Implementation of Cooperative R&D Projects in Italian Industrial Districts

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1. Introduction

Industrial districts are a form of industrial clustering very diffused in Italy and characterized by a network of firms manufacturing similar products. Despite that firms are normally small and medium sized enterprises, the total employment and turnover of a districts may reach comparable figures existing for very large firms. The limited dimensions of districts firms make difficult the engagement in R&D projects especially for radical innovations, able to give real competitive advantages, but requiring large financial availability and long term commitments. This situation is a handicap for technological development in districts, especially facing globalization, as overseas competitors may easily introduce the same incremental innovations. Furthermore it could not be excluded that in future overseas companies may develop radical innovations and put in great difficulties the districts. One way to overcome such difficulties consists in organizing cooperative R&D projects for innovations in which costs are divided, experience exchanged and results shared among the firms participating to the project. It should be told that cooperation of district firms in various business activities such as trade marks, centralized buying and warehousing, technical cooperation, etc. is relatively diffused but not in the case of technology innovation and R&D projects as it is an activity poorly known that touches directly the strategies of the single firms. The carrying out of shared studies and research is a well known practice in what it is also called multiclient study or research, promoted by consulting and research organizations with the participation of large firms and multinational companies. For example Battelle Memorial Institute laboratories, one of the oldest and largest contract organization for industry, carried out its first multiclient study already as the fourth research contract, at the beginning of its activity in the thirties of the last century, joining four iron-mining companies on a project on the feasibility of concentrating low-grade iron ores for making iron (G. Bohem, A. Groner, 1972) and such practice is now largely diffused. Transferring this approach to the case of industrial districts should take account of a very different environment and the existing of delicate equilibrium between competition and cooperation among firms. Many aspects of the work we have done in introducing technology development in industrial districts may be considered in the perspective of what is called science of complexity and that has been object of an international conference on “Complexity and Industrial Clusters” held in Milan on June 2001 and whose proceedings have been published by Quadrio Curzio and Fortis M. (2002).

In chapter 2 we present the importance of industrial districts in Italy, their technological structure and their problems in making technology innovation because of limited size of enterprises. In chapter 3 we discuss our bottom up approach used in organization of cooperative development of technology innovation derived from typical methods for multiclient studies carried out by international contract research organizations. In particular we present the results of Ruvaris, a real case of generation and evolution of R&D cooperation in a district with 15 years of history. Considering this experience we think that adopted method can be generalized. Essentially it consist in studying in detail in term of structure and particularly processes choosing which could be transferred in the new environment: After that it is decided the approach that may be bottom up triggering some processes, and eventually introducing new ones, to emerge a structure, or top down introducing a new structure able to work with effective processes. In the conclusion of the paper we have reported two examples of possible applications concerning the collaboration between

universities and industry in technological innovation and the case of transfer of the venture capital/ start up system, typical of the Silicon Valley, to boost the generation of radical innovations.

2. Technology structure and processes in Italian industrial districts

Italian industrial districts are spontaneous agglomerations, some formed even in the second half of the XIX century, but their development occurred especially just after the second world war. Italian industrial districts have generally a socio-economic origin from previous crafts activities or from return of emigrants with know how acquired abroad. From this point of view Italian industrial district are very different from other types of industrial agglomerations such as local subcontracting firms of large companies or on based knowledge complementarities as the typical well known case of the Silicon Valley. Italian industrial districts are in fact an autopoietic system, meaning that they exist in the measure that firms are essentially generated by firms within the district and characterized by existing specific processes. This fact make difficult to define and classify correctly districts only in term of minimum number of firms, employment or turnover as often it is done. Although a certain number of firms are of course necessary to trigger the formation of a district the processes more than the number of firms are important to maintain alive a district. The Italian industrial districts play an important role supplying the typical "Made in Italy" products that cover about 40% ot the total Italian export. Because of the low number of large firms existing in Italy, it is correct to affirm that Italian industrial districts make the difference allowing the country to be placed among nations with a high degree of industrialization.

Italian industrial districts are characterized by the existence of various typical processes such as the spin off of employees forming new firms as well as, in period of crisis, the return of entrepreneurs closing their firms, as employees in former or other firms of the district. The exchange of people and information of technical, but also marketing and organizing nature, is intense. That makes D. Lane (2002) to affirm that a district is more a network of people than of firms and that such network is sustained by a scaffolding structure composed by formal institutions such as local associations, exhibitions, conferences, etc. but also informal events such as meetings among the entrepreneurs of the district and so on. The firms of a district make similar final products using common basic technologies although differentiated in many cases in term of concept and design. The technological structure and processes existing in a district could be described considering the various steps of fabrication existing for the main products. In Figs. 1 and 2 we have reported a simplified step structure of two technologies respectively in the production of faucets and valves and household products.

