Proposing a virtual operations network to support a business policy for the Medicinal and Aromatic Plants sector

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Abstract
This research found out a more robust conceptual basis behind three missing links concerning the requirement for a virtual operations network to support a business policy for the Medicinal and Aromatic Plants (MAP) sector. Industry was pictured from secondary data gathered from a 12 experts panel. The factors to configure a collaborative network, e.g. relationships and structure, enabled the operationalisation of a previously defined social platform. Requirements for information infrastructure, co-ordination and DSS were also expressed. Moreover, the role of enterprise knowledge to the formation of collaborative ventures helped the modelling of the social-momentum of the platform. Finally, it is argued (i) for the confirmation of a significant Operations Management contribution to defining a MAP policy and, (ii) for the outlining of a collaborative network representing an advance to the usually ambiguous prescriptions of virtual operations. An interview guide to run an empirical test could be generated as further work.

Keywords: Collaborative network specification; Medicinal and Aromatic Plants (MAP) business policy, social platform operationalisation, virtual operations network.

1. Introduction

This research proposal attempts to justify a business policy supported by a collaborative operations virtual network for the Medicinal and Aromatic Plants (MAP) sector, in Portugal. It starts by addressing the potential business interest of MAP and by establishing the scope of organic MAP. Then, the presentations and minutes of a high-level meeting organised by public entities enabled to empirically picture the state of the art of the business sector, by listening to the stakeholders voice. Data is further organised into five categories, as follows: *Market and competitive environment*, *New product development and R&D*, *Collecting and treating data about the sector*, *Production*, and *The supply chain appeal*.

The next step is to analyse the current business requirements, by generating as an outcome three significant missing links. These pointed out a virtual supply chain as a conceptual operations model adequate to fulfil the needs of "*fileira*" and so, addressing the requirements expressed by a panel of experts for the MAP business. Furthermore, the existing social platform is considered an entrepreneurial initiative requiring formalisation as a collaborative partnership, where different types of partners are identified. There also is a final requirement to operationalise a technological platform to support the conceptual proposal for MAP.

In the final section, before conclusions, the ideas coming from the identified missing links in the results analysis are examined by positioning them in the scope of the adequate knowledge areas. The purpose of the exercise is to check its interest, to complete them and to build up a more robust conceptual basis. Thus, the SC fundamentals are revisited, the competitive environment is reviewed, the concept of virtual enterprise is comprehensively defined and collaborative processes are specified. This specification addresses not only the network configuration factors, but also the technical challenges of a collaborative network and the definition of knowledge in a collaborative context.

A final conclusions section closes the paper arguing for the contribution of Operations Management to the definition of an effective business policy, also pointing out the development of a questionnaire based on this assignment as a relevant inquiry tool to elaborate a diagnosis and an adequate collaborative network proposal.

2. Setting the business context for organic Medicinal and Aromatic Plants (MAP)

Definition and use of MAP

Many plant species are primarily used for their medicinal or aromatic properties in pharmacy or perfumery products, and because of that, they are defined as Medicinal and Aromatic Plants (MAP) in the EU (Verpoorte et al., 1999; Gomez-Galera et al., 2007). These MAP are a rich source of secondary metabolites which account for those properties and many of those plants are cultivated in order to obtain the natural constituents that are used in the production of fine chemicals or specialty products (Das, Raju, and Gutam, 2008).

For thousands of years, the natural plant products have been utilized for human healthcare in the form of drugs, antioxidants, flavours, fragrances, dyes, insecticides and pheromones. However, the use of synthetic drugs has led to a reduction in the consumption of plant-derived compounds, throughout the last century. Nevertheless, in recent years the consumption of MAP has increased, firstly because the synthetic drugs have side effects that are not found in plant-derived medicines, and secondly because there is a growing demand of the markets for high quality natural products, such those offered by MAP (ECPGR, 2014).

Definition and importance of organic farming

The industrial revolution was a turning point for agriculture, as factory-made implements designed to saving labour were widely diffused and artificial fertilizers were introduced (Grigg, 1984). Gradual increases in crop yield were due to the step-by-step replacement of human and animal labour with tractors and a wide range of machines, and also, to the chemical control of pests and diseases. However, the increasing use of synthetic chemicals in agriculture has had disadvantages, such as eutrophication and hypoxia (McIsaac et al., 2001), teratogenic effects on animals, health problems in humans and reduced populations of beneficial insects (Soule et al., 1990). Moreover, conventional agriculture also lacks sustainability because it heavily depends on petroleum for powering farm machinery, and for transporting products to markets that can be very far away from the farm (Pimentel and Pimentel, 1996).

Organic farming has arisen as an alternative to agriculture depending on chemicals. It is a method that has delivered improved productivity combined with consideration for quality of soil, environmental welfare, and human health. The key principles were self-sufficiency and

economic viability, despite maintaining soil fertility through crop rotation and careful management and use of animal manures (Stockdale et al., 2001).

The area of organic land, the number of organic farmers and the organic market continued to grow. In Europe, 11.2 million hectares, constituting 2.3 percent of the agricultural area, were under organic management in 2012, an increase of 6% if compared with 2011. There were more than 320 000 producers. The value of the European organic market in 2012 was 22.8 billion euros and the overall growth rate was approximately six percent (FiBL-AMI-IFOAM, 2013). The European Department/Council of Agriculture estimates that the value of retail sales of MAP produced in organic farming in 2013 was approximately $6 billion (GPP, 2013). The number of organic farmers in EU has been increasing by about 12% per year (Carrera and González, 2011), most of them, small-scale producers.

