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R&D Networking Model for Support of SME's Competitiveness

Alessandro Basile
Department of Economics and Business, University of Catania,
Corso Italia N°55-95129, Catania, Italy

Abstract: The aim of this study is to provide new evidence on the relationship concerning R&D networking and firms competitiveness in a local SME entrepreneurial system. Researcher wants to investigate and test the role of R&D linkages on the firm's productivity drivers and innovation processes. Researcher consequently presents an empirical evidence exploiting detailed and specific survey-based data on 63 Italian SME's. Researcher found that R&D networking (R&D partnerships and agreements) has a moderate impact on the SME's productivity and a strong impact on the innovation processes. Finally on the practical implication of this moderate finding, researcher presents a R&D Model for support the competitiveness of SME's located in peripheral districts.

Key words: R&D agreements, networking, firms competitiveness, firm's productivity, innovation processes

INTRODUCTION

The role of cooperative R&D in the improvement of firm competitiveness has been an issue of increasing interest that has been extensively investigated in the management literature of recent decades (Das and Teng, 2000; Arora and Gambardella, 1990; Ahuja, 2000b; Basile, 2011; Hagedoorn, 2002). The main reason is represented by the intensity and increasing competition worldwide due to internationalization trends.

Firms' internal resources are seen to be insufficient to achieve greater economies of scale to reduce the levels of uncertainty involved to compete in local and international markets and to exploit new business opportunities (D'Aveni *et al*., 2010). It is largely accepted that the reduction of transaction costs such as those related to negotiations and the establishment of contracts between firms is behind the emergence of a new architecture of relationships (Coase, 1937; Williamson, 1985). For these reasons, collaborative processes are considered a strategic option to improving individual performance levels in the case of small and medium firms or SME. To have access to new information and knowledge is one of the most powerful motivations behind cooperation between firms. If we assume innovation is an interactive process that involves more than 2 actors and for this reason, the role of external actors acquires a higher importance. Then, it is now accepted that both competing and cooperating relationships involve key factors in the enhancement of firms' competitiveness levels (Lundvall, 1992).

The main idea extracted from the available evidence is that collaborative networking may increase firms' competitiveness, chiefly favouring productivity and innovation in a SME. Although, it is agreed that the Italian case has been paradigmatic, others experiences are reported for other European cases as well as for North American and Japanese. In addition, management analysis has tried to explain how R&D collaboration strategy affects a firm's decisions to improve innovation process and firms' productivity.

> Surprisingly, the key question whether cooperative R&D has a positive impact on SME's (innovation) performance and productivity has remained partly unexplored as in the management literature (Das and Teng, 2000). Several researchers have included a cooperation variable in empirical models explaining differences in firms' innovation processes but most of these studies have investigated the impact of R&D expenditures on performance, diversificated firms impact and labour productivity. At the same time, management literature showed analysis to particular performance indicators in specific sectors, e.g., the effect of alliances on high tech start-up firm performance in the biotech industry (Baum *et al*., 2000; Powell *et al*., 1996; Liebeskind *et al*., 1996) or the effect of learning in alliances on market share performance in the global automotive industry

Research has not examined systematically differences in impacts across R&D cooperation types, R&D cooperative networking in small firms and R&D networking impact on both innovation processes and productivity, simultaneously.

This analysis exploits data for a local economic system composed of manufacturing and market service

firms where Small Medium Enterprises (SME) are dominant and synergies bet R&D networking as a driver of firms competitiveness. Secondly, researcher primarily tests the relationship between R&D networking and firms competitiveness (productivity and innovation processes), then researcher present a new R&D Networking Model for support SME's activities.

In this research, researcher attempts to offer some empirical evidence to better understand if and how R&D networking in a peripheral area can influence SME's performance and development. The issue is analyzed from the perspective of the strategic implications for 63 SME's located in Sicily and the survey is designed to define bottom-up entrepreneurial implications on R&D decision making.

The impact of R&D networking in SME's; literature background: Small and medium-sized enterprises represent relevant drivers in the economic development of any country and regional economic systems (Schillaci and Faraci, 2002).

