ORGANIZATIONAL SUCCESS FACTORS IN MARKET-DRIVEN LOCAL AGRO-FOOD INDUSTRIES: A REGIONAL CASE STUDY FROM SICILY

Gabriella Vindigni, Department of Agricultural Economics and Resource Valuation, University of Catania (Italy)
Peter Nijkamp, Department of Spatial Economics, Free University Amsterdam (The Netherlands)
Giuseppina Carrà, Department of Agricultural Economics and Resource Valuation, University of Catania (Italy)
Iuri Peri, Department of Agricultural Economics and Resource Valuation, University of Catania (Italy)

Abstract

Local industries often face fierce competition in the same region, especially as regards traditional products. Competition mechanisms to survive may be based on learning principles and organizational networks. The present paper summarizes the most important literature in the field and tests the above proposition by means of a case study on local honey production in Sicily. The analysis is based on a recently developed artificial intelligence method for nominal (linguistic) information, coined decision tree analysis.

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1. New Horizons for Innovation and Entrepreneurship

The interest in innovation has focused new attention on "the entrepreneur". Entrepreneurship is a creative act leading to a new combination of capital, people and resources. In our modern information age, entrepreneurship normally means an active and guiding involvement in complex network constellations that create value added through changes in business by deploying so-called network externalities. Thus, orgware management is a critical source of innovation.

Economic development is thus the outgrowth of new and creative combinations of economic activity. The dynamics in this process can largely be ascribed to the innovative behaviour of risk-taking entrepreneurs. Studies on entrepreneurship have, in the course of economic history, shown a fluctuating pattern of interest among economists. Illuminating examples can be found in the works of Schumpeter (1934) and Galbraith (1967). An interesting overview can be found inter alia in Hébert and Link (1982), who address the motives and economic backgrounds of entrepreneurship. In their rather comprehensive study they distinguish the German, Chicago and Austrian schools of thought. In general, the entrepreneurial act is pursued by a risk-taking rational businessman, who in a small-scale setting, dares to choose new, potentially beneficial directions. Entrepreneurship is based on the inspiring courage of individuals who dare to explore unknown horizons in terms of production or organization; it often finds it origin in small-scale economic activities.

In the past two decades we have witnessed a renewed interest in the seedbed conditions for small- and medium-sized enterprises (SMEs), as it was recognized that the innovative potential of the SME sector was very high (Acs 2002, Acs and Audretsch 1990). Many start-ups are small-scale in nature and hence it is no surprise that new entrepreneurship is often found in the SME sector. The current economic conditions also reflect new types of industrial organization among commercial firms (e.g. network constellations) in which entrepreneurship plays a key role. It is therefore conceivable, that in recent years the idea of entrepreneurship is back on the stage with a particular view to the regional and network conditions for the emergence of innovative and competitive entrepreneurship (Foss and Klein 2002, Nijkamp 2003, Pineder 2001). Entrepreneurship means a sailing tour under very uncertain and changeable weather conditions, driven by survival strategies in a competitive and sometimes antagonistic world (see Mehlum et al, 2003, Stough et al, 2002). In such evolutionary economic developments due attention should be given to incubation conditions and technogenesis processes which drive regional growth.

Recent years have witnessed an avalanche of interest in entrepreneurship, in particular the critical success factors of the modern "entrepreneurial hero" and regional development implications of emerging entrepreneurship, in particular seedbed areas. It goes without saying that in the recent past also the conditions that facilitate proper entrepreneurship policy or the opportunities of public-private partnership constellations have received increasing attention. Research in this field has focused in particular on fact finding, on theory development and on model contributions and has aimed to achieve a better

understanding of a complex multi-actor force field. Contributions have been made by representatives from different disciplines, in particular economics, regional science, industrial organization or behavioural psychology. In this context, the critical importance of knowledge and information in our ICT driven world is increasingly recognized.

It is thus widely accepted that knowledge is the key to success, and that explains why with the advent of the ICT revolution so much emphasis is placed on the promises offered by our modern knowledge society (cf. Audretsch and Thurik 1999, Nijkamp and Stough 2002). The ICT sector in combination with drastic changes in the industrial organization will exert profound influences on modern spatial-economic systems. This will imply that network-based entrepreneurial activities have the best chance to survive and flourish in our ICT age.

Nowadays, with the advent of the ICT sector favouring network formation, such constellations based on flexible specialization are usually referred to as *virtual organizations* or *virtual enterprises* (cf. Cooke and Morgan 1992). They refer to organization networks that have a flexible structure, are governed by trust and innovative spirit, and for the outer world resemble one unambiguously identifiable and complete organization. The control and command structure is not always very clear and may be flexible as well. According to Hale and Whitlam (1997) "*The virtual organization is the name given to any organization which is continually evolving, redefining and reinventing itself for practical business purposes*". Virtual enterprises may have different appearance forms. Some archetypical examples are (see Noorman 2002):

- *internal virtual organization:* an organization comprising relatively autonomous teams which can be flexibly employed (Campbell 1997); illustrations can be found in virtual offices and lean offices.
- *stable virtual organization:* an industrial model based on an outsourcing of non-core activities to a relatively small and fixed number of intermediaries.
- *dynamic virtual organization:* large-scale but flexible co-operation between industrial organizations based on ad hoc opportunistic market motives (cf. Upton and McAfee 1996).
- *web-enterprise:* an organization centred around a (temporary) network of experts in a given field, sharing knowledge management and information for dedicated purposes.

Clearly, in reality various mixed forms may emerge. The advances in the ICT sector have of course induced the transition to virtual network activity. It is clear that a wide variety of virtual enterprises is emerging nowadays. Their common feature is the trend to shorten the product life cycles, to be subject to permanent innovation pressure, to be information-oriented, to be driven by high quality targets ('zero defect'), to operate in non-hierarchical modes, to be market-oriented through learning-by-using interactions and to take care of the entire value chain (cf. Morgan 1991).