While the per-hectare gross income from organic farming is less than that from conventional farming, the total benefit is higher. In fact, a 21-year study of biodynamic, bioorganic, and conventional farming systems in Central Europe found out that in the organic systems, crop yields were 20% lower, but fertilizer input was lower by 53% and pesticide input by 97% (Mäder et al., 2002). In this paper, MAP is considered as organic farming, focusing on the utilization of resources from the farm itself, excluding the use of synthetic fertilizers, pesticides, herbicides and growth regulators (Morujo, 2012).

Figure 1 produces a comparative analysis of the biggest organic markets.

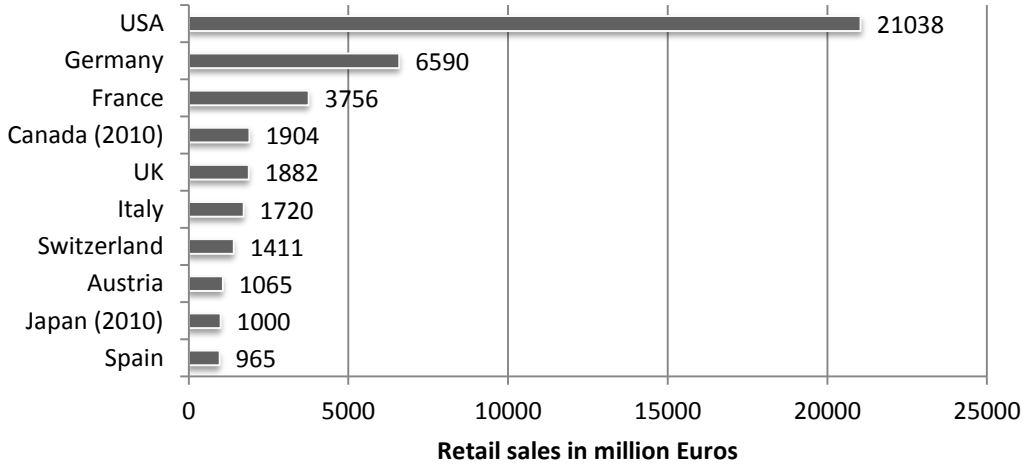

Figure 1. The largest organic markets. Source: FiBL – AMI-IFOAM (2013)

MAP importance in the world and in Portugal

Statistical information about MAP trading is neither abundant nor updated. According to some studies, the worldwide market for MAP worth about 60 000 million euros, and has a steady growth, which can vary between 3% and 12% per year (Gruenwald, 2010), depending on the market segment (Figure 2).

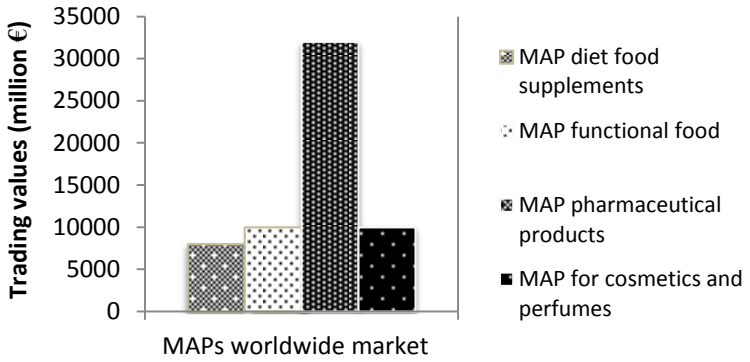

Figure 2. Figures for various segments of MAP. Source: Gruenwald (2010)

The exceptional conditions of Portugal, as regards soil and climate, could be a success story in the production of MAP since many of the big markets are dependent on imports. Thus, in economic terms, its production can provide good growth rates.

Portuguese flora comprises numerous MAP species, which show an exceptional potential for the development of sustainable explorations. Production in Portugal presents other advantages, such as: low labour costs and so, low harvest and processing costs; favourable edaphic and climatic conditions; and herbicide and chemical free production. However, despite all this potential, the development of the MAP sector is changing mainly due to the demand increase and to the interest of young farmers with high level of education. In fact, the *"Programa de Desenvolvimento Rural do Continente 2007-2014"*, ProDer, funded 240,61 hectars of projects from 257 young farmers (2008-2013, 1rst Quarter) (ProDer, 2014). Moreover, as depicted in Table 1, recent data shows that the MAP sector has risen significantly in Portugal. In fact, the explorations increased fourfold over the past four years (GPP, 2013) with significant growth expected to continue, and cultivated areas soared from 230 to 1324 ha in seven years.

Table 1. MAP Producers and MAP cultivated areas. Source: GPP (2013)

	2004	2005	2006	2007	2008	2009	2010	2011
Producers	27	37	51	54	50	70	173	197
Area (ha)	230	242	84	75	167	1625	1430	1324

The GPP (2013) study indicates that 197 MAP producer's croplands spread over each region of the country, being the largest area of production found in the coastal zone (Beira Litoral) (Figure 3).