> SME's seem to be the appropriate units to be collaboration nodes because of their lean structure, adaptability to market evolution, active involvement of versatile human resources, ability to establish sub-contracting relations and good technological level of their products. In light of the above, SMEs have many advantages in terms of flexibility, reaction time and innovation capacity that make them central actors in new economies

The driving force of innovation and productivity is learning, both organizational and intellectual human capital (Zucker *et al*., 1998; Davenport, 2000). Accordingly, as Powell *et al*. (1996) suggests the locus of competitiveness may be found rather in inter-organizational collaboration than in firms.

In this perspective, the increasing costs of R&D in combination with a shortening of product and technology lifecycles, blurring industry boundaries in a dynamic technological environment and a improving international competitiveness have made it almost impossible to develop innovation and technology on a stand-alone basis. Actors, especially small organizations use these collaborations to reduce costs of R&D, to transfer technology in order to improve innovative performance, to reduce time-to-market or to search for new technological opportunities (Hagedoorn, 2002; Sumathisri, 2012).

On the management perspective, the view that the locus of innovation and productivity performance is in networks of interorganizational relationships (networking) focused on R&D strategic agreements. Basile (2011) divides non-internal R&D activities into two categories: external (licensing, R&D contracts, outsourcing, customer-supplier relationship) and quasi-external (strategic alliances).

Explanations for collaborative R&D that have been extensively discussed revolve around factors such as sharing risks and costs in the face of uncertain technological developments (Das and Teng, 2000) sho of scope and scale or synergistic effects through efficient pooling of the firms' resources, learning through monitoring technology and market developments, dealing with regulations and industry standards and responding to government subsidy policies. Although, it has been noted more generally that a substantial share of alliances fail (Harrigan, 1988), R&D alliances may be a source of competitive advantage and have long lasting effects on firm performance.

Dickson and Hadjimanolis (1998) examined SME's performance and R&D networking among small manufacturing companies. They found some tentative evidence that companies operating in terms of the local strategic network are more innovative than those operating in terms of the local self-sufficiency.

> The typical Taiwanese or Chinese production system is a cooperative network of SME's that are extremely flexible and respond quickly though under-capitalized and sensitive to market demand and highly integrated in the global economy

Strategic alliance formation has been touted as one of the most critical strategic actions that SME's must undertake for survival and success (Malecki and Tootle, 1996). In other words, a certain level of competitiveness may be felt as a prerequisite for an SME's survival when dealing with dynamic business conditions.

> To compete with global markets and overcome rapid technological changes as well as product varieties, SME's must be able to accomplish innovation processes. Dickson and Hadjimanolis (1998) shows that since small companies are typically lacking of some of the essential resources for innovation they have to acquire that from external sources such as other companies, technical institutions and actor providers

R&D networking offers especially to SMEs, an opportunity to global growth which would be otherwise impossible or remarkably difficult. There are several modes to grow through R&D networking. In one case, companies SME's with their own products can operate in global markets focusing on their core business and co-operating with module design partners.

To summarize with regard to the relationship between networking and firms performance, the majority of research highlights the role of individuals and more

specifically the importance of R&D networking for the diffusion of innovation processes. Studies of R&D networking in particular have identified specific conditions under which collaborative arrangements are most beneficial. Powell *et al.* (1996) conclude that R&D consortia are advantageous when the knowledge base of an industry is both complex and expanding, the sources of expertise are widely dispersed and the pathways for developing technology are largely uncharted:

> They argue that under these conditions, the locus of innovation will be found in networks of learning, rather than in individual firms as in the case of the biotechnology sector. A key finding from a diverse set of studies is that R&D intensity or the level of technological sophistication in industries is positively correlated with the intensity and number of alliances in those sectors (Powell *et al.*, 1996). However, more generally while the utility of R&D agreements and collaboration for enhancing the development of innovations and innovation diffusion is well-established there appears to be a need for more focussed research on the impact of networking on the development and diffusion of different forms of innovation (e.g., product, process and organisational). The study on network formation and networking activity, therefore clearly demonstrates that whilst firms collaborate in networks for many different reasons the most common reason to gain access to new or complementary competencies, technologies and markets. Liebeskind *et al.* (1996) identifies several reasons why new SME's firms may heavily depend on interorganizational system. The first reason is an access to knowledge. External collaborations ensure obtaining relevant, reliable and novel knowledge. These characteristics are of crucial importance for the biotechnology industry. The second reason is that optimization (reduction) of costs as collaboration may reduce the amount of sunk costs. Third, social networks may provide more protection against appropriation than market where even legal contracting may not prevent misappropriation (Liebeskind *et al.*, 1996). Research has evidenced that some SME's benefit from cooperation for their innovation processes whereas others experience major problems. The positive effects include increased turnover, higher profit rates and expansion of the product range. However, SME's often find it difficult to establish and benefit from inter-organizational innovation project

