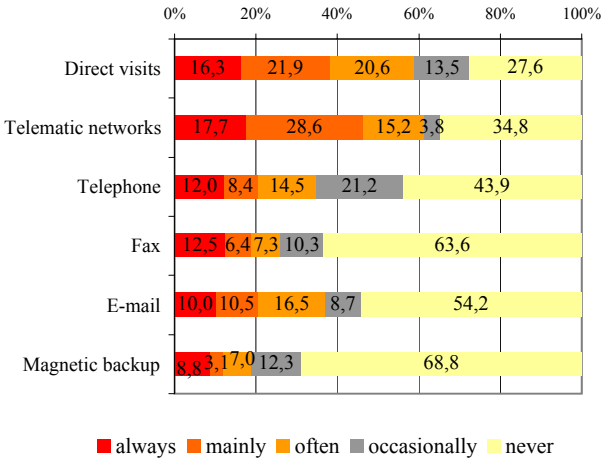
Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees

Source: our elaboration of data from interviews to the Unimec-Metalnet sample

Conto proprio firms



Subcontracting firms



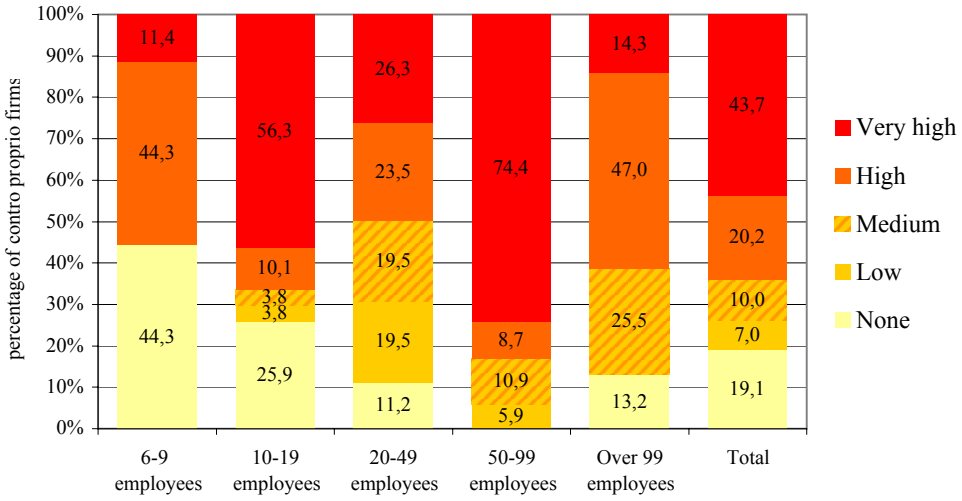
Graph 9

Level of competition indicated by the firms, by tipe of firm and class of employess (2000)

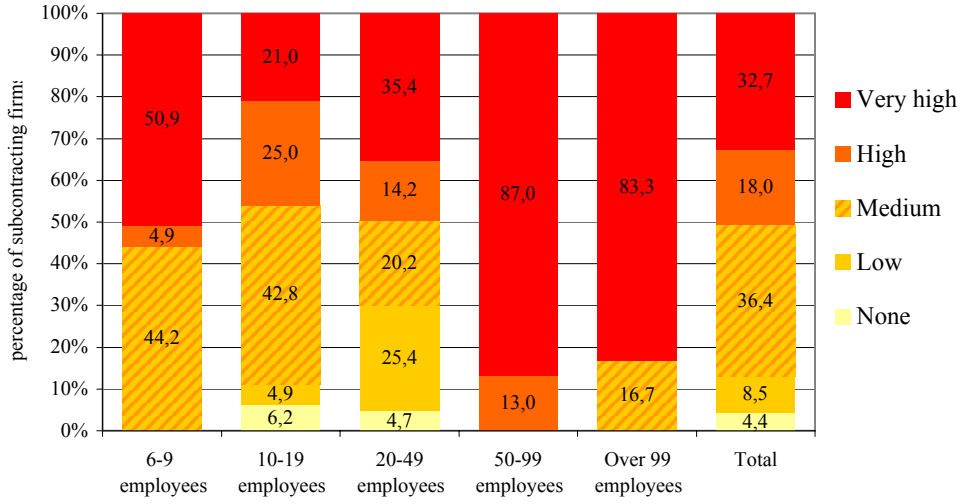
Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees

Source: our elaboration of data from interviews to the Unimec-Metalnet sample

Graph 9a. Firms producing mainly in conto proprio



Graph 9b Firms producing mainly in subcontracting

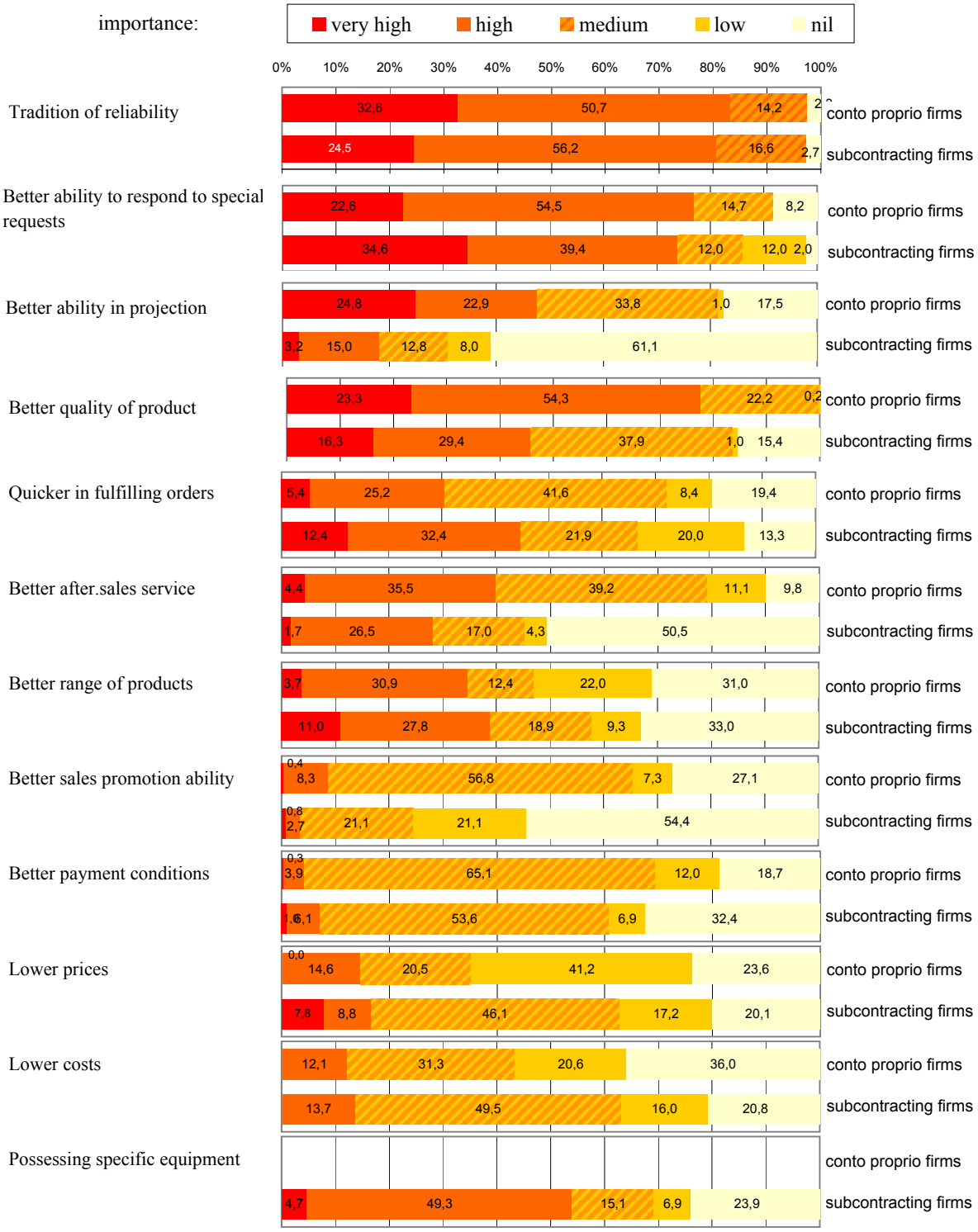


Graph 10

Importance of factors of competitive advantage, 200

Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees

Source: our elaboration of data from interviews to the Unimec-Metalnet sample



Graph 11

Percentual composition of investment made in 1998-2001*, by type of firm and type of investment expenditure

Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees

Source: our elaboration of data from interviews to the Unimec-Metalnet sample

* for 2001 the data refer to estimates supplied by the firms

Total firms	Conto proprio firms	Subcontracting	
3.194	2.060	1.135	investment 1998-2001 (bns of current lire)
100,0%	64,5%	35,5%	percentage values

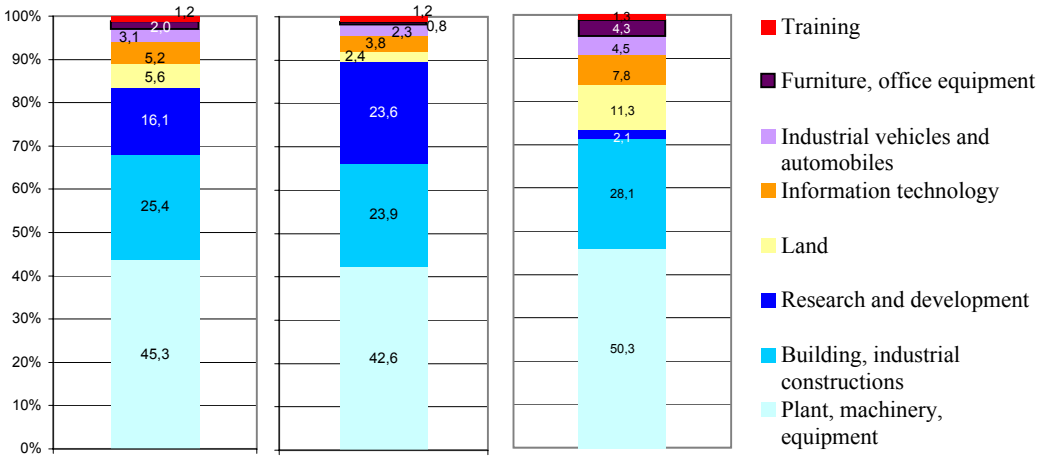


Table 1

Firms and employees by class of employees and type of firm (2000)

Absolute values, referring to the universe of engineering firms of the province of Modena, with more than 5 employees

Source: our elaboration of data from interviews to the Unimec-Metalnet sample

	Conto proprio		Subcontractors		Total	
Class of employees	firms	employees	firms	employees	firms	employees
6-9 employees	62	439	142	1.267	203	1.706
10-19 employees	232	3.077	400	5.626	631	8.703
20-49 employees	119	3.446	181	5.075	300	8.521
50-99 employees	92	7.024	24	1.377	116	8.401
Over 99 employees	43	12.347	16	2.069	59	14.415
Total	547	26.333	762	15.413	1.309	41.746

Table 2

Firms and average number of habitual suppliers, by class of employees

Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

	Conto proprio		Subcontractors	
Class of employees 2000	Number of firms	Average number of **habitual** suppliers	Number of firms	Average number of **habitual** suppliers
6-9 employees	62	123	142	16
10-19 employees	232	34	400	34
20-49 employees	95	91	169	49
50-99 employees	89	144	12	102
over 99 employees	36	202	16	43
Total	513	86	738	35

Table 3

Firms and average number of suppliers mainly working for the firm, by class of employees

Percentage values referring to the universe of engineering firms of the province of Modena with more than 5 employees
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

	Conto proprio		Subcontractors	
Class of employees 2000	Number of firms	Average number of suppliers **mainly working** for the firm	Number of firms	Average number of suppliers **mainly working** for the firm
6-9 employees	27	0	137	0
10-19 employees	232	2	385	2
20-49 employees	92	2	152	3
50-99 employees	89	12	17	5
over 99 employees	36	12	16	5
Total	476	4	706	2

Table 4

Firms and average number of suppliers considered strategic, by class of employees

Percentage values referring to the universe of the engineering firms of the province of Modena with more than 5 employees
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