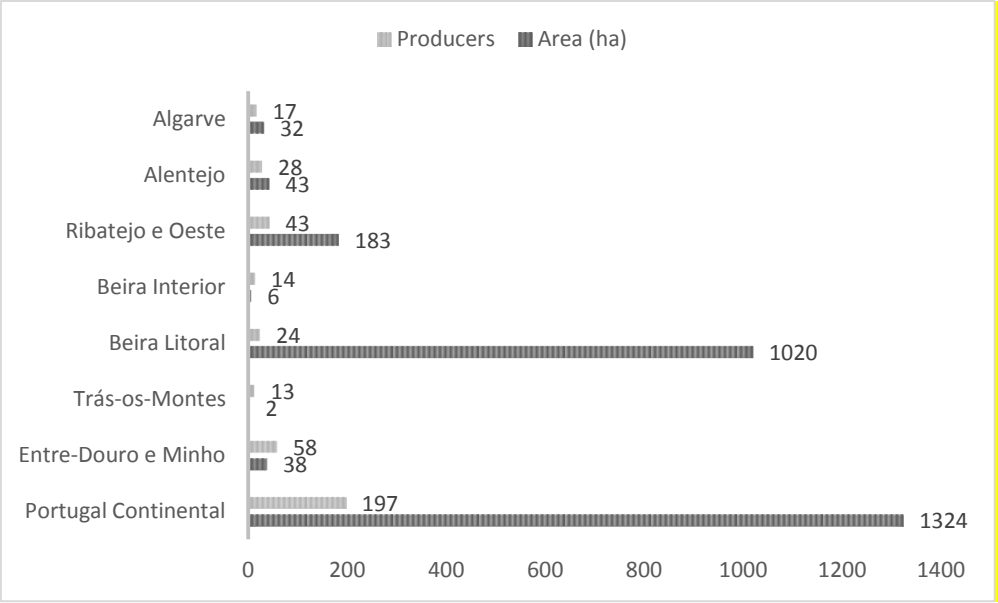

Figure 3. MAP Production Area (ha) and producers in Portuguese regions. Source: GPP (2013)

However, this increase in MAPs explorations, number of producers and outputs is not sufficient to ensure appropriate coverage of the broad range of the increasing market needs, as shown in Figure 4.

Main exporters and importers of MAP

Figure 4 depicts the MAP main exporter and importer countries according to the United Nations Commodity Trade Statistics Database for the years 2009-2012 (UN Comtrade, 2013).

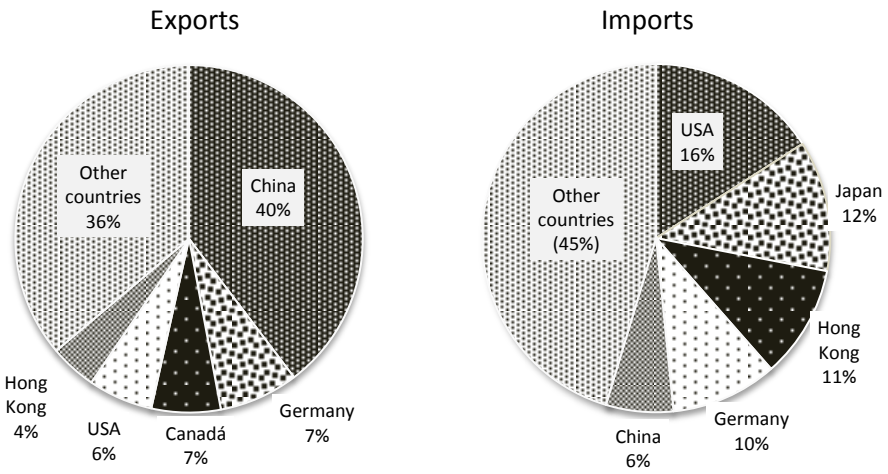

Figure 4. MAP exports and imports for the years 2009/2012. Source: UN Comtrade (2013)

3. Case Study

Methodology

This exploratory research proposal justifies a business policy for MAP supported by a collaborative operations network. So, it addresses the potential business interest of Medicinal

and Aromatic Plants, by setting the scope of organic MAP and, it establishes the state of the art, by analysing the business requirements expressed by four panels of selected stakeholders. Finally, the resulting missing links are cross-examined within the context of the adequate knowledge areas.

Secondary data were used and generated by the participants in the four panels of the "National Forum – PAM Producers", venue: Oeiras, Portugal, 12th April 2013, which made a characterization of the MAP sector. Twelve people participated from Government (2), Rural Development Associations (5) and producers (5). The event was supported by the portuguese *Ministério do Ambiente, Ordenamento do Território e Energia*. The panels concerned the following topics: 1) Results of the EPAM project; 2) MAP production; 3) Markets; 4) Producers organization. The twelve participants were the Secretary of State, representatives of rural development associations and from the producers.

Characterization of the MAP sector

Next five subsections present the synthesis of this meeting concerning the MAP sector, in Portugal.

Market and competitive environment

The competitive environment was described as very unstable and as requiring a close relationship and monitoring. On the other hand, the market was defined by requiring a big sales effort, in a tough competitive environment, needing investor knowledge, which could be a problem for the new entrants. Visits to International Exhibitions, e.g. Biofach, were strongly advised. This could also help to track new market trends for gourmet products and, for plants on demand, e.g. stevia, as a non-caloric sweetener.

Pharmaceutical industry and health sector, perfumes and cosmetics, food, aromatherapy, phytotherapy, detergents and other chemical products were confirmed as the main applications and so, markets, of MAP. Europe, i.e. France and Germany were pointed out as a major destination, for bulk products sold in big bags. However, Japan and USA are addressed markets for essential oils and gourmet cans.

Prices were described as very volatile, while quantities kept varying, despite the same, as always, high requirements for quality. This places a threat to the traditional key success factors that assume high prices for high quality. In addition, the lack of tradition on recognizable brands appears to worsen things, as concerns essential oils and gourmet products. Other threats were shared, e.g. the requirement for tighter standards for health use, more demanding skills and specific equipments, in the short term.