Beside the fabrication of final products for consumers, in a district generally exists a certain number of firms specialized in certain types of technological operations supplying to main firms intermediate products or services. For example in the production of faucets and valves technological operations such as casting, chromium plating and hot stamping are often carried out by subcontracting firms and the same is for household products for operations such as anti-adherent coatings and polishing reported respectively in Figs. 1 and 2. In many cases the firm subcontracting a technological operation has this capability in its own plants but prefer subcontracting to external firms the work instead of increasing capacities of its own plant. This production structure give to the district a high flexibility because in the case of temporary increase of demand the firms find outside the excess of capacity needed without risky new investments, on the other side in the case of crisis subcontracting firms may lose contracts but as they normally have more than one client they could survive supplying firms that are less touched by the crisis. Such interlaced technological structure gives flexibility but arise certain handicaps in the introduction of new technologies,

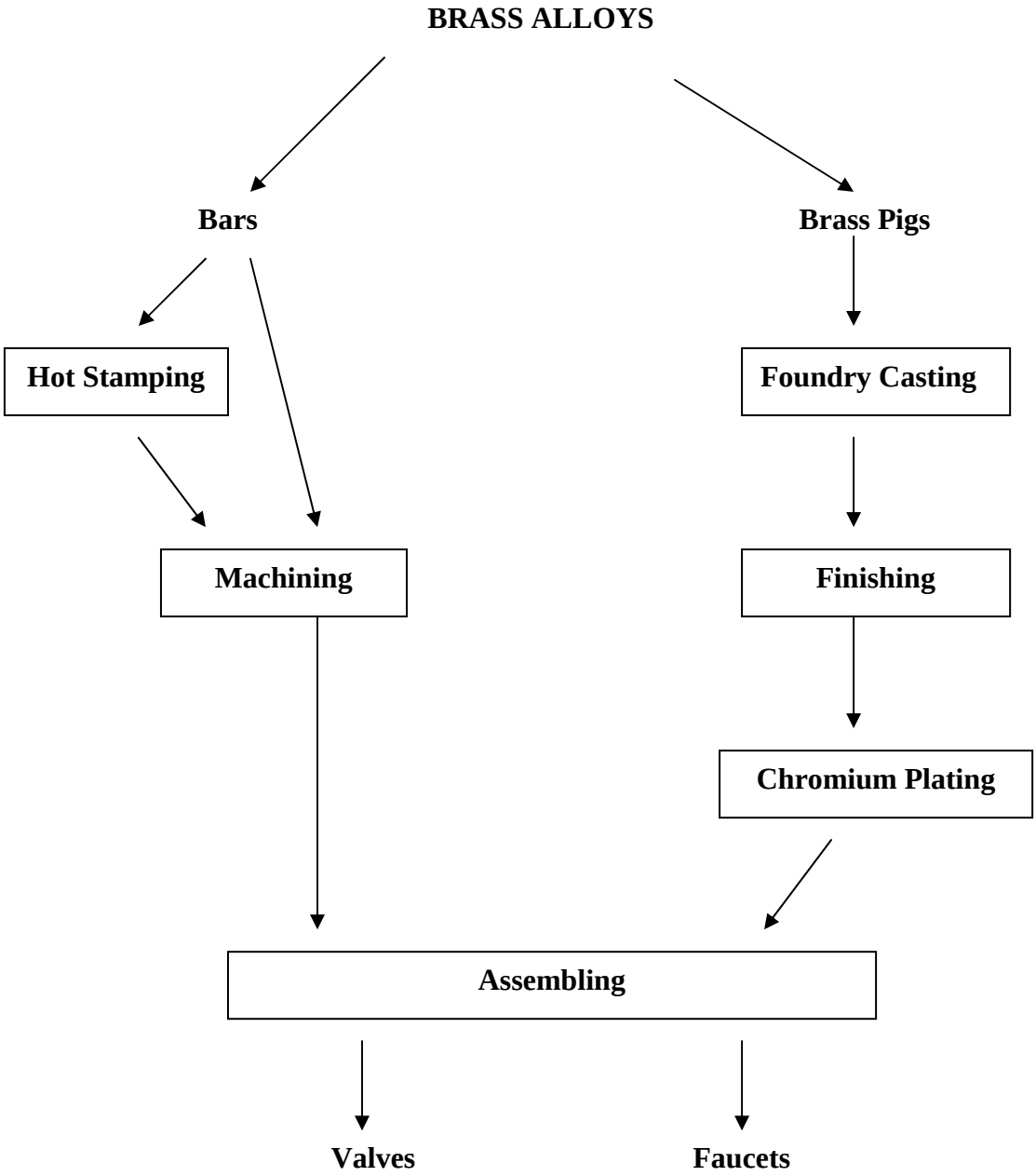

Fig. 1. Technological operations in production of faucets and valves

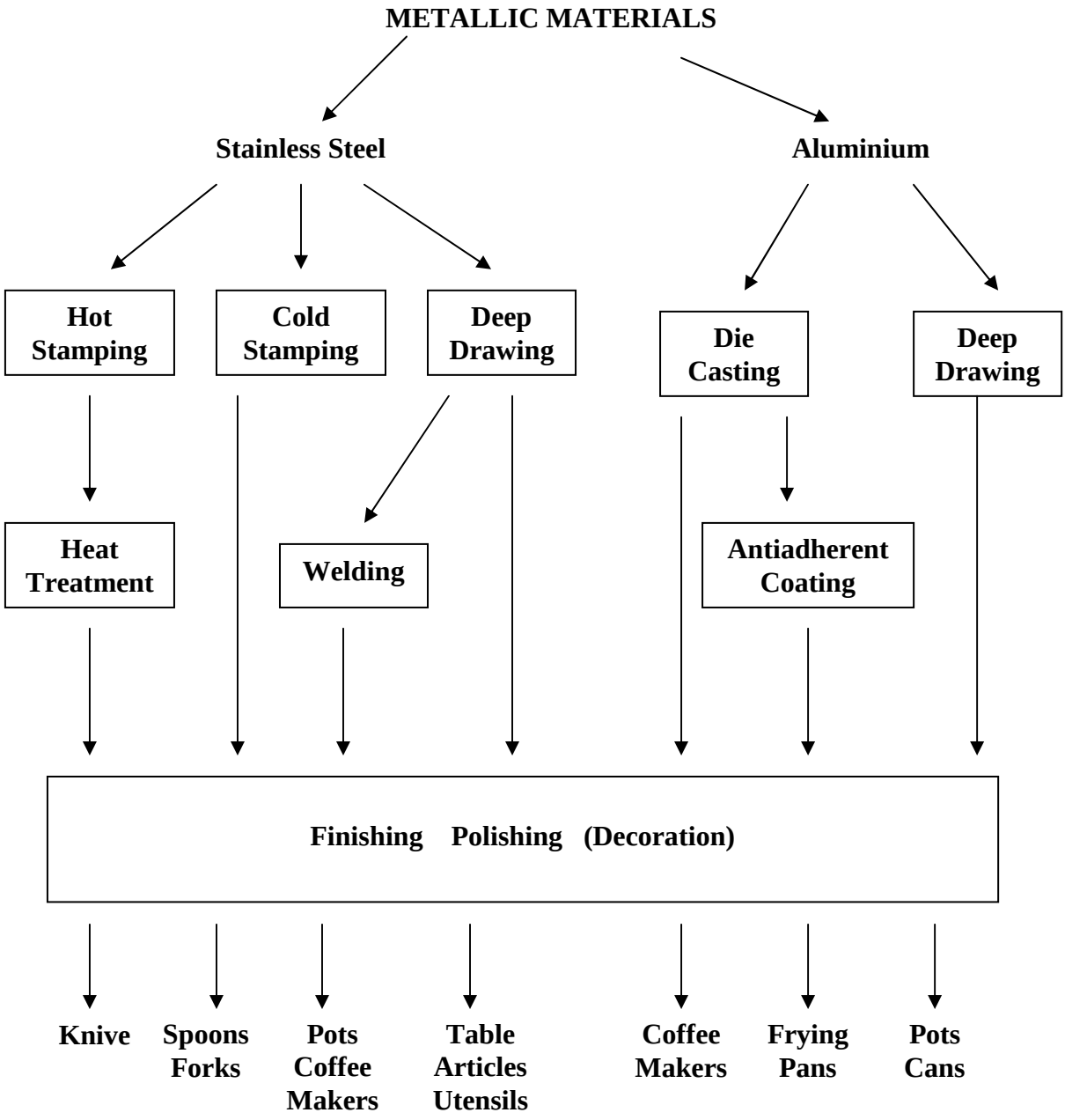

Fig. 2. Technological operations in production of metallic household goods

especially radical ones, because such innovations may involve other independent firms in the production process that may not be interested to use the new technology or made investments to be able to use it. Such fact, that limits also the generation of new patents in districts, has been observed by M. Russo (2003) in her studies on the ceramic tiles district of Sassuolo. Such interconnected technological structure of the districts should be considered when promoting cooperative R&D projects as all technological steps may be necessarily involved in the cooperative group firms carrying out an innovation projects.

Despite of these limitations, Italian industrial districts are nevertheless attentive to technology innovation, but their activity in this field is often limited to learning by doing and adapting new technologies more than making real R&D projects. In the past there were the possibility to realize new important radical innovations simply in workshops. Nowadays the complexity of technologies make practically necessary R&D activities to make new radical technology innovations. It is well known that radical innovation are the true generators of durable competitive advantages. In fact, radical innovations involve new competences, not easily available to competitors, avoiding the situation of the so called red queen regime in which competitive advantages of innovation in one firm are readily