One of the reasons is that smaller companies cannot enforce their will upon others. The distribution of the results is therefore a key issue for them. The literature evidences show a number of key points for SME's:

- The nature of R&D networking, different kinds of linkages and its utility for innovation and competitiveness depends on the strategic characteristics of individual agents (Powell *et al.*, 1996)
- R&D networking formation often differs between different forms of innovation required by actors; networks for product innovation are quite different from networks for process innovations (Pittway *et al.*, 2004)
- The sustance of a firms' R&D alliance network during formation can have important ramifications for future innovation processes and productivity performance (Baum *et al.*, 2000)
- All types of networking constantly change and adapt depending on the requirements and ties of partners and the context within which the collaboration process operates
- Both in R&D networking and business networking, science/providers firms play a role of interface for innovation processes. However, findings appears to be mixed with evidences for and against their capacity to promote R&D networking success (Phillimore, 1999)

Collaboration networking and firms performance; innovation processes and productivity: In order to elaborate a good collaborative management strategy in SME's, cultural, behavioral and organizational issues need to be tackled before even considering technical issues. The importance and the difficulties of the R&D networking decision for innovation has been particularly investigated in the case of SMEs. As they suffer more material constraints, small and medium-sized firms are less able to innovate by themselves and thus networking is often vital:

> The empirical literature, however does not clarify whether the general relationship between networking and innovativeness holds true for such companies. Analysing >1,600 Spanish manufacturing firms, Pittway *et al.* (2004) find that size has a positive and significant effect upon R&D cooperation since large companies enjoy more absorptive capacity. In another research regarding using Community Innovation Survey data for the UK, Torbett (2001) concludes that the larger the firm, the more positive are the effects of technological collaboration on its innovation intensity (i.e., expenditure on R&D, the acquisition of machinery and training as a proportion of company turnover); conversely, he found a more positive effect of technological collaboration upon

innovation performance (i.e., the proportion of turnover due to new processes) among small firms than among larger companies

Management researchers showed certain evidences, both with respect to their effects on firm performance (productivity) and regarding innovation performances. Reearchers refer to Pittway *et al.* (2004) who focused on techno-organisational factors, organisational bundles and firm innovation performances. Powell *et al.* (1996) analyse formal and informal training links; provide other evidence on the EU arena focusing on manufacturing firms show a networking between firms and universities, internal R&D and external knowledge acquisition. Basile (2011) shows the role of science partner as R&D networking provider for firm's competitiveness.

There are further empirical researchers exploring the sources of productivity growth and in particular, the role of inter-firms networking (Adams and Jaffe, 1996; Coe and Helpman, 1995; Basant and Flikkert, 1996). These studies shown that collaborative networking that may arise from interaction with other firms through international trade, foreign direct investments and input-output linkages have a positive impact on productivity growth. Similarly, empirical studies have documented the positive impact of own R&D on productivity at the firm level (Grilliches and Mairesse, 1984; Lichtenberg and Siegel, 1991).

In these studies, large firms are generally found to be more productive than their local SME's industry competitors which is attributed to MNEs efficient exploitation of firm-specific assets allowing for multi-plant economies of scale and the transfer of accumulated tacit and specialized knowledge on production. In summary, the literature suggests that an analysis of different types of cooperation choices should take into account the different possible aims of (collaborative) R&D efforts. For example, labour productivity increases may be more reflective of incremental innovations and affected by collaborative R&D aimed at cost reductions while sales expansion through innovative processes is more likely to be related to basic R&D efforts and client collaboration. Researcher explores empirically the effect of R&D cooperation and agreements on one type of productivity performance as the growth in sales of innovative products that are new to the market per employee (innovative sales productivity)

A number of empirical studies have found a positive impact of engaging in R&D cooperation on innovation performance (Liebeskind *et al.*, 1996; Baum *et al.*, 2000; Pittway *et al.*, 2004). Research has evidenced that some SME's benefit from cooperation for their innovation processes whereas others experience major problems. The positive effects can include increased turnover, higher profit rates and expansion of the product range. However, networking can also be positively associated with innovativeness (Pittway *et al.*, 2004). Several researchers have argued that innovation processes start-up are the outcome of interactions between actors rather than the efforts of one firm in isolation (Lundvall, 1992; Oliver and Erbers, 1998). Networking between firms can increase the sharing and diffusion of technological knowledge which thereby increases the innovative capability of such firms (Powell *et al.*, 1996). Inter-firm cooperation in joint R&D allows the firms to share the costs and risks of innovation. Networking can also allow firms a greater specialization of innovative labour.