New product development and R&D

The Secretary of State suggested to formalize R&D by a protocol led by the *Instituto Nacional de Investigação Agrária e Veterinária* (INIAV), the state laboratory responsible for research in agriculture and veterinary. ADCMoura and Animar should act as mediators among the farmers and INIAV. Both associations are non-profitable and target the sustainable development of rural regions.

Few initiatives of joint projects with universities were mentioned. The development of a new infusion and of new consumer habits involving the *Universidade do Porto* and other ProDer project concerning new own brands and product certification were quoted. Thus, no

significant number of innovative projects is going on, despite the delegates recognition of the importance of R&D for new products and processes. Moreover, there were complaints about lack of institutional support. The Secretary of State still stressed the growing number of young and highly educated farmers entering the sector, as an opportunity to create more dynamic and innovative projects.

Nevertheless, it was mentioned that there is evidence of investment by foreign investors implementing greenhouses advanced technologies to foster productivity and to take advantage of the edafoclimatic conditions of Portugal. Finally, it was argued for the need to develop entrepreneurship both in the MAP sector and in its agents. ADCMoura provides an example of an initiative in this domain, to excluded people (ADCMoura, 2010).

Collecting and treating data about the sector

"Entrepreneurship in MAP" (EPAM) was mentioned as a successful initiative within the *Méditerranée Innovation Senteurs Saveurs* (MEDISS) project. It aims at divulgating MAP, by building up a data repository about georeferenced producers and by implementing several activities to animate the sector, e.g. conferences, panels, etc. Moreover, it was also argued that the EPAM site, which is visited by 4000 people per month, could act as a broker by distributing MAP products in medium/ long term.

Finally, the *Ministério da Agricultura e do Mar* divulgated the intention to release a study, in October 2013, to fully characterize the MAP investment in Portugal, by surveying the producers. The audience welcomed the initiative, despite it should be stressed the different nature of this information, when compared with the outcome of these panels, which included an important dimension of shared living experience. Thus, a detailed and reliable compilation of producer characterization, such as local, amount invested, average production, plants, public funding, producer age was expected (GPP, 2013).

Production

The concern with a fragmented production with many and small producers of which income provides just a weak economic sustainability was also mentioned. Some delegates did even argue for a need to link sales and agriculture. On the other hand, one of the most important worries regarded production costs. It was argued that costs are high because of: (i) manual operations; (ii) transportation cost for bulk products; (iii) underutilization of buildings and equipment; (iv) control difficulty; (v) no consistency in outputs; (vi) crop yield variation, specially in essential oils; (vii) imprecise capacity definition; (viii) small production volumes; (ix) not fully addressed need to adapt plant, machinery and techniques to the type of soil.

The supply chain (?) appeal

The "*fileira*" (supply chain?) emerged as a strong requirement to be developed and operationalised. There were many views on this issue, as follows: (i) it should be developed from the farmers (upstream focus); (ii) it should link consumers to producers (downstream focus); thus, waste should decrease and better stock control should arise; (iii) it should promote the intensification of partnerships and collaborative processes, as well as, people's relationships, education and training, getting funding, R&D effort, i.e. full networking fostering; (iv) it should develop the institutional perspective of sector organization in national/regional associations, no matter the juridical personality.

On the other hand, the great diversity among partners due to many small farmer structures was also recognized, as well as the need for an open environment favouring knowledge

sharing between producers and, voluntary work. Some stakeholders believed that there was no critical mass, despite hoping this would improve in short term. Finally, there was a call for putting together an operational group for "Horizon 2020".

An analysis of this very specific "selfie" of the MAP business is going to follow.

Results analysis

It was believed that Operations Management could have a unique contribution to this situation (Almeida et al., 2014). By Operations it was understood a holistic approach to the business greatest purpose, without discriminating the main typical business functions, i.e. R&D, marketing, production and finance. Therefore, three core missing links of the Business Policy are revisited, as follows:

First missing link

One identified missing link concerned the "*fileira*" concept that all delegates to the panel were able to spot, despite their different views on it. Thus, "*fileira*" was characterised like something that one expects to materialize in a tangible and stable relationship, solving most of the misunderstandings of the MAP business and appearing to require administrative regulation by the State.

Nevertheless, the proposed conceptual Operations Model by Almeida et al. (2014) works in a completely different way. In fact, in the MAP business, one company handling all the market issues to adapt in the competitive context was found out as hard and expensive. Therefore, it was suggested to pay more attention to the areas of inter-organizational co-operation, and to invest in more flexible logistics processes and supply chain (SC) networks, supported by information technologies (IT). The deployment of adequate IT systems could, then, push all the organizations involved, to collaborate and integrate temporary, to achieve momentary goals, based on shared core competencies, despite their dispersed geographical locations. So, it was proposed a Virtual Supply Chain model in which a variety of participants could dynamically cooperate, either to strategic or operational activities. The target was to share resources, risks and costs to create temporary co-operations to realize the value of short business opportunities that the partners could not address on their own.

The proposed conceptual model appears to addresses most of the specificities and requirements of the MAP business, through interactive collaboration, as follows: 1) it provides flexibility to adapt to unstable environments, enabling Collaborative Planning, Forecasting and Replenishment (CPFR); 2) it brings together all the agents of the supply chain from the brokers or even final customers to the producers and entrepreneurs, including rural development associations, funding partners, logistics service providers, certifiers, entrepreneurs, governmental agencies, universities and other R&D institutions; 3) it enables sharing core competencies within this partnership, despite being geographically dispersed; 4) it enables sharing physical resources, through common management at distance, reducing investment; 5) it enables shared services, e.g. training, maintenance, consultancy, etc.