compensated by similar innovations in concurrent firms. Such facts constitutes a handicap for industries that do not carry out significant R&D activity. Another problem appears when district technology, dues to the absence of radical evolution, becomes deeply dependent on suppliers of technical equipments external to the district. In this case export of technical equipment to industry of emerging countries may cause great difficulties to the district. A case of such type has been described by M. Russo (2004) for ceramic tiles industrial district of Sassuolo facing the challenge from China. Limitations to radical technology innovation in districts are, on the other side, the same than in the case of traditional small enterprises and may be condensed in three points:

- Low experience in managing complex activity such as R&D necessary to technology innovation
- Limited availability of capitals to finance technology innovations
- Limited availability of time to personnel of the firms to follow R&D projects and have consequently a continuous activity in this field

Cooperation in R&D activity may be a solution to previous problems supplying competences, reducing financial support of single firms and making available time to carry out the projects.

3. Development of a method for R&D cooperation in Italian industrial districts

When speaking of cooperation of small firms in the field of technology innovation it is important to consider that such type of cooperation presents significant differences from cooperation in other field such as trade marks, centralized buying or storage, equipment sharing, markets developments and other typical outsourced activities which have a certain diffusion in districts. The main difference concerns the low experience that small firms have in carrying out cooperative R&D projects characterized, especially in the case of radical innovation, by complex problem of risk management associated to the projects development and subdivision and exploitation of industrial property that could arise from research. Such types of problems are successfully solved in the so called multiclient studies typically organized and carried out by consulting and research organizations joining large and multinational companies around specific studies or R&D projects. When in 1996 we faced the problem to organize cooperation in technology innovation in the districts of faucets and valves we thought to apply the multiclient method used by the international consulting and research organization modifying it in function of the different environment existing in Italian industrial districts. The history and management of this work has been reported in a

previous publication (A. Bonomi, P. Marenco 2006) whereas this document describes in detail the origin and application of the method adopted to generate R&D cooperation that we may call Ruvaris method from the name of project carried out.