Knowledge and entrepreneurship are not ubiquitous goods that are freely available everywhere; they have clearly geographical and institutional backgrounds. There is a recent avalanche of studies on the geography of innovation and economic progress (see e.g. Boekema et al, 2000, Gallup et al, 1999, Van Oort 2002). Despite the 'death of distance', physical geography is historically still a major determinant of competitive economic conditions, such as access to main transport and communication arteries. The recent interest

in the new economic geography has clearly pointed out the critical importance of spatial accessibility in regard to the emergence of innovative attitudes and institutional support mechanisms (see Acemoglu et al, 2001, Hall and Jones 1999). Such institutional ramifications may not only relate to regulatory systems such as property rights or stable political regimes, but also to self-organized modes of cooperation and competition in the private sector. The main challenge from a research perspective is the identification of promising human capital conditions from a regional–institutional perspective, while taking account of the self-organizing potential of business life in a given area (see Lundvall 1999, Norton 2001, Oakey 1996). The concept of a 'learning economy' should be mentioned in this context as well, as this notion indicates that evolution is not a rectilinear development. It is dependent on deliberate choices and cognitive feedback decisions of humans in an uncertain environment, who respond endogenously to new challenges and to creative opportunities offered by social and economic interaction. This new mode of producing and interacting is a major departure from Fordist's mass production methods of the past. Learning models are also in perfect agreement with network-based modes of competition and cooperation.

Mass production in large-scale concentrations has been a prominent success factor in the age of industrialisation. Labour specialization and - later on - capital specialization were a *sine qua non* for a productivity rise that was needed to survive in a competitive economy or to become a winner in a growing market. Mass production however, also creates a high degree of path dependency, lock-in behaviour and hence inertia in large-scale enterprises, with the consequence of a low degree of flexibility and adaptability to new circumstances. In the course of history we have learned that mass production is not the only mode of industrial organization, but is also accompanied and sometimes even facilitated by SMEs which have often demonstrated a surprising ability to adopt new production possibilities (including distribution and logistics) (cf. Marsili 2002, Suarez-Villa 1989). The fact that 'big size' is not always the optimal level of a firm has been thoroughly analysed by You (1995), who offers four explanatory frameworks:

- *technological:* the optimal scale of a firm is determined by economies of scale and scope as well as by the span of control, so that the optimal firm size is the result of scale economies and diseconomies.
- *institutional:* according to the transaction cost theory (see Coase 1937 and Williamson 1985), the governance of a complex undertaking with many activities may cause high internal transaction costs, so that it may be more beneficial to resort to the market for specific activities (e.g. non-core activities).
- *organizational:* the type of industrial organization (e.g. monopoly, oligopoly or monopolistic competition) is reflected in the market share of a firm, which is in turn determined by the price, the product uniformity (or specialty) and the managerial structure.
- *dynamic:* due to path dependency, lock-in behaviour, cultural environment, age of the firm and other determinants, the past situation of the firm may impact on its future size.

Although the Industrial Revolution has created the seedbed conditions for large-scale industries, the importance of small-scale activities with a great variety of appearances has to be emphasized here. Despite the variety, we observe in almost all cases a decentralized

mechanism for governing co-operative relationships. Cooperation becomes volatile, but needs rules and trust. Consequently, the principle of trust has become a popular concept; it is less based on emotion but rather on economic rationality, which may be more transaction-specific (Dasgupta 1988, Granovetter 1985, Linders et al, 2003). Consequently, there may be need for more institutional support systems or various forms of institutional embedment in order to prevent destruction of human capital for ad hoc purposes (cf. Hagen and Choe 1998). This brings us to a major issue public policy issue: is it a non-formal public-private governance mechanism that ensures public interest (e.g. a stable regional development) and enhances private performance (e.g. innovative behaviour)? Availability of resources, smart infrastructure and proper education and training systems, accompanied by close interactions between the business world and the public sector are critical success factors in this context (see Stough 2003). Against the backgrounds of the previous remark, we will now develop a framework for analysing the role of orgware networks in a regional competitive environment, taking a specific industrial branch (i.e. the honey sector in the region of Sicily) as a test case. The main focus will thus be on orgware innovation.

2. An Analytical Framework for Orgware-Oriented Industrial Innovation

In many rural areas, innovation through the adoption of productivity-enhancing technologies and new management practices for existing productions operation is an essential key factor for the survival and viability of rural manufacturing. Creation and destruction are critical ingredients for this sector.

Products and machines constitute visible and tangible aspects of innovation, but there are also intangible components that are present in the memories of individuals, in the behaviour of stakeholders and in organizational structures. These intangible components, usually called know-how, are increasingly regarded as the main driving factors for sustainable comparative advantage. Innovation often requires the combination of various new and existing competencies.

A clear exposition of the key components that constitute an innovation can be referred to three strongly interrelated territorial dimensions: a) *hardware*, understood as the infrastructure on which the territory relies, such as the communication and the transport system; b) *software*, includes the immaterial level of development, such as the quality of human resources and the capacity of production of knowledge and information of the territory; and c) *orgware*, being the capacity of economic, social and institutional organization that a territory adopts.

Many different theories seek to explain the influence of knowledge, learning processes and inter-firm cooperation modes in localized innovation systems. Particularly in the last two decades, we have seen a remarkable rise in popularity of the so-called territorial innovation models, which emphasize the accumulation of tacit knowledge, collective learning and the growth of associative structures as the basis of formal and informal interdependencies. Coordination occurs through trust, reciprocity and long-term strategic agreements, supported by locally embedded structures (de Bruijn, 2003).

In the analysis of economic organization and production with a central focus on firms, transaction cost analyses (Coase, 1937; Williamson, 1985; Langlois and Robertson, 1995) as well as theories based on competence view points (Penrose, 1959; Foss, 1996) have gained a dominant position. Storper (1995) uses the concept of untreated interdependences to refer to conventions, informal rules and habits that coordinate economic actors under condition of uncertainty. Technological spillovers are mostly coordinated not through market mechanism, but are "in the air" like in the Marshallian concept of "industrial atmosphere".