Second missing link

The second missing link concerned the need to formalise the enlarged social platform of all the active agents – individual or organizations, private or public, business or non-profit, producers or customers – involved in the MAP business. This should be based on the civil society and built up on the top of the already established associations for rural development.

No need to create more institutions was found out. Moreover, divulgation, motivation and pure interest were gluing together all these agents. The recognised multilateral interest on the MAP cluster was considered as a cornerstone, despite individual initiatives were also welcome. Thus, this loose network of the MAP stakeholders, was put together, only, by non-mandatory interest, by understanding the need and the value of trust and collaboration, in order to build up a voluntary partnership. This was identified as the so-called "*fileira*" by Almeida et al. (2014).

Moreover, the SC agent – producer – was analysed. Several types of producers were defined, representing several SC agents with different needs, as follows: 1) small independent farmer; they do need to share resources and support to reach the market, producing on a small scale; 2) big independent farmer; they do have their own resources, producing on a larger scale; they do have dimension to go to the market on their own and to have their own R&D; 3) small dependent farmer; they just provide labour, usually they come from Employment Agencies and lack all other resources; 4) big dependent farmer; investors provide funding and they might also provide technology, in a franchising like model; they do not share resources.

The entrepreneur role was also addressed. In general, "Entrepreneurship is the process of identifying and starting a business venture, sourcing and organizing the required resources and taking both the risks and rewards associated with the venture." Therefore, as regards the resources, the entrepreneurs may own them or not, as long as they get access to them, which might also happen by a collaborative partnership. The important point is that entrepreneurs must create something innovative at a calculated risk that adds value for the society. It was concluded that it was not enough to be in the MAP business to automatically become an entrepreneur. This was a serious misconception that was being promoted, since farmers, businessman and entrepreneurs are different agents in their essence, despite their roles could mix once a while. To sum up, in the production domain several SC agents were identified with different roles and interests.

Third missing link

The third missing link was about the implementation of the social platform. The definition of a virtual platform was required, as well as its operationalisation. Nevertheless, one might not forget that there would be no virtual platform without the social one. This social momentum towards the MAP was found out as the most important issue, which was also identified as very time consuming and risky to create. Their mentors, promoters, pioneers and leaders were praised by their truly entrepreneurial initiative and by their perseverance to overcome so many obstacles during so many years. In summary, the social platform was found as the owner of the virtual one, which appeared to be a tool to operationalise the "*fileira*". Therefore, regulation, social interaction and the access typology were identified as key issues on this matter. Finally, it was found important to focus on specifying the functionalities of the technological platform based on the stakeholders requirements and, the design should favour a phased implementation. State of the art software, hardware and gadgets should be used to enable advanced updated features.

Missing links summary

A Virtual Supply Chain Model was proposed by Almeida et al. (2014), as a conceptual Operations Model to fulfil the needs of "*fileira*" and so, addressing the requirements expressed by a panel of experts for the MAP business. The existing social platform was branded as a truly entrepreneurial initiative requiring formalisation as a collaborative partnership. Moreover, several different types of partners were identified, as well as different

producers were described. Finally, the need to operationalise a technological platform to support the conceptual model arose.

4. Discussion – building up a more robust conceptual basis

The ideas coming from the identified missing links in the results analysis of the case study are going to be cross-examined under a few current selected views of the related mentioned topics, in order to be developed a more robust conceptual basis. The objective is not to achieve an optimum solution, but to propose a relevant approach that might be just as valid as many others (Silva, 2009).

Firstly, the SC fundamentals are revisited confirming integration and co-ordination as the core mechanisms to design business processes supported by adequate Information and Communication Technology (ICT). Secondly, the competitive environment is reviewed providing support for the Business Policy considered in the first missing link. Thirdly, the factors to configure a network are introduced which operationalises the first part of the specification of collaborative processes, i.e. the second missing link concerning the need to formalise the enlarged social platform. Next, the third missing link is addressed in the subsection Technical Challenges of a Collaborative Network. Finally, the social platform and its social momentum were also modelled by considering the role of enterprise knowledge in collaborative ventures, as presented in the following subsections.

Revisiting the Supply Chain (SC) fundamentals: integration, co-ordination and ICT role

Organisations have been seeking to make the supply network more competitive as a whole. Therefore, models should attempt to integrate the different functions across the supply chain, which deal with the multidisciplinary problems of location/routing, production/distribution, supplier selection/inventory control, and scheduling/ transportation (Huang et al., 2009). Thus, the intertwined and overlapped co-ordination and integration mechanisms of the SC are recognised as fundamental to determine the impact of managerial levers on logistics processes across the entire supply network. Its understanding can help managers in the decision-making process to select the most appropriate action from a set of alternative solutions (Romano, 2003). Furthermore, integration mechanisms can also help managers to define to what extent such actions should pass through organisational boundaries, i.e. between functions and between companies. Romano (2003) also suggests the need for a cultural and attitudinal shift to address new ways of sharing risks and benefits between network members, in the long-term, by overcoming opportunistic individual behaviours. So, one might conclude that the above proposed CPFR approach appears to be aligned with an updated view of the phenomenon under study.