Multiclient method

In order to explain how the Ruvaris method has been developed it is useful to give some details about the typical multiclient method applied in organizing studies and R&D projects involving large companies. In Fig. 3 we have reported schematically the combination of the three elements that are important in applying the method and the result in term of studies or R&D projects. The first element is the existence of consulting or research organization owning the capability to carry out the proposed studies or the R&D projects. The second element consists in the identification of a global problem of general interest that may be treated by a study or a R&D project. The third element is the existence of a certain number of large companies or multinationals that share the problem and may be interested to participate. When these three elements are present there are the conditions to launch a multiclient study or project applying the method. At the beginning a brief explanation note is prepared and distributed to potential participants. Sometimes such note is preceded by a preliminary survey of the potential interest by questioning a small group of possible participants. Such note is followed by the elaboration of a full proposal. containing the work program, the necessary budget to make the work, and an estimation of the possible number of participants that determines the fee required by each partner. The study is generally started with a number of participants slightly lower than the fixed minimum number by the proposal. That because the starting of the study has generally a strong effect of favoring the arrival of further partners. The multiclient study or the R&D project is normally carried out and managed by the organization. As usual in contract research means and competence are supplied within available time and budget without guarantee of results. Generally all the clients of the study are visited by researcher of the organization to discuss the running work and a certain number of meetings for all clients organized at the beginning, during and at the end of the study. Intermediate meetings are useful to decide possible modifications of the program in function of preliminary results obtained within the available time and remaining budget of the study.. Typically during the meetings there are limited discussions among the partners and at the end of the study the group is dissolved and any participant decides about the use or not use of the results of the study. It is interesting to give details on the nature of typical multiclient studies or R&D projects taken examples from activity of the Geneva Research Centre of the Battelle Memorial Institute in the seventies and eighties of the last century. In the case of R&D we had for example a project on corrosion of lead-calcium alloys used in maintenance free batteries that now are in general use in automobiles, and an R&D projects on hydrolysis of cellulose to produce glucose and finally ethanol as answer to the oil shock occurred in the seventies (the development was abandoned due to technical problems and unfavorable economy), In the case of studies there was treated for example potential applications of plasma furnaces in chemical and metallurgical fields, as well as many other multiclient studies concerning the market of industrial products. Such studies, following the typical Battelle approach ,were in fact carried out considering the evolution of the market as a function of the technological evolution expected in the correspondent industrial sector.

Ruvaris method

Before discussing the Ruvaris method it is useful to remark the important differences existing in the case of a system composed by international research organizations and large and multinational companies interested to global problems in respect to small and medium companies organized in an industrial district, having some common basic technologies and products with specific problems of technological innovation in the product or production process. The major difference may be observed in the final goal. In the case of multiclient method the group of companies participating to