With regard to outsourcing in the supply chain, subcontracting networks can enable firms to improve their individual products and thereby increase overall innovation by saving both capital and labour resources which may then be redirected towards R&D activities (Suarez-Villa and Rama, 1996).

A further innovation-linked reason for networking is that firms which possess accumulated capital (technological, commercial and social) enjoy advantages in the cooperation market as other companies view them as attractive potential partners (Ahuja, 2000a). At the same time if there are unobserved firm characteristics that impact at the same time firms' incentives to cooperate and their innovative output, a positive correlation between cooperation and innovation may be spurious rather than causal (Klomp and van Leeuwen, 2001)

In this research, researcher predict a positive relationship between R&D networking and SME's competitiveness. More specifically, researcher propose:

H_1: Innovation processes output are positively associated with R&D networking

H_2: Firm's productivity is positively associated with R&D networking

Regarding the factors that linked R&D agreements to innovation process, according to management literature a predict a positive link with: science and technology linkages, R&D employees, technology innovativeness and company age. Regarding the impact on the firm's productivity as innovation sales products, researcher predict a positive link with: SME's agreements, R&D expenditures/investments, market target and also logistics infrastructure accessibility. A range of scientific perspectives supports the idea that the competitiveness of the firms depends on external drivers/resources not only on the development and planning of networking system (Malecki and Tootle, 1996; Basile, 2011) and the

existence of an innovative environment (Camagni, 1991) but also on the existence of external infrastructures supporting entry mode to new businesses (Porter, 1990). According to Maskell and Malmberg (1999), the competitiveness of industrial firms depends on a particular combination of local characteristics and external factors located in the productive district that influence the development of local SME's of economic defining a positive impact of logistics systems and infrastructures (i.e., airport proximity) (Adeniyi and Cmilt, 2011).

MATERIALS AND METHODS

Data setting: The aim of this study is to provide a methodological framework to support the empirical test on the relationship between R&D networking and SME's competitiveness such as innovation processes and productivity. To test the hypotheses, a questionnaire was created. The survey was conducted between January and October, 2010. Direct interviews were based on a semi-structured questionnaire. Interviews typically lasted from 1/2 to 1 h. Interviewees included the owners, chief executives and managers responsible for the decisions on the international processes of their firm.

The survey targeted potential respondents belonging to firms located in Sicily, an Italian region characterized by a wide range of industrial areas. The research presents data from a survey of 63 SME's (sud-East Sicily) located between the 1st and 2nd and 3rd isochronous catchment area (between 30 and 90 min) of Comiso airport, designed to define bottom-up managerial and entrepreneurial perspectives and implications. Empirical literature showed the positive impact of logistics systems and infrastructures (i.e., airport proximity) on the SME's development. The strategic implications, supplementary and complementary to the analysis of the airport impact have been defined and analyzed through an intensive desk analysis of the development of the conditioning variables Ragusa is a peripheral area located in sud-East Sicily; this area is characterized by a high degree of entrepreneurship (34.000 firms, 99% SME's on 310.000 citizen), a low degree of mortality of enterprises and a high domestic productivity (Chamber of Commerce of Ragusa). Firms were identified from lists obtained by industry and entrepreneur associations: Italian Chamber of Commerce, Confindustria Ragusa, the AIDA Bureau Van Djik Database. The final survey participation count represents >63% of the original participation goals. Out of 100 total firms selected with Euro 2,000,000 of revenues, 63 responded. The sample was consequently reduced on the basis of dimension (Revenues, SME with at least 6 employees, upto 250), industry (manufacturing and services sectors), international markets experience (exporters) and R&D efforts.