The literature on enterprise clusters, industrial districts and dynamics of industrial organization is relevant in this context. In an Italian study on how production is spatially organized, Garofoli (1991) proposed a typology of models of local development that has been rather influential on later work. This classification introduced concepts such as Local production systems and System areas, and described the rise in the complexity of the local system that may occur, with inter-firm and inter-institution synergies growing widespread and effective. Markusen (1996) broadens the picture to include several different forms of industrial organization within the definition of an industrial district. She argues that the emergence of 'sticky places' in a 'slippery space' - characterized by dramatically improved communications, and increasingly mobile production factors and enterprises - may be related to numerous variants of industrial districts. Thus she opts for a more extensive connotation of the idea of an industrial district, which is not confined to the most common and traditional usage (for example, the Marshallian district or its 'Italian' variant). Therefore, the proper definition of a modern industrial district utilized is the following: "an industrial district is a sizeable and spatially delimited area of trade-oriented economic activity, which has a distinctive economic specialization, be it resource-related, manufacturing, or services" (Park and Markusen, 1994).

Although the various models differ significantly from each other in terms of their conceptualization of innovation, all of them emphasize the importance of knowledge. Some of them focus on the importance of R&D (e.g. Krugman, 1991; Audretsch and Feldman, 1996) while others, more concerned with the use than generation of knowledge, focus on the presence a of skilled/experienced labour force for knowledge spillovers.

Many empirical studies in this set of district theories have adopted a cognitive approach. Firms can be interpreted as a cognitive system: a social-productive system in which knowledge, social experiences, mental models and collective beliefs are accumulated in a specific space through time. Firms can be thought of as a "cognitive lab", where knowledge and information are elaborated in a complex way, and where culture and social values are generated. The local accumulation of tacit knowledge in firms provides the necessary distinctive elements to fuel firm competitiveness.

The application of a psychological metaphor of learning at the level of an organization involves fostering the idea that learning in individuals can be transformed into more general improvements, and that it will led to more success and prosperity for the organization (Rhodes, 1996). Organizational learning is as natural as individual learning, where an organization attempts to adapt and survive in an uncertain world (Halloran, 1999). According to Dogson (1993), just as a psychologist distinguishes different levels of learning,

the learning organization can be seen as a move from natural learning, by seeking varied forms of understanding, to other systems including congenital learning, experiential learning, vicarious learning, grafting, searching and noticing.

Huber (1991) contends that learning can occur not only due to knowledge acquisition from outside the organization but also due to the rearrangement of existing knowledge, the revision of the previous knowledge structure. In this context organizational memory refers to the repository where knowledge is stored for future use. Knowledge management is defined as a process that governs the creation, the dissemination of growth and the leveraging of knowledge in order to fulfil organizational objectives. In this framework, knowledge is the capacity to take effective action and encompasses an organization's intellectual capital (Seemann et al, 2000).

Decision makers store and retrieve not only hard data or information. Skill acquisition, learning, and accumulation of capability over time are the core of knowledge management within an organization (Nonaka, 1994 and Tecce, 2000). The source of information is based on networks, because both the organization and its employees are increasingly regarded as a resource of competitive advantage. Knowledge is information that is transformed by the active intervention of organizational participants in such a way that is applicable to specific work functions or situations (Lee and Yang, 2000).

The orgware and learning model posits that networking improves the flow of information. The absorptive capacity of individuals is the ability to recognize and to assimilate, and it incorporates organizational information, either internal or external. The model suggests that the absorptive capacity is based on the construct that knowledge can be tacit or explicit. Tacit knowledge is embedded in people, their know-how, skills, practices and experiences, while explicit knowledge is generally held in formal policies, procedures, systems and historical and financial records. The first of the two types of knowledge, i.e. tacit knowledge may be more valuable because of its uniqueness.

3. Pathways to Innovation in Rural Areas: A Regional Case Study

Rural areas have in recent years exhibited dynamic developments. Beside the process of specialization and concentration of the agro-food sector at the global level, also some significant countertendencies have in the mean time emerged.

Recent research suggests that there is an impressive increase in the performance of enterprise activities that are associated with farm activity diversification, like agro-tourism, the supply of care facilities, environmental services, etc. This is especially true in the extending of activities in order to achieve more added value per unit, as in the production of high quality products and regional specialities, on-farm processing and marketing, as well as the creation of alternative supply chains. The innovative behaviour of these enterprises is due to their newly created activities and linkages between market and local resources, including the regional environment, local knowledge, personal skills, available assets (Van der Ploeg and Renting, 2000; Marsden et al, 2000). Nowadays we can observe a broad portfolio of local and regional initiatives in the region that all support firms' innovation.

The way in which the enterprises interact with their region may induce the creation of new organizational patterns that offer more opportunities for introducing innovative processes, using external elements in a local style of farming (Iacoponi, 1995). Learning-by-experience supports the know-how of the entrepreneurs to master the techniques of production and elaboration of the products, adopting new practices through cooperation and a close connection with their community.

The learning of organizational and managerial capabilities constitutes a critical factor in the evolution of the firm. The learning processes in our case are achieved through the understanding and transfer of past experiences into initiatives, which expand the body of knowledge. Furthermore, even non-formalized and unplanned, a system of relation and exchange of information and experience is developed among the firms as a particularly suitable tool, which frequently evolves through experimental and imitative behaviour (Becattini, 1987).

We will investigate now the orgware driving forces of innovative behaviour in the agricultural sector in a given region, in particular the question of how far its network use and organizational reform is incorporated in this novel behavioural patterns. Our work is based on a field survey among honey producers in Sicily.

The survey investigates the entrepreneurs' innovative behaviour and the decisive role that the learning process has in determining the success of the enterprises. Our research underlines the importance of the close relationship between learning and entrepreneurial achievement: family background and professional learning are key factors in this process. Other important factors include the specificity of the assets and availability of market opportunities.

The local honey production system is based on small-scale production modes and equipment, a moderate use of machinery and a use of available local resources. On-farm processing and marketing is a distinctive characteristic of this system. Through these activities, individuals or groups of entrepreneurs increase their capacity to capture a greater share of the market for their product. The specific physical assets are characterized by low opportunity costs of the factors and the specific human assets enable the enterprises to exploit local opportunities and help them to avoid high business risks and threats.