Hewitt (1992), Cooper et al., (1997) and Mabert and Venkataramanan (1998) are just some of the authors that have recognised integration as a fundamental principle of SCM, since it supports business processes across a supply network as being closely related with the effort to overcome intra- and inter-organisational boundaries. Moreover, Bechtel and Jayaram (1997) identify four dimensions of integration on SCM, namely, referring to internal and external functional integration, to the integration of logistics activities, to the integration of intra- and inter-company information flows and, to the integration of business processes across the supply network.

On the other hand, supply network co-ordination relates to planning, monitoring and aligning intra- and inter-organisational integrated logistics processes that extend from the market place, through the firm and its operations and beyond that to suppliers (e.g. Christopher, 1992;

Hewitt, 1994). Thus, materials, information, money and, even, ideas and people of the SC members flow, interact and require co-ordination. Moreover, a co-ordination mechanism is a pattern of decision making and communication among a set of actors who perform tasks to achieve goals (Malone, 1987) consisting (i) of the informational structure – who obtains what information from the environment, how is that information processed and then distributed among different members participating in the mechanism itself, and (ii) of the decision-making process helping to select the appropriate action that need to be performed from the set of alternative solutions (Marschak and Radner, 1972, in Romano, 2003).

Finally, Information and Communication Technology (ICT) has been considered as an important enabler of effective SCM, since that information holds the supply chain together (Kopczak, 1997; Simchi-Levi et al., 2000). Thus, ICT integration should be addressed because it not only facilitates information transfer between various companies and individuals in the network, but it also supports the shift from local to the whole network optimisation that the SCM asks for (Forza et al., 2000). In fact, the co-ordination mechanisms can be effectively activated (i) through the intensification of information exchanges, i.e. contacts, communication, opportunities alignment between the network members and, also, (ii) through the increase of visibility of each member on the whole network (Romano, 2003). Members of networks might include customers and suppliers, as well as, complementors and competitors. Interactions might consider other types of organisations, i.e. non-business (e.g. government agencies, laboratories, etc.), in addition to businesses (Ritter et al., 2004). In this way, all the mentioned stakeholders of MAP appear to be naturally included in the proposed solution.

One might argue that developing and managing intra- and inter-organisational business processes might be technologically simple, since most of the MAP firms are micro-enterprises and SMEs, i.e. of small size, with a few intermediate management levels, with no legacy systems, favouring centralisation in control and easing co-ordination. Perhaps the biggest barriers to overcome are of political, cultural and power nature, i.e. social, despite the scale of the problem still helping to set a solution.

Introducing virtual enterprises and networks: context, definition and positioning

The globalized nature of current business environments leads to the emergence of new networked enterprise organizational paradigms, e.g. supply chains, extended enterprises, virtual enterprises, collaborative networks, etc. (Ribeiro et al., 2012). Uncertainty, instability, turbulence and insecurity in the competitive environment, i.e. ever-changing markets, technology development, customer demands and global competition and decreases of product life cycles are key drivers of the demand for flexible, robust, autonomous, and responsive virtual enterprises (VE) linked together in a supply chain (Samdantsoodol, et al., 2012). Despite the challenges, a competitive and agile supply chain represents a unique opportunity for SMEs to tackle otherwise unreachable markets and opportunities concentrating their efforts on their core capabilities (Ribeiro et al., 2012) by leveraging collaboration, integration, intra- and inter-organizational networking, dynamic alliances, e-business through the Internet and ICT (Samdantsoodol, et al., 2012). Roche et. al. (1998) conclude that the main challenges in designing a virtual enterprise are (a) the fast reaction to customer demand; (b) the re-organization capability; (c) the communication between "incompatible" software and hardware systems (e.g. legacy systems, different IT sourcing, proprietary systems, etc); (d) the integration of heterogeneous entities; and (e) the knowledge exchanging and sharing.

To sum up, a virtual enterprise (VE) might be defined as a loose coalition both vertically and horizontally integrated in a temporary inter-organizational dynamic network with many

different relationships based on trust that should be coordinated and aligned with the internal systems, and that might operationalise an alliance or a consortium of independent stakeholders, geographically dispersed, from which some might be in co-optition, to pursue a primarily temporary (that might also be permanent) breaking boundary co-operation driven by market and demand, sharing opportunities, information, cost, risk and technology, perhaps in projects required to adapt to change in order to address mostly short business opportunities, in fast changing market opportunities to realize value, by achieving more together, by focusing on distribution, on knowledge development and, on innovation explosion offering business opportunities and challenges. Moreover, workflow and information flows need to be controlled by well-defined decision-making process and coordination, to design an effective enterprise collaboration, based on sometimes peer-to-peer multi-agent systems, eventually, participating in other virtual enterprises and, enabled by IT, ICT software, Internet and mobile technologies, common communication protocols, object technology, application inter-operability, specification and exchange of standard information models, in order to magnify its core competencies, resources and skills with complementary ones (e.g. Samdantsoodol, et al., 2012).

Illustration of empirical interest of the concepts and models being proposed

The VE paradigm provides strong signals of fitting to the requirements of the MAP business because dispersed SME, unified by a collaborative network, based on trust, exchange and share and, supported by ICT, become stronger as regards common competences and resources. They can also get closer to the adequate supplying critical size, as well as to the required response/supplying needs, to address both a market and a competitive environment that are dynamic, uncertain and unstable.