	Conto proprio		Subcontractors	
Class of employees 2000	Number of firms	Average number of **strategic** suppliers	Number of firms	Average number of **strategic** suppliers
6-9 employees	34	11	137	3
10-19 employees	232	12	392	5
20-49 employees	102	17	164	4
50-99 employees	89	22	17	11
over 99 employees	36	11	16	5
Total	493	14	726	5

Table 5

Conto proprio firms: Incidence of the first three clients on turnover, by class of employe

Values referring to the universe of engineering firms of the province of Modena, with more than 5 employe

Source: our elaboration of data from interviews to the Unimec-Metalnet sample

Class of employees	Share of turnover first client	Share of turnover second client	Share of turnover third client	Total 1st, 2nd and 3rd client
	mean % value	mean % value	mean % value	
6-9 employees	48,0	23,1	18,7	89,8
10-19 employees	29,9	14,7	5,5	50,1
20-49 employees	30,0	11,6	8,9	50,5
50-99 employees	23,5	15,5	8,5	47,5
Over 99 employees	32,7	6,3	3,2	42,1
Total	31,4	14,7	8,3	54,4

Table 6

Subcontracting firms: Incidence of the first three clients on turnover, by class of employe

Values referring to the universe of engineering firms of the province of Modena, with more than 5 employe

Source: our elaboration of data from interviews to the Unimec-Metalnet sample

Class of employees	Share of turnover first client	Share of turnover second client	Share of turnover third client	Total 1st, 2nd and 3rd client
	mean % value	mean % value	mean % value	
6-9 employees	70,6	13,0	6,8	90,4
10-19 employees	41,0	14,2	9,7	64,8
20-49 employees	51,9	15,1	9,1	76,1
50-99 employees	23,2	18,5	14,7	56,4
Over 99 employees	58,5	10,0	5,4	73,8
Total	49,4	14,2	9,0	72,6

Table 7
Collaboration in design and in research and development
degree of collaboration with commissioners by firms performing subcontracting
Percentage values referring to the universe of subcontracting firms, with more than 5 employees
The table shows only combinations with values other than zero
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

	frequency of collaboration in designing	frequency of collaboration in research and	val. %
1	never	never	37,8
2	never	occasionally	14,7
3	occasionally/only for some clients	never	16,5
4	occasionally/only for some clients	occasionally/only for some clients	8,9
5	occasionally	almost always	0,4
6	almost always/always	never	3,6
7	almost always/always	occasionally/only for some clients	12,1
8	almost always/always	almost always/always	6,0
total cases			100,0

Table 8

Collaboration by subcontracting firms with commissioners: comparison between groups 1 and 8

Source: our elaboration of data from interviews to the Unimec-Metalnet sample

	firms of group1	firms of group 8
type of collaboration with commissioners	**never collaborate** either in design or in research and development	**always collaborate** both in design and in research and development
size	small size (almost 90% of the firms belong to the 10-19 employees class)	larger size (almost 73% belong to the 20-49 employees class)
production	production in series or batches, second level supplies (to a greater extent than the average)	production of prototypes or single items for large firms (to a much larger extent than the average of the subcontracting firms
commissioners	small size mainly located in the province of Modena	also small and medium firms mainly located outside the region
agreements to collaborate in research and development	slightly above the average mainly with private consultants	more than double the average especially with the University and research centres, not only Italian; and with service centres
competition	not very important (operating essentially for the local market)	higher than the average

Table 9

Average number of competitors, by class of employees and type of firm

Data referring to the universe of engineering firms of the province c ena
with more than 5 employees, 2000
Source: our elaboration

	CONTO PROPRIO	**SUBCONTRACTORS**
Class of employees	Average number of competitors	Average number of competitors
6-9 employees	4	20
10-19 employees	47	14
20-49 employees	5	13
50-99 employees	28	9
Over 99 employees	6	18
Total	27	15

Table 10

Average number of competitors by localization and class of employees of the firms

Data referring to the universe of the engineering firms of the province of Modena, with more than 5 employees, 2000