The processing and marketing activities add value to the products and improve their quality as well as the entrepreneurs' bargaining power. Cooperation with other entrepreneurs plays a strategic role in further expansion. In order to integrate new activities into an individual or collective farm strategy of development, it is necessary to understand more in depth how local knowledge is improved by information and what the factors are that facilitate it.

For the enterprises involved in the production of local or regional goods, innovative behaviour is to a considerable degree a market driven process. New opportunities in quality-oriented marketing strategies are identified by the local producers, which increase their returns through effectively meeting end-user demand. The EU regulation on label of origin denomination (designation) and on organic food plays an important role in their innovative

behaviour, since it has created a new market space and a new source of innovation and symbolic power (Brunori, 2000).

The entrepreneurship business performance is, in our case study, expressed in terms of sales or sales price increases from the viewpoint of strategic factors, such as the internal technical or organizational structure, as well as the external social and economic context. We argue that the enterprise is competitive if it is profitable seen from the viewpoint of market returns, if it supplies products demanded by consumers and if it can flexibly adjust itself to market challenges (Tangermann, 2003). In the next section we will offer a more detailed description of our case study.

4. Description of the Honey Production System in Sicily

4.1. Introductory remarks

To clarify the above arguments, in this section we will analyse a cluster of firms in a rural area of Sicily (named *Monti Iblei*), specialized in honey production. The local production system is characterized by small-scale owners/producers farmers, who have a long tradition in beekeeping, and whose capabilities are focused on the production of niche or high quality and artisan-type products. Although those industries are usually classified as 'traditional' and 'low tech', they recently have demonstrated a new dynamism. Most of them lack an overall strategy, however, we have found dynamic small local farm enterprises with a interesting output in term of innovation, which has added value to the agricultural production of the area.

Most of the firms are small, but some of them have increased their competence level through training and apprenticeship. In terms of technological capability they also have upgraded their operation, and a few are close to the new frontiers. Firms in these clusters also exhibit the capacity to implement new technology adaptations, to improve quality products and processes and to bring them to the market. A distinct characteristic of this cluster of firms is their cooperation and networking with member firms. Through this process they have became more specialized and more organized.

In the past these firms simply benefited passively from the externalities spontaneously created through clustering. Recently, in a novel organizational phase, these enterprises engaged actively in the creation of collective efficiencies stemming from a high degree of linkages within and between different actors, in terms of horizontal (coordination) ties, a progressive specialization in the various production phases, frequent exchange of information and regular technical discussions among producers and subcontractors. Tacit knowledge flows were facilitated by this conscious, pro-active set of interactions.

Cooperation between the public and private sector also contributed to meeting the new challenges faced by the firms in this cluster. National and local producer associations played a pivotal role for obtaining public support for establishing technical training facilities, a special credit line for providing short-term loans to local manufacturers, for state support, and as interlocutor with the local and regional government.

The empirical data for our research stem from in depth personal interviews, held in the first part of 2003 among 25 entrepreneurs in the area. Their names were extracted from the information base of the Chamber of Commerce of Siracusa and Ragusa. The sample contains only information on these entrepreneurs who had a priori expressed a willingness to be interviewed. In this context, we have looked at some shared characteristics that could identify both the production and organizational system of honey and have defined the principal aspects of innovation process.

4.2 General characteristics

The socio-demographic characteristics of our sample show that beekeeping is a male activity. Next, the majority of interviewees appear to be relatively young: 56 per cent do not exceed the age of 40 years, which reflects a typical young farm activity. Finally, the educational level appears rather low (primary or secondary educational level), while only few farmers were more highly educated (higher professional training or university education).

A further look at relevant business aspects reveals that most of entrepreneurs are active in other areas. Approximately 84 per cent of the entrepreneurs are owners and employ family work force; moreover, most honey activity constitutes part-time work, which can be partly explained by the small-scale activity of the firms. Today, honey production still represents a form of productive diversification of the traditional agricultural enterprise with functions of integration of the yield for the family.

In total 76 per cent of the enterprises started in recent decades and only 24 per cent before 1990, a process favoured by the technological change in the sector.

Beside, we have investigated the entrepreneurial participation in trade associations in order to analyse their propensity to collaborate with other firms. In our study we have registered only horizontal coordination; a majority of the honey producers are members of business associations at the local or national level (64 per cent) or take part in consortia (16 per cent). All producers are involved in the promotion of an initiative for acknowledgment of the DPO (Protected Denomination of Origin), while at the same time many of them have adopted the HACCP system (76 per cent). The organizational structure in 96 per cent of all cases is very simple with a clear concentration of the production, processing and marketing of products in the hands of the holder.

4.3. Marketing, focused markets and distribution channel logistics

In the context of marketing organization, we can observe in our sample that a large part of the enterprises concerned (76 per cent) invests in marketing expenses.

In relation to marketing channel choices, the sample shows that the market channel utilized is mainly the direct channel, without interference in general of marketing intermediaries. A substantial proportion (42 per cent) of the small-scale honey production is sold by producers directly to consumers; thus they do not have to pay for the services of intermediaries and can maintain closer ties with consumers. The remaining part of the honey production takes place trough retailers (26 per cent) or middlemen (31 per cent).

This form of commercialization implies that the market is almost local, only in few cases regional and rarely national, which can be explained in part by the fact that many enterprises have inherited the same distribution channels previously used by informal productive activities.

4.4. Product and process innovation

The probability of state innovation is directly related to the motivation to innovate. In our sample, the principal element to induce the entrepreneurs to introduce innovation in firms is linked to brand consolidation (16 per cent), labour saving (48 per cent) and demand increase (36 per cent). In this context it is relevant to note that the innovation is an endogenous process and that the importance of public research institutions to foster innovation for the entrepreneurs interviewed is evident (52 per cent).

One of the relevant aspects of our analysis concerned the product and process innovation. The effects of process innovation are mainly linked to a reduction in costs and an improvement in quality. But process innovations are also concerned with quality, another highly important variable in competitiveness, especially in the case of typical local products. The adoption of new manufacturing processes is, therefore, of great importance in respect to maintaining these specific characteristics.