One might quote the example of essential oils in the MAP business, as a requirement for cooperation, in order to achieve success. In fact, it is not technically and economically feasible for a SME to develop both effective and efficient technology to extract the oils on its own. On the other hand, at least two research projects one from a main State Labo (INETI) and another one from a big public university (Faculdade de Ciências), which have been forgotten "off line", for a couple of years, have been identified in this investigation. These entities need to be captured to be part of a collaborative network. They also cannot pursue their research projects on themselves without being part of a broader formalised network of common interests.

Moreover, some crops need to be highly synchronised with the production process, in a very short gap of time, when the raw material for the oil is ready to be collected. This raises several types of operational problems, from logistics to production scale that also need to be fixed, within a collaborative environment. Despite some pilot collective initiatives to produce essential oils from ADCMoura are in progress, they look far from being satisfactory at an industrial scale.

Specification of collaborative processes

Network configuration factors

Configuration factors are necessary for describing and analysing collaborative networks. The factors *common goal* (which products?) and *relationship* (partnership) concern the strategy of the network. The *partners* (competencies, capacity, culture, motivation – learning, transferring of knowledge, improving competitiveness, etc. – objectives, localization, and

roles) and the *organization* (high-level structure/topology; dependency or flow of resources between activities) concern the structure requirements. Finally, *duration* (short/long life, predefined or not) and *stability* (static/dynamic, same/new partners) concern the behaviour of the network. These characteristics allow us to understand both the collaboration type and, the goals and objectives of the network (Rajsiri, 2009).

Frayret et al. (2003) distinguish six possible relationships of inter-enterprise collaboration, including relationships between an enterprise and its customers, suppliers, competitors, service providers, complementary enterprises, as well as universities, which fit the situation of the MAP stakeholders well. In addition, two of the three groups suggested by Fombrun et al. (1982) also support the Frayret taxonomy and match the relationships among the MAP stakeholders, as follows: (i) on one hand, competition or horizontal relationship, concerning the collaboration between enterprises in the same business or industry, enable substitutability in terms of offers. The partners are currently competing for similar resources, or producing similar products, in order to increase negotiation power. The horizontal relationship relies on the strategic management domain; (ii) on the other hand, group interests or transversal relationships, concerning enterprises which are, neither substitutable, nor essentially interdependent, but add reciprocal value. The partners provide services that would be a benefit to each other. The partners establish their relationship in order to achieve the same interests, such as shared technology development.

The concept of topology might describe the structure of networks, as well as the duration, stability, and decision-making aspects. Burn et al. (1999) distinguished six different models of network. A few of them were selected because of its potential to fit to the MAP problem, as follows: (i) In star-alliance, some partners are dominant players, the leaders that supply competency and expertise to members (e.g. the different types of MAP producers); (ii) In value-alliances, participants may come together on a project basis co-ordinated by a general contractor; (iii) In market-alliances, organizations exist primarily in the cyberspace operating in the electronic market (potential alliance, based on cooperatives, similar to Mondragon (Mondragon Corporation, 2012, initially); (iv) Virtual brokers design dynamic networks prescribing strategic opportunities (virtual organization led by potentially emerging MAP brokers). Katzy et al. (2000) suggest the characterization of networks being based on three topologies: chain, star, and peer-to-peer. A peer-to-peer topology entails mutual relationships between all partners, which could be an adequate topology for some MAP situations. It is characterized by the lack of hierarchy where any peer may interact directly with any other peer. Their management is usually based on self-organization. The management competencies are distributed within the members and the decision making power is equal for every member. Such networks seem to be appropriate in industries where access to knowledge and expertise is of primary concern. However, establishing such networks requires careful selection of members, developing and enforcing strong codes of behaviour, as well as investing in building trust amongst each other.

In order to specify a MAP network, one have to make decisions about its configuration. Partners have to be carefully chosen and criteria must be set to match the desired relationships, as well as the network structure, among others. It might be possible to have different types of relationships and several co-existing virtual networks. For example, while one might be broker-led to meet commercial targets, the other one might be set on a peer-to-peer basis to share resources and develop competences. Examples from Mondragon (Mondragon Corporation, 2012) or from the moulds sector in Portugal are just an illustration

of cases that could be approached in order to gather empirical knowledge at the business level to improve the accuracy of the characterization of the collaboration.

Technical challenges of a collaborative network

The ability to capture and share information between the information systems of different enterprises is very important, in order to set up a collaborative network of multi-enterprises, given the heterogeneities in culture, language, business, or technology. By definition, interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged (IEEE, 1990). Thus, relevant approaches for defining a knowledge-based system dedicated to the specification of collaborative processes will be pursued.

Interoperability can be seen as the capacity of enterprises to structure, formalize, and present their knowledge and know-how in order to be able to exchange or share it. In this case, interoperability is a crucial requirement for enterprises that need to be dynamically integrated. The problem of enterprise interoperability relies generally on three levels: data, resources and business processes (Rajsiri, 2009). This author made a proposal to capture knowledge from collaborative network partners, to develop a knowledge-based system, in order to specify collaborative process models, addressing the following questions: (i) What Knowledge on collaboration, where and how to capture it? (ii) How do we keep, store, represent and reuse existing collaboration knowledge? How do we derive new knowledge about collaborative processes from existing one? (iii) How and by which language do we describe, model and represent the collaborative process model?

Camarinha-Matos and Afsarmanesh (2006) refer to a collaborative network as being an alliance constituted of a variety of entities (e.g. organizations and people) that are largely autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals, but that collaborate to better achieve common or compatible goals, and whose interactions are supported by a computer network. This view both supports and summarises the above compiled definition.