Three of the most common type of questions used in questionnaires or surveys includes open-ended, closed-ended questions and Likert scales. An open-ended question does not provide the participant with a choice of answers. Instead, participants are free to answer the question in the manner they choose. The Likert scale asks participants to provide a response along a continuum of possible responses. For example: Is it important whether the managers of the firm have R&D provider partner? (5) strongly agree/high influence (4) agree (3) neutral (2) disagree (1) strongly disagree/no influence. Field survey, conducted via visits to the companies and interviews aimed to verify the effectiveness of R&D networking defining strategic implications. To test the hypotheses, a logistic regression analysis was used which is common in studies related to networking, strategic alliance value, firm's competitiveness (Baum *et al*., 2000). Moreover, a logistic regression is the preferred choice when:

- The dependent variable is dichotomous
- There is a combination of continuous or categorical independent variables (Pallant, 2007)

A summary of the independent variables is shown in Table 1. The operationalization of their measures is shown in Table 2. Table 2 also lists the dependent variable, Y1 (Firm's competitiveness as IP (Innovation processes) COMP and P (Productivity) COMP) which was assigned a value of 0 for a low (COMP) and 1 for a high degree of COMP.

Table 1: Summary independent variables

Hypotheses	Factors	Description
H_1	Science and technology linkages	R&D agreements (equity and no-equity) with science and technology provider such as science and technology parks, hub R&D organization, public centre of technology transfer and other innovation network provider
H_1	R&D employees	Intellectual capital involve in the innovation processes
H_1	Technology innovativeness	Innovativeness level, degree of complexity and modularity of innovation outputs
H_2	SME's agreements	Type of external linkages (R&D contracts, subcontracting, horizontal link, partnership, strategic alliance, joint ventures, agreements with suppliers)
H_2	R&D expenditures/investments	Amount of internal R&D financial efforts
H_2	Market target	Geographical market target, foreign markets, local business expansion
H_1-H_2	Company age	Years of activities, business experience, internationalization experience
H_2	Infrastructure accessibility	Degree of accessibility (time, cost, financial efforts, distances) due at logistics infrastructure in the area. Role of the logistics infrastructures (In this research: airport's proximity)

Table 2: Operationalization of dependent and independent variables

Variables	Factors	Description
Dependent variables H_1	H_1-IP COMP-innovation processes competitiveness	Value of 0 for low degree of IP and 1 for high degree of IP
Independent variables	Science and technology linkages	Responses with scale Likert 1-5, 1: No influence, 5: High influence
(Drivers of R&D networking)	R&D employees	0-1
	Technology innovativeness	Responses with scale Likert 1-5, 1: No influence, 5: High influence
	Company age	Responses with scale Likert 1-5, 1: No influence, 5: High influence
Dependent variables H_2	H_2-P COMP-productivity competitiveness	Value of 0 for low degree of IP and 1 for high degree of IP
Independent variables	SME's agreements	Responses with scale Likert 1-5, 1: No influence, 5: High influence
(Drivers of R&D networking)	R&D expenditures	0-1
	Market target	Responses with scale Likert 1-5, 1: No influence, 5: High influence
	Company age	Responses with scale Likert 1-5, 1: No influence, 5: High influence
	Infrastructure accessibility	Responses with scale Likert 1-5, 1: No influence, 5: High influence

Table 3: Correlation matrix

Variables	VIF	H_1	H_2	H_3	H_4	H_5	H_6	H_7	H_8
Science and technology linkages	1.31	1	-	-	-	-	-	-	-
SME's agreements	1.11	0.23*	1	-	-	-	-	-	-
R&D expenditures	1.21	0.04**	0.23*	1	-	-	-	-	-
R&D employees	1.34	0.04	0.01**	0.12*	1	-	-	-	-
Technology innovativeness	1.27	0.03	0.02	-0.01	0.05	1	-	-	-
Market target	1.34	0.01	0.03	0.12	0.06	0.21*	1	-	-
Company age	1.19	0.11	0.07	0.31	0.02*	0.17	0.01**	1	-
Infrastructures accessibility	1.42	0.04*	0.08	0.45	0.37	0.09	0.03*	0.12	1

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed)

RESULTS AND DISCUSSION

Empirical evidence: Researcher employed a logistic regression with a backward elimination approach for the analysis. Regression analysis is among the most commonly used statistical methods and logistic techniques are used when the outcome is binary (e.g., competitiveness level). Prior to conducting the logistic regression, researchers created the correlation matrix of independent variables. This matrix provided no indication of multicollinearity problems (Table 1). In this study, VIF score was between 1 and 2 which is very small and reduces the possibility of multicollinearity (Pallant, 2007).