At a technical level, we do observe a rapid diffusion of both the process innovation, which reduces the costs of production, and the product innovation, which satisfies the increasingly complex private demand requiring a more diverse product set. The innovation in the honey production sector may range from to a change in the packaging to a new honey quality. For example, 76 per cent of producers has introduced a different packaging, while 64 per cent has modified the production characteristics linked to the quality of the product. Particularly, interesting in the innovation process has been the fact that 60 per cent of the producers introduced new equipment and that they utilized new technologies for the production. Although honey is appreciated for its intrinsic qualities and its genuineness as a natural product, it manifests clear dynamism in the innovation of product.

It is noteworthy that typical products possess certain physical characteristics that have been established by tradition and, as previously indicated, they are a result of a convention accepted by manufacturers and consumers; therefore, the application of a new product strategy may make them lose their typical character. In the case of a regulation with formal conditions, this might seriously restrict new product strategies. Small innovations, as those referred to above, usually do not create important problems.

However, product innovations concerned with the design and introduction of new products call for extensive technological and marketing efforts. The launching of new products becomes necessary, when old products are reaching the end of their natural life for various reasons including technical progress, the evolution of consumer tastes, and new products from competitors. A new product technique may comprise a wide range of features, varying from a small change in the product, packaging, or its presentation to putting a totally new product on the market. The percentage of enterprises in the honey sector that have introduced such a product innovation is rather high (78 per cent). Most types of modifications

however, regard packaging or incremental innovations. Product innovation is related to the characteristics of a different quality of honey, such us multiflora production modes as well as a new production of single-flower varieties of honeys (thyme, carob, orange blossom, eucalyptus, chestnuts honey) and other products from the hives such as pollen, royal jelly, propolis, and beeswax. Product innovation also shows up in a different modality of distribution and packaging for utmost care in protecting the valuable properties of the honeys. The production diversification and the search for new varieties reveal the interest of some enterprises to capture new consumer segments.

In a traditional agro-food production system, such as in our case study, the transfer of technical knowledge of the family tradition is mainly based on a transfer between its members (84 per cent). At the same time, in our sample, the process of knowledge acquisition is based on learning by doing (64 per cent). Nevertheless, we recently observed an increasingly significant role of learning processes among owners-entrepreneurs in honey production, who take part in specific training courses (72 per cent).

4.5. Coordination Forms

The coordination between principal agents, producers, middlemen and consumers also deserves attention. Our honey production system represents a traditional activity where the relationship between the producers and consumers, via middlemen agents, represents an institutional arrangement that assumes an intermediate position between a spot market and vertical coordination. Following Jaffe (1995), in this intermediate form of relationship between producers and buyers, the contract coordination appears, in most cases, to be a principal institutional arrangement (88 per cent). It is also noteworthy that in our case the relationship between the producers and the consumers is based on trust and most contracts are verbal. Only in few cases (12 per cent) the relationships are based on a spot market. On the other hand, however, with regard to the institutional arrangements that concern the relationship between producers and suppliers, our sample shows that these are mainly based on a spot market (76 per cent); the rest are characterized by an institutional arrangement of a spot market type.

5. Discussion of Results from a Decision Tree Method

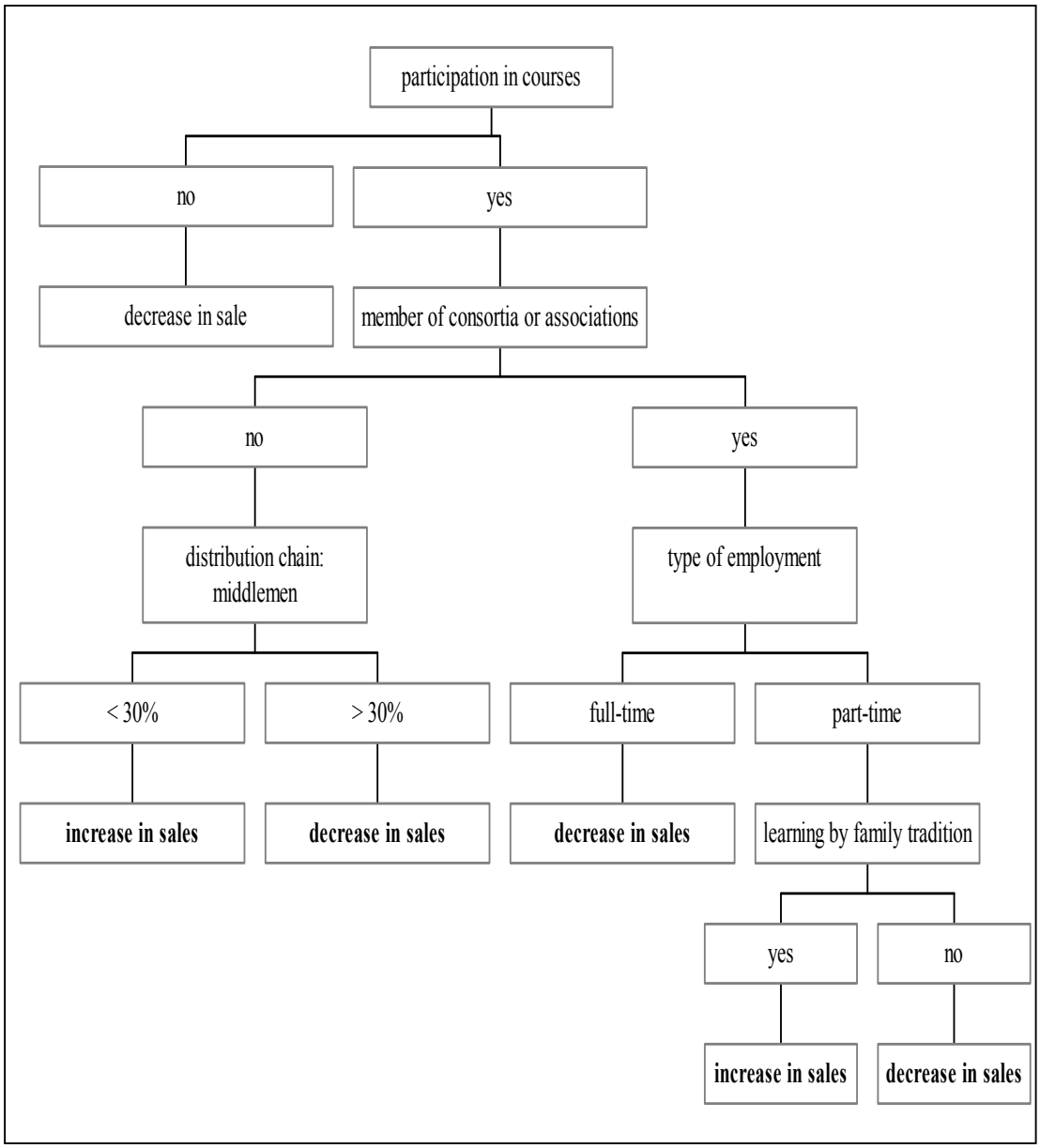
The innovation system in our sample exhibits some interesting characteristics. It is, therefore, important to identify the causes and backgrounds of the performance of enterprises in the honey production sector. Given the nature of the qualitative data of all respondents in our survey questionnaire, it is not really possible to apply standard statistical methods (such as discrete choice models) to this data set in order to identify critical success factors. As mentioned above, we had to resort to qualitative multidimensional techniques that were able to handle only nominal data. Given the limited sample and the explanatory aim of our research, conventional multivariate methods like contingency table analysis and log-linear analysis were not suitable either. Our nominal data, however, can properly be treated by a recently developed nonparametric statistical method developed in the artificial intelligence