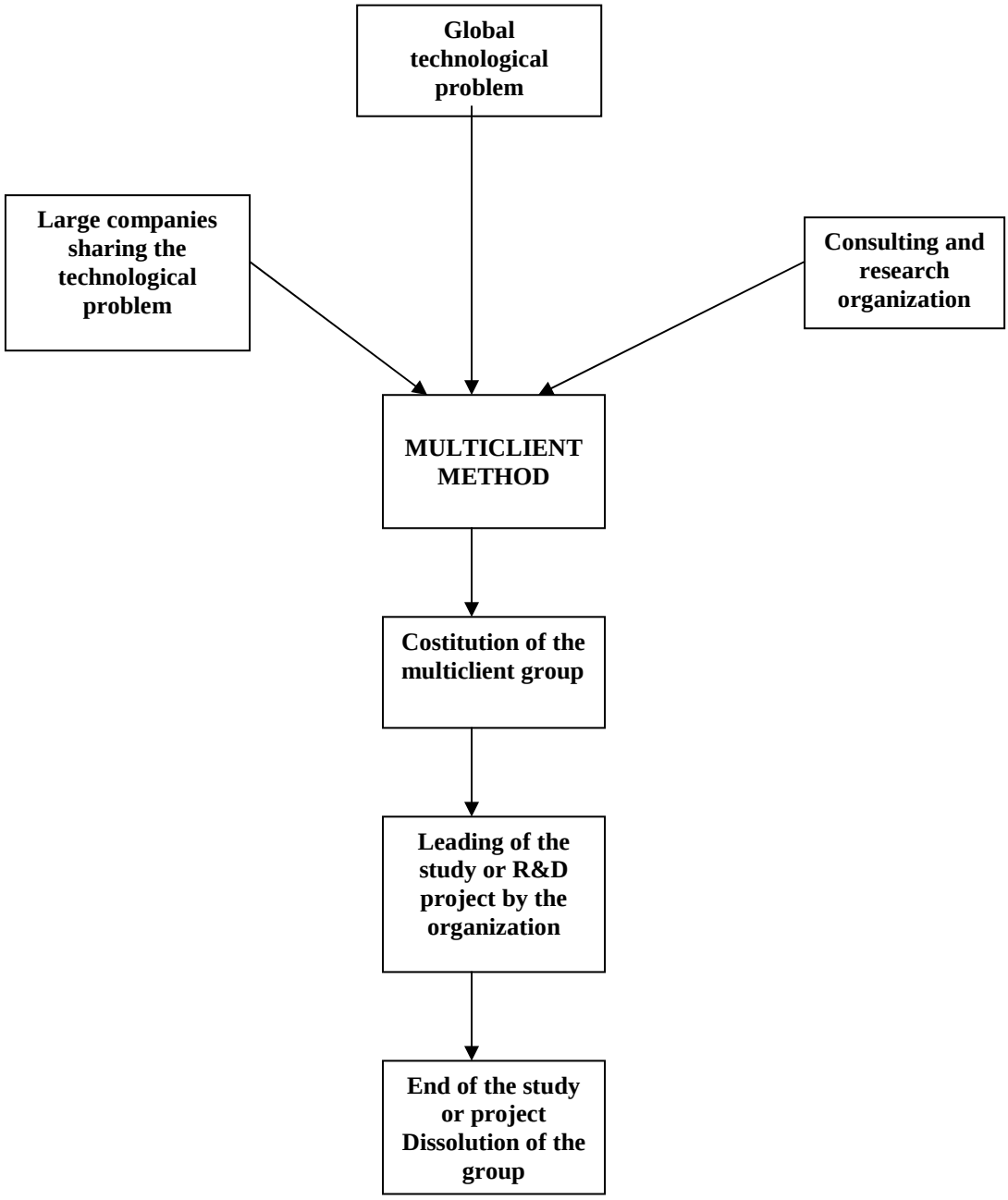

Fig.3. Schematic view of the multiclient method for technological studies or projects

the study is dissolved at the end of the study and the organization proceeds considering other studies and other companies interested by participation. In our case the final objective was to organize a continuous activity in studies and R&D projects among the various firms of a district. Other important differences were the limited amount of financing available in small firms for the studies, the necessity to know the real technological problems of the district and the fact that the organization that historically begun the process, the "Tecnoparco del Lago Maggiore", had capabilities in making studies but not laboratories and personnel to carry out R&D projects interesting the district. In these conditions it was clear the necessity to start the process by carrying out a study allowing to identify the best technological innovations useful to the district and suitable for cooperative R&D projects, innovation that was not clear neither to the district firms nor to Tecnoparco. What it was started was in fact a bottom up approach organizing meetings and contacts with firms to discuss the problems of the district and define a multiclient study to identify a list of R&D projects of great interest for the district and suitable for cooperation. As reported by A. Bonomi, P. Marenco (2006), the launching of the study was successful and results involved three possible projects. One of these projects found six companies to form Ruvaris Srl. This company developed the RUVECO® process, a patented technology to eliminate tap lead contamination of drinking water. Some years later a similar study of identification of new cooperative projects, organized directly by Ruvaris Srl, made possible the transformation of the company in a pool of firms called Consorzio Ruvaris. The pool composed presently by more than 20 firms is dedicated to carry out R&D projects and studies for the associated districts firms. Differently from the Multiclient method, that has a typical top down approach with an organization that proposes and carries out the study or project, the Ruvaris method is in fact a bottom up approach in which the nature of project to be developed and decision to form a company emerges from meetings and discussions among the firms of the district. A few years later after the starting of the work on Ruvaris we found that our bottom up method belongs to more general management practices derived by studies in the field of complex systems and described by S. Kelly and M.A. Allison (1998). Such practice was used by these authors in the successful restructuration in 1991-92 of Citicorp, one of the major US bank. Although the example of practice is completely different from our one, it is very interesting to note that some processes and key operative figures, when described in the general terms offered by complexity science as reported by these authors, are the same observed in our practice. Then in the following description of our method we can adopt the terminology used by these authors. In the Fig. 4 we give a schematic view of Ruvaris method. As in the case of multiclient method there are necessary three elements to enable the use of the method. Such elements are in fact three figures that are necessary to start the process. They are, following the terminology used by S. Kelly and M.A. Allison (1998): leader, catalyst and eco-technician. The specific explanation of their role in the Ruvaris method is the following:

Leader

The definition of leader in the general term of the method is a figure responsible for consolidation of a vision encouraging an open communication and networking decision-making. In the case of Ruvaris method the leader is represented by an entrepreneur of the district, typically from a medium-large company, that believes in the importance of cooperation in the field of technological innovation. This figure has an essential role to give credibility to cooperation favoring the agglomeration of firms and in managing the formed network. It is not an easy figure to find as entrepreneurs are as normal largely involved in activity of their firms and do not have much time to dedicate to cooperation management although they may have help by some other entrepreneurs or manager of firms sharing the same vision.

Catalyst

In general term a catalyst is a figure able to trigger with expertise and effective communication the rate of change of business or team contest enabling the self organization of the system. This figure

at the beginning of application of the method may be backed by an external organization, in the case of Ruvaris it was Tecnoparco and catalyst its director Paolo Marenco, facilitating the organization of meetings and possibly the capability to make studies or even R&D projects. With the development of the cooperation he may a be also involved directly in the formed structure as he was in the case of Ruvaris.

Eco-technician
This term, created specifically by S. Kelly and M.A. Allison (1998), indicates a consultant, in the case of Ruvaris the author of this paper, with expertise in various aspect of complex systems in term of non linear behavior and self-organization and in analysing structures and processes of a system. His role is in supporting leaders and catalysts in their action by making visible patterns of interaction and possible scenarios. In the specific case of Ruvaris he suggested in particularly how to make the transfer of Multiclient method identifying the processes that should be started to develop the bottom up approach for cooperation of firms in R&D activity.