Source: our elaboration of data from interviews to the Unimec-Metalnet sample

Table 10a Conto proprio firms

Class of employees	Province of Modena	Province of Reggio Emilia	Province of Bologna	Rest of Reggio Emilia	Rest of Italy	Other EU countrie	Other countries	Total
6-9 employees	2	2	0	1	0	0	0	5
10-19 employees	0	0	0	2	39	1	0	42
20-49 employees	2	0	0	0	2	1	1	6
50-99 employees	6	0	0	5	4	12	0	27
Over 99 employees	1	0	0	0	2	2	1	6
Total	2	0	0	2	17	3	0	24

Table 10b Subcontracting firms

Class of employees	Province of Modena	Province of Reggio Emilia	Province of Bologna	Rest of Reggio Emilia	Rest of Italy	Other EU countrie	Other countries	Total
6-9 employees	20	0	0	0	0	0	0	20
10-19 employees	5	1	2	1	1	0	0	10
20-49 employees	4	2	1	2	4	0	0	13
50-99 employees	4	0	0	0	4	0	0	8
Over 99 employees	3	2	0	3	10	0	0	18
Total	8	1	1	1	2	0	0	13

Table 11a

Conto proprio firms: presence of suppliers among the competitor firms, by class of employe

Data referring to the universe of the engineering firms in the province of Modena, with more than 5 employees, 2000
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

	Presence of suppliers among the competitors					
	Yes		No		Total	
Class of employees	abs.val.	% val.	abs.val.	% val.	abs.val.	% val.
6-9 employees			62	100,0	62	100,0
10-19 employees	87	40,7	126	59,3	213	100,0
20-49 employees	14	14,0	86	86,0	101	100,0
50-99 employees	61	68,4	28	31,6	89	100,0
Over 99 employees	4	9,6	33	90,4	37	100,0
Total	166	33,1	336	66,9	502	100,0

Table 11b

Conto proprio firms: characteristics of competitor-suppliers, by class of employee

Data referring to the universe of the engineering firms in the province of Modena, with more than 5 employees, 2000
Source: our elaboration of data from interviews to the Unimec-Metalnet sample

	characteristics of the competitor-suppliers							
	case a: in same sector and geographic area		case b: in same sector but different geographic area		both cases		Total	
Class of employees	abs.val.	% val.	abs.val.	% val.	abs.val.	% val.	abs.val.	% val.
6-9 employees								
10-19 employees	75	85,8	5	6,1	7	8,1	87	100,0
20-49 employees			14	100,0			14	100,0
50-99 employees	61	100,0					61	100,0
Over 99 employees	4	100,0					4	100,0
Total	140	84,1	19	11,7	7	4,2	166	100,0

Table 12a

Subcontracting firms: presence of clients among the competitor firms, by class of employees

Data referring to theuniverse of the engineering firms of the province of Modena, with more than 5 employees, 2000

Source: our elaboration of data from interviews to the Unimec-Metalnet samp

	Presence of competitors among the clients					
	Yes		No		Total	
Class of employees 20(	abs. val.	% val.	abs. val.	% val.	abs. val.	% val.
6-9 employees	44	30,9	98	69,1	142	100,0
10-19 employees	159	41,3	228	58,7	387	100,0
20-49 employees	36	21,8	129	78,2	165	100,0
50-99 employees	10	51,3	9	48,7	19	100,0
Over 99 employees	12	100,0			12	100,0
Total	261	36,1	464	63,9	725	100,0

Table 12b

Subcontracting firms: characteristics of the competitor-clients, by class of employees

Data referring to theuniverse of the engineering firms of the province of Modena, with more than 5 employees, 2000

Source: our elaboration of data from interviews to the Unimec-Metalnet samp

	characteristics of the competitor-clients							
	case a: in same sector and geographic area		case b: in same sector but different geographic area		both cases		Total	
Class of employees 20(	abs. val.	% val.	abs. val.	% val.	abs. val.	% val.	abs. val.	% val.
6-9 employees	44	100,0					44	100,0
10-19 employees	85	53,5	74	46,5			159	100,0
20-49 employees	33	93,0	3	7,0			36	100,0
50-99 employees	5	45,8	5	54,2			10	100,0
Over 99 employees			2	16,7	10	83,3	12	100,0
Total	167	63,9	84	32,3	10	3,8	261	100,0