literature, viz. classification trees analysis (or decision tree method) For more details we refer to the annex.

5.1 Decision tree results

The empirical experiment presented in our study aims to identify the behavioural patterns of locally-based SMEs in the honey sector. The application of decision-tree algorithms appears to lead to the identification of highly interesting sets of critical success factors (Figure 1).

Figure 1 – A decision tree representation of the driving forces of entrepreneurial performance



The analytical framework developed in our experimental case study sheds light on the relevance of learning processes brought about by training courses though participation by entrepreneurs in a context where local know-how accumulates over time, where spatial

transfer of creative know-how among local agents emerges via inter-firm linkages and where there is a turn-over of the labour force within the local environment.

Knowledge and competencies appeared to emerge as the most critical resources for a firm's competitiveness. Much of the existing literature on innovation in SME enterprises has focused on the importance of tacit and codified knowledge as a principal source of obtaining a sustainable competitive edge (Polany, 1962; Nelson and Winter, 1982; Spender 1996). The emphasis on the importance of developing a distinctive core competence, intangible assets or firm-specific "dynamic capabilities" has emerged as a central theme in the resource-based strategic management literature (Penrose, 1959). Interest in tacit knowledge has also grown rapidly as an important component of the knowledge used in innovation (Dosi, 1988; Rosemberg, 1982; Pavit, 1987).

The results of our analysis focuses, in particular, on the education and training system as a factor, which contributes to the social construction of knowledge. It determines the extent to which this is used as a basis for the interaction with organizational structures, the types of labour market and the use of different types of knowledge. Moreover, our case study stresses the distinction between tacit and codified knowledge and shows that the interaction between these modes is vital for the firm's competitiveness. The participation of entrepreneurs in training courses - and thus the role of the explicit knowledge considered in the study - explains most of the entropy endogenous to the data set. Coded knowledge supports and reinforces the dynamics of learning capability. It helps to create a responsive educational system that is capable of meeting the competency and skill requirements of the firms.

The decision tree therefore, appears to split into two branches. The first branch of the tree shows how the producers use the distribution channels, both the direct channel producer-consumers and the indirect channel producer-middlemen-consumers. The direct channel, which bypasses the middleman, seems to offer more opportunity for developing sales. It reduces price fluctuations and guaranties the transmission of information through the relationship that is established between the supplier and consumer. The second branch of the tree refers to the participation of firms in business-oriented associations and other organizational structures, showing that they play a central role and provide an institutional framework and social infrastructure for tacit learning.

In our sample a small number of firms takes part in national associations of the sector concerned, and thus we may question whether the distinction between the participation in national or local organizational structures is relevant or not. In this branch of the tree, the driving factor appears to be the nature of the type of employment. Here the process of collective learning is attributed to the mobility of the local labour market that feeds its own knowledge. Local actors may grasp this cumulative knowledge, which is a source of competitive advantage. A high rate of inter-firm mobility fosters the formation of social networks and skills within the community. It turns out that, if these synergies do not exist, in other words, if social interaction is absent, the competitiveness of the enterprises is only potential.

In accordance with the literature on learning economies, the lower branch of the tree shows that knowledge transfer through family tradition represents the major criterion. This

emphasizes the importance of the tacit component of human knowledge. Although the conceptual distinction between tacit and coded knowledge has been well explored in the literature, they are not separate and discrete in practice. Explicit and tacit knowledge appears to be mutually correlated. Nonaka and Takeuchi (1995) argue that knowledge is generated through the combination and the dynamic interaction of these two modes of knowledge. Similarly, Nelson and Winter (1982) in their evolutionary theory of firms assume that firms provide a special context in which the explicit and tacit modes of knowledge are selected by interaction whit the external economic reality and then stored in organizational routines. Thus, over time, firms appear to differ in their capacity to foster the interaction between these two modes of knowledge, which can explain their superior performance.

5.2 Decision rules

After the above representation of our results, the pattern-class relationship expressed in the tree can also be written as a set of empirical rules in the following way:

Rules:

Rule 1: (7/1, lift 1.4)
Participation in courses = No
-> class Decrease [0.778]

Rule 2: (18/10, lift 0.8)
Participation in courses = Yes
-> class Decrease [0.450]

Rule 3: (3, lift 2.5)
Membership of consortia or associations = No
Middlemen <= 30
-> class Increase [0.800]

Rule 4: (3, lift 2.5)
Membership of consortia or associations = Local and national association
Type of employment = Part-time
Learning by family tradition = Yes
Participation in courses = Yes
-> class Increase [0.800]

Rule 5: (2/1, lift 1.6)
Membership of consortia or associations = Local and national association
Participation in courses = Yes
-> class Increase [0.500]

Each rule consists of a so-called Statistics (n, lift x) or (n/m, lift x) that summarizes the performance of the rule. Specifically, n is the number of training cases covered by the rule, while m, if it appears, shows how many of them do not belong to the class predicted by the rule. The rule's accuracy is estimated by the Laplace ratio $(n-m+1)/(n+2)$. The lift x is the result of dividing the rule's estimated accuracy by the relative frequency of the predicted class in the training set.