In the case of Ruvaris such key figures integrated the work in such way: the eco-technician supplied at the beginning a choice of processes from Multiclient method experience and later new ones adapted to the situation. Catalyst and leader organized the necessary agglomeration of firms around a study or R&D project as well as the creation of a structure such the Ruvaris Srl company or the actual Consorzio Ruvaris for cooperative R&D. Expertise and communication ability of the catalyst and the role of reference and reassuring of the leader were essential for the success of the method.

It is interesting to enter in the detail of the triggering event occurred at the beginning that was essential to start the process. It was a casual meeting between an entrepreneur of the valve district and Paolo Marenco, at the time managing the Tecnoparco del Lago Maggiore, about the possible help of Tecnoparco in solving a problem of valve corrosion. Such meeting was followed by a talk that I had as consultant with Marenco about such problem. During the conversation I suggested that it might exist much other important research problems in tap and valve industry difficult to face because of the limited dimension of the firms and that a solution might be found applying a multiclient method used to group companies around a study or R&D project in which the cost is shared among the partners. Such idea was found very interesting by Marenco and as I suggested the process was started by organizing a certain number of meetings with tap and valve industry about the research problems of the sector leading to the first multiclient study on identification of the R&D projects more interesting for this industry. It is important to know that the entrepreneur cited previously acted as leader in encouraging the companies of the district to participate to the meetings and animate discussions during them. Marenco in fact acted as catalyst and myself as eco-technician in such a way that all the three necessary figures to trigger the bottom up process of the development of Ruvaris. It is interesting to know that the figure of leader changed for various reasons with time and other entrepreneurs was leaders during the existence of Ruvaris Srl and also new leaders are managing presently the Consorzio Ruvaris.

In Fig. 4 we have reported a schematic view of the Ruvaris method going through agglomeration of firms, subcontracting or execution of R&D projects or studies and establishment of a continuative cooperation. In Fig. 5 we have reported the evolution with time of the number of participants to the two studies carried out for identification of the best cooperative R&D projects in the industrial sector of faucets and valves, the first organized by Tecnoparco in 1997 and the second one by Ruvaris Srl in 2005. We may see in both cases an agglomeration effect on firms participating to the study after the acceptation to participation of the first firms. Such effect, as previously cited, is also present in multiclient studies and make possible a current practice to start the study before reaching the minimum established number of participants by proposal sure that the starting of the study or project would agglomerate further participants.