Table 3 provides information about the contribution of each variable. The Wald test was conducted to indicate the significance of each estimated coefficient providing tests for the individual hypotheses.

A positive coefficient in the regression represents a direct relationship between independent variables and entrepreneurial orientation to enter new markets while a negative coefficient represents an inverse relationship. To develop a model with the best possible fit to the framework, researcher used backward elimination (up to move >0.05) based on likelihood ratio estimates.

As shown in Table 4 and 5, the hypotheses have been tested. An important result is that with regard to the impact of R&D linkages on the firms productivity, no statistical support was found. SME's agreements, R&D expenditures, market target are not related significally to SME's productivity (Sig. >0.01, 0.05). Company age and local logistics infrastructure accessibility have a moderate and significant impact (B = 0.789; Sig. = 0.049) and (B = 0.569; Sig. = 0.049). Reversely to the literature, the empirical survey regarding hypothesis H_2 shows R&D networking not affect firm's productivity. According to the predicted relationships deepened in the management literature hypothese H_1 is confirmed and statistically significant. These findings are consistent with other studies that found a strong link between R&D agreements and the start of innovation processes in SME's.

R&D Networking Model to revitalize SME's competitiveness: Regarding data of SME's interviews and items, entrepreneurs and managers confirm the difficulties to engages R&D agreement with other actors. SME's often find it difficult to establish and benefit from R&D interfirms linkages. SME's involved in R&D cooperations are not necessarily more innovative, at least in the short-run than those involved in other types of cooperations, particularly subcontracting. Researcher also find that companies engaged in R&D cooperation tend to have spatially less extensive network relationships, i.e., they cooperate with local partners.

However with regard the impact on productivity, researcher find only weak results for differences between local and extra-regional R&D networking. While, production subcontracting is the most common form of inter-firm cooperation, cooperations for technological innovation are the second most frequent form of cooperation in his sample.

In general, companies who collaborate in R&D do not choose R&D networking provider such as science and technology parks, business incubator and other R&D providers. There is further empirical management literature

Table 4: Model coefficient (H_1)

Variables	B	SE	Wald	df	p-values	Exp (B)
Science and technology linkages	0.511	0.204	0.742	1	0.009	1.034
R&D employees	0.432	0.177	0.346	1	0.015	0.861
Technology innovativeness	0.321	0.219	2.536	1	0.045	0.651
Company age	0.389	0.517	0.388	1	0.031	0.675
Costant	-0.874	1.231	0.452	1	0.489	0.376

p<0.01; p<0.05; Model Chi-square: 9.599 (sig. 0.006); -2 Log likelihood: 1,203.452

Table 5: Model coefficient (H_2)

Variables	B	SE	Wald	df	p-values	Exp (B)
SME's agreements	0.311	0.204	0.342	1	0.094	1.084
R&D expenditures	0.132	0.247	0.746	1	0.125	0.761
Market target	0.421	0.319	2.736	1	0.081	0.651
Company age	0.789	0.577	0.488	1	0.041	0.675
Accessibility infrastructure	0.569	0.371	1.629	1	0.049	0.723
Costant	0.674	1.435	0.652	1	0.619	0.816

p<0.01; p<0.05; Model Chi-square: 7.519 (Sig. 0.089); -2 Log likelihood: 1,403.122

that show the positive role of R&D provider to improve innovation and competitiveness in SME's (Basile, 2011, 2012; Phillimore, 1999; Vedovello, 1997).

In this research, researcher present a new model of R&D networking for SME's located in peripheral district. This model aim to revitalize firm competitiveness and support the effect of R&D collaboration strategy to improve productivity and to start new innovation processes in SME's (Fig. 1).

The R&D Collaboration Model is comprised of a set of SME's whose main motivation for participating in a co-operative system is directly related to an increase in productivity (innovative sales productivity) and innovation processes. A R&D Networking Model provides a new innovation process produced by a set of partners and this process or service is then captured by another set of partners in the collaboration system.