In our system of calculation, a few of the most reliable rules will be discussed now. These two rules demonstrate the way in which the results of the tree analysis are expressed. The first rule states that if the entrepreneurs participate in consortia or associations, if the honey production is a part-time activity and if in the learning process the family tradition and training courses play an important role, then the firms are competitive in terms of growth in sales; its accuracy is estimated to be 80 per cent. The second empirical rule refers to the role of the middlemen in the distribution channel and claims that if entrepreneurs do not participate in consortia or other organizational associations but use a direct distribution channel, then the firms are competitive in terms of growth in sales; its accuracy is estimated to be 80 per cent.

5.3. Performance assessment

In order to explore which class distribution will yield the best classifier, we have chosen the two-performance measure, i.e. *classification accuracy* (or error rate) and the *confusion matrix*. Classification accuracy is the most common evaluation metric in machine-learning research. In our system the estimated error of 16 per cent is significantly low. However, using accuracy as a performance measure, assumes that the class distribution is known and, more importantly, that the error costs of incorrectly classified instances are equal. Accuracy is particularly problematic as a performance measure, when the data set studied is biased in favour of a majority class (Weiss and Provost, 2001).

An alternative method is to analyse the confusion matrix that offers better insight into the classification and misclassification distribution. A confusion matrix contains information about actual and predicted classifications derived from a classification system (Kohavi and Provost, 1998). The performance of such systems is commonly evaluated using the data in the matrix. The following table shows the confusion matrix for a tree classifier related to our empirical data. In the matrix both the rows and columns have the same headers, but there is a distinction between them. The rows of the table are the classes available for use in the classification process; the columns of the table are the classes chosen during the classification.

Table 1 - Confusion matrix of the case study classification

(a): class Decrease	(b) : class Increase	(c) : class Stable	<-classified as
14			(a) : class Decrease
1	7		(b) : class Increase
2	1		(c) : class Stable

The entries in the confusion matrix represent the number of instances of the row class, which have been classified as a member of the corresponding column class. Misclassifications occur when the row and column classes of a cell do not match. If the predicted intersections cross and the actual classes of different levels do not contain any number, then no misclassification occurs. The results in this table can be interpreted as follows:

- 14 instances of a pertinent class “decrease in sales” were correctly classified using the generated rules as members of the class “decrease”;
- 7 instances of the known class “increase in sales” were correctly classified using the generated rules as members of the class “increase”; 1 instance of the class “increase in sales” was incorrectly classified using the generated rules as members of the class “decrease”.
- no instances of the known “stable” class were correctly classified using the generated rules as members of the class “stable” ; one instance of the class “stable” was incorrectly classified using the generated rules as members of the class “increase” and two in the class “decrease”.

6. Concluding Remarks

Our analysis has clearly demonstrated the importance of network organizations and learning mechanisms for innovative behaviour in a competitive environment. The honey sector in our study has clearly revealed common elements in firm strategies.

In modern economies, clusters are often based on networks. In the past, traditional industries that were neither science-based nor knowledge-intensive were thought not to require the kind of learning and innovation that have propelled export growth in ‘high tech’ industries. The low level of R&D expenditure in such industries gave further support to this belief. The very locus of change in traditional industries however, makes the level of R&D expenditure a poor indicator of innovation for these sectors. Nor can the innovativeness of firms in such industries easily be determined from responses to the intriguing challenge of the introduction of new products, since this question often fails to capture changes in design or materials that significantly modify products but do not result in the creation of an entirely new product.

Where competitive conditions in these industries are changing, sustained selling growth would only be possible if firms in these clusters were to be engaged in a continuous process of innovation. Under these conditions, the trajectory of a cluster’s exports becomes, over time, a useful proxy for innovation. It would be a useful experiment to extend the scope of our research to a larger sample, to other regions and to other sectors.

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ANNEX

The Decision-tree Method for Identifying the Hierarchical Determinants of the Agro-Food Firms' Competitiveness

5.1 Learning decision trees with C5/See5

Through classification it is possible to order the information contained in a multivariate database so as to discover structural relationships between class characteristics and relevant attributes of the phenomena to be classified. The method of decision-tree induction, which belongs to the class of multidimensional classification methods (such as neural network analysis, fuzzy set analysis, rough set analysis and decision tree analysis), is widely and increasingly used for classification purposes. This method aims at analysing and predicting the membership of a class by the recursive partition of a multi-dimensional data set into more homogeneous subsets (see, for details, Quinlan, 1986). This leads to a hierarchical decision-tree structure where instances are classified by sorting them down the tree from the root node to a leaf node, which provides the classification of the instance. Each node in the decision-tree specifies a test for an attribute of the instance concerned, and each branch descending from the node corresponds to one of the possible values for this attribute. An instance is classified by starting at the root node of the decision tree, testing the attribute specified by this node and moving to the next node down the tree branch that corresponds to the value of the attribute. This process is then repeated at the node on this branch and so forth, until a leaf node is reached.

In a decision tree algorithm, the critical step method is used to assess splits at each internal node of the tree. Often the information theory approach, which examines entropy in relation to the information contained in a probability distribution, is employed (see Shannon, 1948). The aim is then to select the attribute that is most useful for classifying instances, based on the so-called information gain (a measure for the goodness-of-separation for a given attribute for the training examples according to their classification; for details, see DeFries and Chan, 2000). Entropy is then used as a measure of the reduction of disorder when ordering a set of variables in a data set with respect to different classes. By interpreting information gain as a measure of the expected reduction in entropy, we can - by considering the next node down - define a measure of the effectiveness of an attribute in classifying the training data, caused by positioning the instances according to this attribute. The process of selecting a new attribute and positioning the training examples is then repeated for each non-terminal descendent node, this time using only the training examples associated with the node concerned. Attributes that have been incorporated higher in the tree are excluded, so that any given attribute can appear at most once along any path in the tree.