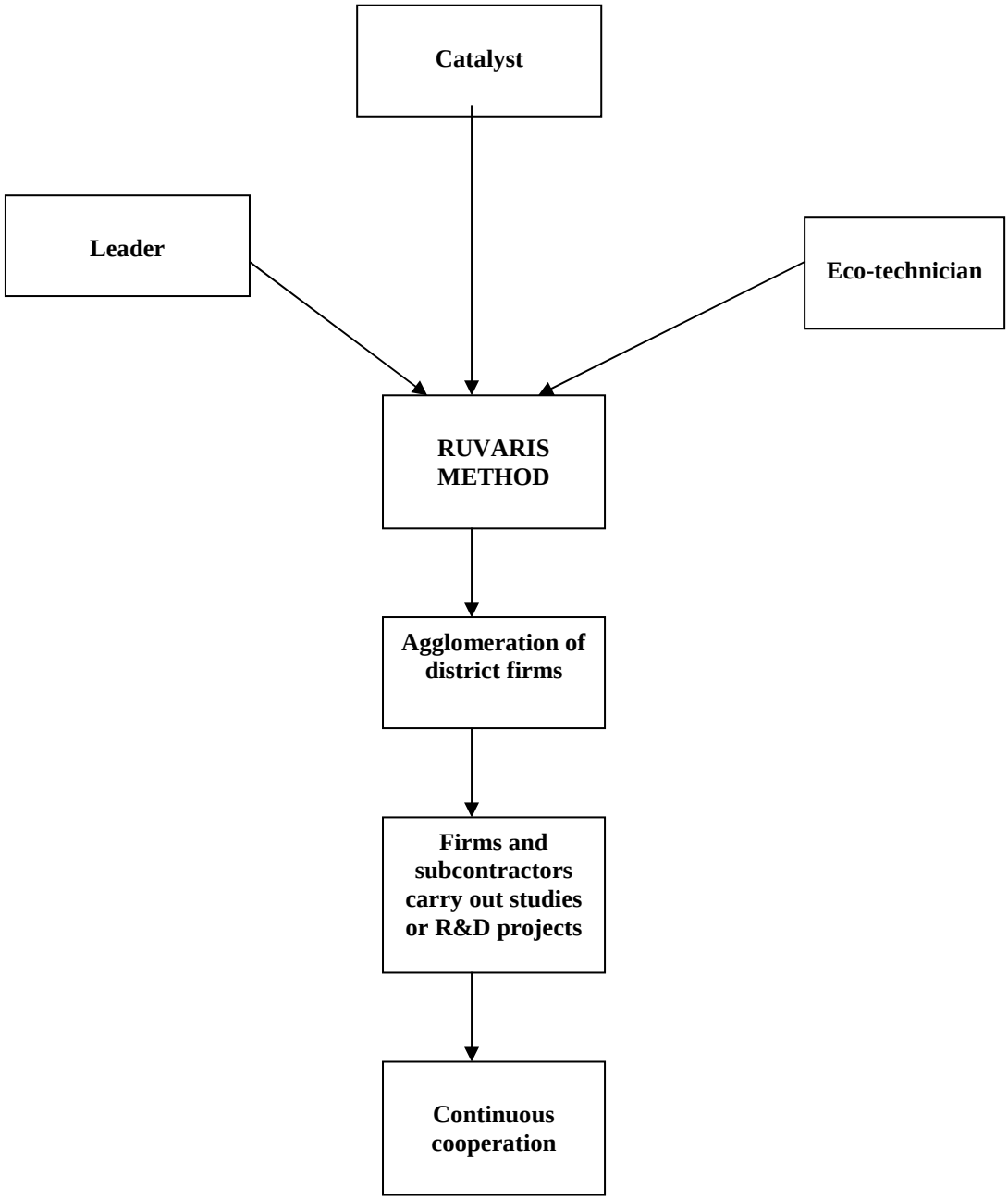

Fig. 4. Schematic view of the Ruvaris method for technological studies or projects

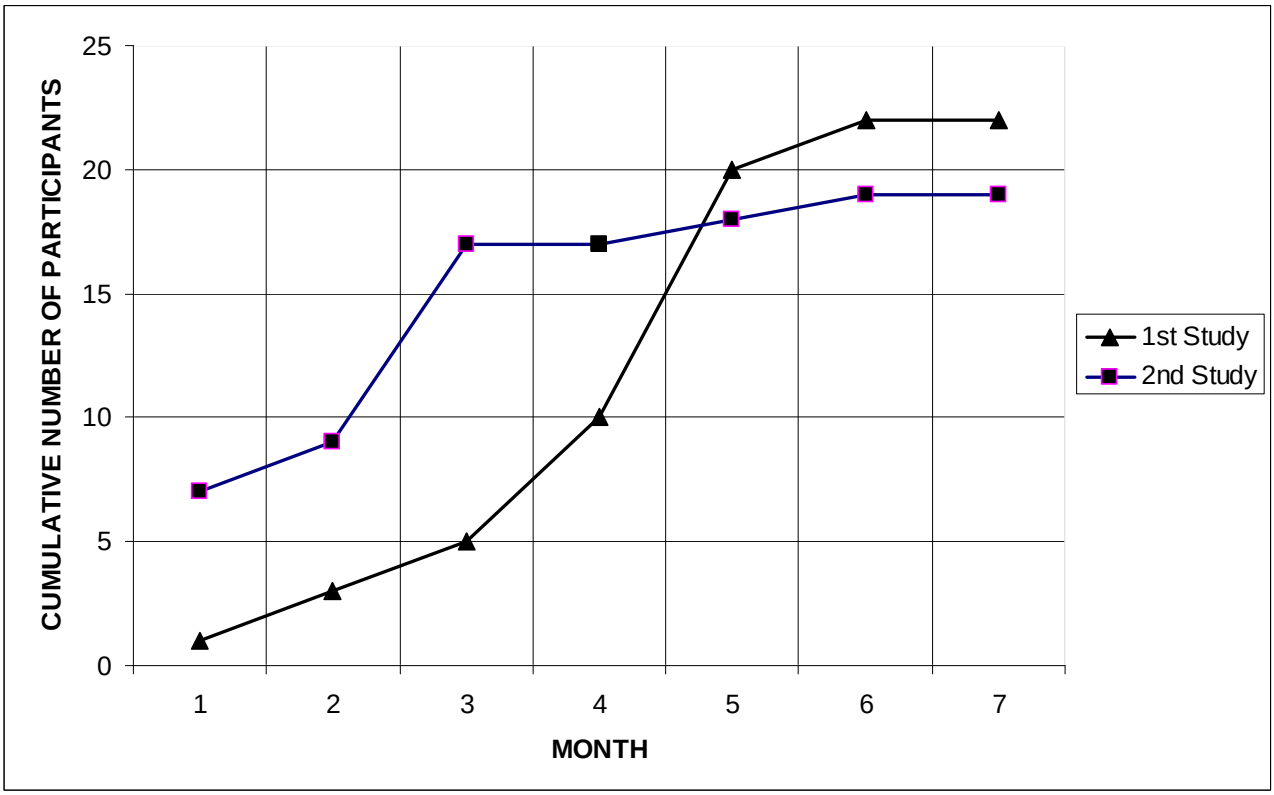

Fig. 5. Agglomeration effect on firms participating to the Ruvaris studies

There are major differences in carrying out studies or R&D projects between the typical multiclient study and the Ruvaris case. In multiclient studies the launching organization normally assumes management and tasks to carry out studies or R&D projects presenting and discussing results with the participants. Subcontracting of a part of studies is inexistent or marginal. In the case of Ruvaris the role of participating firms is much more important supplying essential information and suggestions to the study or projects. Differently from typical multiclient studies, technical discussions among the partners may be extensive while in multiclient studies is limited to clear up aspects of the study while exchange of experience is practically absent among participants. Subcontracting is important in the case of Ruvaris, especially in the case of studies and R&D projects for which firms do not have suitable laboratories. Subcontracted tasks may be carried out by external laboratories or firms internal or external to the partners group. Management of studies or R&D projects may be carried out by an external organization that has launched the multicient study, such as Tecnoparco in the case of Ruvaris, but later such task could be carried out by a suitable structure emerged from the group of partners as was the case of Ruvaris Srl or Consorzio Ruvaris. Such emerged structures are essential for a continuous cooperation among the firms. There is another important aspect that should be considered when organizing technological cooperation in industrial district. In the case of multiclient projects the specific activity of the partners is not of major importance to the study or project as its tasks are practically entirely covered using expertise existing in the launching organization. In the case of Ruvaris the whole expertise for studies or projects is not directly available in single firms and the group should be organized in such a way that all the necessary experience in the various involved technological operations following the schematic representations in Fig.1 and 2 of the technological steps of production.