The R&D Net Model usually has a strong hub-provider such as science and technology providers as science and technology park who is the main source of value-creation lies and knowledge in the dynamic structure of the collaboration system and its ability to adapt to ever-changing market conditions (Ferguson and Olofsson, 1998; Maki, 2002). In R&D networking process regarding peripheral district, science partners play an important role as independent provider and intermediaries within business and R&D collaboration; science partners act as intermediaries or neutral agents within the model enabling different business systems to communicate by generating trust between different SME's. The evidence demonstrates that science partners tend to be most important where the degree of competitiveness is complex and involve more technologies, capabilities and difficulties on the decision making process. They are very important to promote and financing R&D contracts and R&D interfirms projects to developing new innovation output on technology transfer perspective.

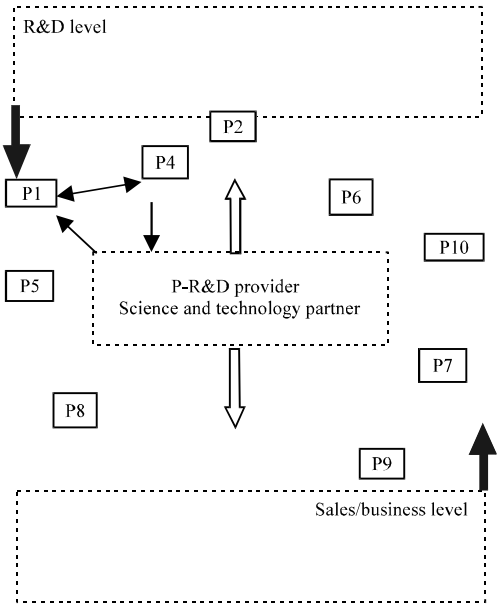

Fig. 1: R&D Networking Model

In addition, there are also some other external groups which are not stakeholders of science parks but are linked to a science park or its firms. Such groups include for example Accountants, Auditors, Lawyers, Merchant and Investment Banks, Business Consultants and other service providers which are located in and outside the parks or whose clients are mainly located in the parks.

To summarise the science centre as science and technology parks could become central actors in networking system for innovation, they could increase the number of linkages could increase the diversity of ties and partners. Consequently, the different kinds of collaboration and actor involve in interorganizational system could increase knowledge, critic mass, capabilities and innovation output.

The R&D Net Mod. is comprised of partners in both horizontal and vertical collaboration (from need of R&D at needs of business sales level) and it is comprised of a set of firms of short size whose main motivation for participating in a network is that of enhancing their knowledge by joint research and development firms. With the main motivation for the individual partner being personal knowledge creation or enhancement, the synergic effects of the collaboration strategy are of great importance for transfer benefit on the internal productivity. Success often lies in the ability to set up and execute contractual research in complex areas without loosing control, overview and manageability of the task at hand.

CONCLUSION

Researcher believes that these results have both practical/managerial and policy-makers implications. Entrepreneurs and managers of SME's should be aware of the importance of R&D networking focused on specific agreements as driver of firms' competitiveness. Empirical evidence confirm the positive role of R&D collaboration on the start of innovation processes in SME's also in peripheral district. Nevertheless, empirical survey showed that R&D networking has not an impact on firms' productivity as (sales on innovation products). This research confirms that SME's often find it difficult to establish and benefit from R&D interfirms linkages; networking process by itself cannot play a role in stimulating productivity but have an significant impact on the start of innovation processes. Difficulties regarding decision-making processes, innovation capabilities shortage, disproportionate focus on productive process and operations, risk sharing and external factors, difficulties in finding of a hub/provider science partner affecting R&D networking impact.

IMPLICATIONS

The first managerial and practical implication regards the R&D Networking Model configuration. Moving from these moderate effects we propose a new model of R&D networking to revitalize firms' competitiveness. This model is based on the role of agreements provider partner as driver of innovation process and productivity. The model has an impact on policy makers decisions to revitalize, promote and finance R&D networking systems in peripheral districts. This is a relevant driver on the regional competitiveness.

Actually the observed local productivity system is characterized by low degree of external collaboration and innovation capabilities. Final recommended line of research involves new business model configurations of SME's. According to the business model literature, external changes (infrastructural, institutional, competitive, technological, operational) creates the need to configure new strategic and organizational assets and core capabilities to create and maintain the firms' competitiveness. The new SME's business model design and configuration as strategic fit tool related to the R&D Networking Model proposed will be the target of further research and implication for entrepreneurs and managers.

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