Formally, the information gain of an attribute is computed by means of the corresponding entropy expression. Given a training data set T, composed of observations belonging to one of k classes {C1, C2 … Ck }, the amount of information required to identify the class for an observation in T is :

$$Info(T) = -\sum_{j=1}^{k} \frac{freq(C_j, T)}{|T|} * \log_2 \left(\frac{freq(C_j, T)}{|T|} \right)$$

where freq (Cj , T) is equal to the number in of cases in T belonging to class Cj, and |T| is the total number of observations in T. It is the average amount of information required to define the class of a sample from the set T. In terms of information theory, it is called entropy of the set T. The same estimate, after separation of the set T with X, is provided by the following expression:

$$\text{Info}_X(T) = \sum_{i=1}^{n} \frac{|T_i|}{|T|} * Info(T_i)$$

Then, the following formula is the criterion of the attribute choice:

$$\text{Gain}(X) = \text{Info}(T) - \text{Info}_X(T)$$

This criterion is calculated for all the attributes and the one that maximises the expression is then selected. This attribute is the test used in the current tree node, and is used for further tree derivation.

TABLE 1 – Characteristics of honey sector

Y_E	Age	W	T_E	C_A	A_H	Y_E	D_C			F_M	M_I	PD_I		PC_I	L_P			C_B	C_S	P_R	D_S
							M	R	C			Q	P	P_E	F_T	L_D	T_Co	C_B			
1999	31	O	F	L_A	Y	Y	50	25	25	L	B	Y	Y	Y	Y	Y	Y	S	S	Y	D
1970	27	F	F	L_A	Y	N	50	10	40	R	B	N	Y	N	Y	N	Y	C	C	Y	D
2001	30	O	F	N	N	Y	0	0	10	L	B	N	N	N	Y	N	Y	S	S	Y	I
2001	34	O	F	N_A	Y	Y	60	20	20	L	L	N	N	Y	N	Y	Y	S	S	Y	I
1988	40	E	F	L_A	Y	Y	10	24	2	N	D	Y	N	Y	Y	N	Y	C	S	Y	D
2001	27	F	F	N	N	Y	0	0	100	L	D	Y	Y	Y	Y	N	Y	C	S	Y	I
1993	54	F	F	L_A	Y	Y	0	0	30	L	L	Y	Y	Y	N	Y	N	C	S	N	D
2000	40	E	P	N	N	Y	70	20	10	N	D	Y	Y	Y	Y	Y	Y	C	S	N	D
1980	29	F	P	L_A	Y	Y	60	25	15	R	D	Y	Y	Y	Y	Y	Y	C	S	N	I
1980	55	F	P	L_A	Y	Y	30	0	5	N	D	N	Y	Y	Y	N	Y	C	S	Y	I
2000	33	O	P	N	Y	Y	0	30	70	L	L	N	Y	Y	Y	Y	Y	C	S	N	I
2000	25	F	F	L_A	Y	Y	60	15	25	R	L	Y	Y	N	Y	Y	Y	C	S	Y	D
1990	60	O	F	L_A	Y	Y	30	50	20	L	D	N	Y	Y	Y	Y	Y	C	S	N	D
1990	59	F	F	L_A	Y	N	50	20	30	R	L	N	Y	N	Y	Y	N	C	C	N	D
1995	40	E	P	N_A	N	Y	40	50	10	L	L	N	Y	Y	Y	Y	Y	C	S	Y	S
1990	34	F	F	L_A	N	N	50	20	30	L	L	N	Y	Y	Y	Y	N	C	S	N	D
1991	57	F	P	L_A	Y	N	0	35	65	L	L	Y	Y	N	N	Y	Y	C	C	Y	I
1980	50	O	P	L_A	Y	N	0	70	30	L	D	Y	Y	N	Y	N	N	C	S	N	D
1992	59	O	P	L_A	Y	N	20	40	40	L	B	N	N	N	Y	N	N	C	C	N	S
2001	43	F	P	L_A	Y	Y	15	80	5	L	D	Y	Y	Y	N	N	Y	C	S	Y	D
2001	39	F	P	L_A	Y	Y	0	60	40	L	D	Y	Y	Y	Y	N	Y	C	S	Y	I
1993	62	O	P	L_A	Y	Y	50	20	30	L	L	N	Y	N	Y	Y	N	C	C	N	D
1993	46	F	P	N_A	Y	Y	70	0	30	L	L	N	N	N	Y	N	N	C	S	N	D
1981	47	F	P	L_A	N	Y	0	35	65	L	L	N	Y	Y	N	Y	Y	C	C	N	D
1993	31	E	F	N	Y	Y	70	20	10	L	L	Y	N	Y	Y	Y	Y	C	S	N	S

CODE:
Y_E=Year of the enterprise;
Age=Age of the entrepreneur
W=Labour forces employed :O=Owners; F=Family labour forces; E=External Labour forces;
T_E=Type of employment: F= Full time; P=Part – time
C_A=Adhesion to Consortia or Associations : L_A=Local Association; N_A=National Association; N=NO;
A_H=Adoption of HACCP: : Y= Yes; N= No;
Y_E=Yearly marketing expenses:: Y= Yes; N= No;
D_C=Distribution cannels : M=Middlemen, R=Retailers, C=Consumers: Y: Yes; N: No
F_M=Focused Markets: L=Local; R=Regional; N=National;
M_I=Motivation to innovate: B= Brand consolidation; D= Demand increase; L= Labour saving ;
PD_I=Product innovation: Q= Improvement of quality, P = Packaging: Y= Yes; N= No;
PC_I=Process innovation: P_E=Improvement of production equipment: Y= Yes; N= No;
L_P=Learning process: F_T=Family tradition, L_D=Learning by doing;Co=Course: Y= Yes; N= No;
C_B=Cooperation with buyers: S=Spot Market; Contract coordination
C_S=Cooperation with suppliers: S=Spot Market;
P_R=Importance of public research institution to foster innovation: Y= Yes; N= No;
D_S=Development of sales: I= Increase; D= Decrease.