As complement of the description of the Ruvaris method it is interesting to give some information about the method used to make interviews to firms especially with the aim to identify possible cooperative R&D projects. Interviews to participants of multiclients study is a current practice of this method and can be extended to other industries or laboratories of interest for the study. Such type of tasks are also carried out in the case of Ruvaris method with the aim to get not only information but generate new ideas for R&D projects. The interview approach used in this case may be considered a mixture of the well known Delphi method and another method based on generative relations. Delphi method consists in interviews to experts in order to determine trends in economic, social or technological field confronting the various opinions. Such approach is useful in cooperative studies but must be integrated by a generative method able to identify potential R&D projects. Relations among individuals generating new ideas are a common aspects of discussions carried out for example during studies interviews and such process has been described in detail by D. Lane and R. Maxfield (1995, 2006) studying the development of successful technological innovation strategies of two firms of the Silicon Valley. In our case the generative relation is established between people carrying out the study and managers and technicians of the interviewed firm interested in technological innovation. The basic elements of this model are agents constituting individuals that act in firms or other organizations discussing together about an artifact, that may be a product, a process or a service, each one interpreting the artifact from his point of view. The discussions are directed toward changes and convergence of the various interpretations in a generative process that realize the emergence of new innovative ideas, in our case, possible technological innovations and R&D projects.

Before concluding discussion about the Ruvaris method we think useful to give some information about a second tentative to apply the method to the case of household districts existing in the province of Verbano-Cusio-Ossola and Brescia. A first tentative was carried out by Tecnoparco del Lago Maggiore, contemporary with the first study generating Ruvaris, with few contacts with firms of the Verbano-Cusio-Ossola district, but with poor results and the tentative was rapidly abandoned

by various reasons. A second tentative was carried out in cooperation with the NISLabVCO, an industrial research laboratory based in Tecnoparco del Lago Maggiore, in 2008 contacting further firms of the Verbano-Cusio-Ossola province as well as the Italian association of producers of household. We found some interest in cooperation and preliminary ideas about possible cooperative technological innovations. The lack at the moment in finding a leader figure for technological cooperation in such districts is in our opinion the basic reason of present failure of such approach. Further contacts with firms, especially in the Brescia region, might be useful to change the situation. However at the moment lacking of budget makes impossible such action as well as the organizing of meetings to discuss such subjects.

4. Conclusions

The success obtained by transferring the multiclient method to the specific case of enterprises belonging to an industrial district may arise the question whether this experience may lead to a more general method able to make transfer of other activities concerning technological innovation between two largely different environments. We think that this is possible by using an open approach consisting in the development of an in depth knowledge of the two different environments concerned by the transfer. It is particularly important to know the structures and especially detailed processes occurring in the environment from which we would realize the transfer. In these conditions we may choose a top down approach by proposing a new structure, that could be also completely different, and implement the necessary processes to reach the goal. In alternative we may choose as more suitable a bottom up approach, it was the case of Ruvaris, by selecting the suitable processes to be transferred and adding possibly new ones to trigger the formation of efficient structures to reach the goal. We may consider for example two cases that are potentially interesting for such approach.

A first case concerns policies of promotion of cooperation between universities and industry and eventually coaching of spin off generated by this collaboration. In many industrialized countries there are organizations that constitute a bridge between universities and industry to do this work. Such organizations may be private as Battelle Memorial Institute or Stanford Research Institute in USA, or Fraunhofer in Germany, or centralized research laboratories created by law and financed by a percentage of turnover of concerned industrial sectors as in France. In the case of Switzerland such work is mainly carried out by federal agencies through polytechnics and professional technological universities. The case of Switzerland may be of particular interest for Italy as in this country private or governmental research organizations for industry are scarcely present, and universities are often solicited to help industry about technological innovation and R&D projects. The question is which structure and processes are the more suitable to satisfy the needs of an Italian territory with a completely different technological and scientific environment.

A second case concerns the problem in boosting introduction of radical technological innovations in small enterprises and particularly in industrial district firms. Radical innovations, although rare, constitute a constant threat to district industries normally oriented to develop only incremental innovations. An historical thread of such type appeared for example in the seventies of the last century when Japanese industry entered in watch market with low price quartz electronic and digital watches impacting strongly the Swiss industrial district producing traditional mechanical watches. A typical system to generate a large number of radical innovations with consequent permanent competitive advantages is constituted by coupling venture capital and start up companies with development of technological innovations coming from universities, research laboratories or even previous start up activities. Such process terminates in case of success with industrialization through IPO and capitalization in stock market or selling technology to multinational or large industries.

The Silicon Valley activity is often taken as example of that to be imitated. In Europe there has been many attempts to introduce a venture capital and start up companies system to boost radical innovations but with quite poor results because of a much lower inclination to entrepreneurship and availability or risk capitals. In the case of industrial district the problem is how to exploit, using Silicon Valley experience, basic research results and competences existing in universities and financing innovations addressed to a limited but not negligible market of district firms.

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