Collaboration can be classified into four levels where each level extends the preceding one, as follows (Rajsiri, 2009): (i) Communication (data communication, exchange and share); (ii) Coordination (sharing and synchronization of tasks, i.e. applications, functions, and services available to partners); (iii) Cooperation (pursuing common goal, supported by the Enterprise Application Integration (EAI) or by the Service Oriented Architecture (SOA)); and, (iv) Integration: enterprises reunite (virtually) as one entity by means of interoperability, equivalent to the collaborative network level defined by Camarinha-Matos and Afsarmanesh (2006). Thus, two of the three technical challenges in the development of VE identified by Choy and Lee (2001) appear to be fully supported, as follows: (i) Development of the information infrastructure enabling to exchange data and business information seamlessly; (ii) Enhancement of design, planning methods and tools adapted for co-operative distributed networking enabling the accountability of the capabilities, capacity, availability and cost of the VE members. The third concern introduces the Development of Decision Support Systems (DSS) for partner selection, which has also already been recognized as a core issue (e.g. Katzy et al., 2000; Li et al., 2006; Samdantsoodol, et al., 2012). Therefore, it argued that one might specify the basic technical requirements for a collaborative network for MAP, since there is guidance to do so, there is a hierarchy of events and, many tasks appear to exhibit enough stability. However, some difficulties might arise with some of the most ill-defined tasks, perhaps occurring for non-routine situations.

Knowledge in a collaborative context

Knowledge is the most valuable asset of any enterprise for learning new things, solving problems, creating core competencies, and initiating new situations for both individuals and enterprises, both in the Present and in the Future (Liao, 2003). According to Kabilan (2007) knowledge is the appropriate collection of information. It describes what actions to take when certain information exists. It has to be useful. On the other hand, data is raw, it exists in any form, usable or not and it has no significance beyond its existence. Moreover, information is data that has been given meaning by way of a relational connection within a specific context. It can also be useful or not. Thus, knowledge is an active part in the process of transforming data into information (data interpretation), deriving new information from an existing one (elaboration) and acquiring new knowledge (learning) (Aamodt et al., 1995).

Nonaka (2007) made popular explicit and tacit knowledge, as well as their related transformations. Therefore, explicit knowledge is formal and systematic. For this reason, it can be easily communicated and shared. Tacit knowledge is not so easily expressible, is highly personal. It is hard to formalize and, therefore, difficult to communicate to others. Nevertheless, knowledge can mutate itself, as follows: (i) from tacit to tacit. Sometimes, one individual shares tacit knowledge directly with another (socialization); (ii) from explicit to explicit. An individual can also combine discrete pieces of explicit knowledge into a new whole (combination); (iii) from tacit to explicit. Converts tacit into explicit knowledge, allowing it to be shared with her project-development team (sharing); and, (iv) from explicit to tacit. As new explicit knowledge is shared throughout an organization, other employees begin to internalize it (internalisation). It is believed that, in the MAP business, all of these situations are found and that there is a continuous progress among most of these categories. Moreover, different categories require different formalization schemas, as well as different IT support.

On the other hand, Li et al. (2006) classifies enterprise knowledge relevant to the formation and operation of collaborative ventures into four categories: (i) enterprise core competence, regards the enterprise's own capabilities and capacities, strengths and weaknesses, and technical Intellectual Property Rights (IPR). This knowledge concerns the enterprise's internal experience which comes from formal and informal sources; (ii) VO (Virtual Organization) formation knowledge, regards best practice, critical factors, legal issues, risk analysis, and application of tools such as maturity gate planning in VO development. It also includes knowledge about collaboration and interoperability issues likely to be critical to partners. It comes from enterprise experience of current and previous collaboration; (iii) partner selection knowledge, regards core competencies, collaboration, interoperability capability and, reliability in collaboration of potential partners. It comes from knowledge of potential and actual partners from previous collaborations; and, (iv) VO operations management knowledge includes the VO enterprise model to support decision making, knowledge of interoperability issues concerning communication, and moderation knowledge about operational factors likely to be critical to partners. This looks as a nicely organised basis to start understanding, gathering and classifying, i.e. operationalising the knowledge required for a collaborative network in MAP.

Finally, according to Rajsiri (2009), the precision of collaboration characterization depends on the knowledge retrieved from partners. The capture of more and better quality knowledge leads to a more accurate characterization of the collaboration and the result will be closer to reality. So, it is absolutely critical that all the MAP partners are involved and participate in the process of expressing the knowledge requirements.

5. Conclusions

This paper reports a research concerning the domain of the Medicinal and Aromatic Plants (MAP). The analysis of the business context argued for organic MAP as being much more valued by the market. Organic MAP is a growing market with high rates of growth between 3 and 12% per year. Therefore, an opportunity in the international market was documented, which also pushed ahead expectations in Portugal that has got excellent edafoclimatic conditions for MAP. Moreover, a new generation of highly educated young farmers is returning to the rural world attracted by these opportunities, being supported by attractive government grants to help to establish themselves. Therefore, a relevant and opportune research question arose about the *adequateness and the refinement of a business policy supported by a collaborative operations virtual network within the scope of the Medicinal and Aromatic Plants (MAP) sector, in Portugal*.

This exploratory research proposal started to address its potential business interest, by setting the scope of organic MAP. Next, it established the state of the art, by analysing the business requirements expressed by four panels of selected stakeholders. Finally, the resulting missing links were examined within the scope of the adequate knowledge areas.

Data were collect from four panels in an event supported by the Secretary of State for Food and Agro-Food Research. Panel conclusions were treated, as follows: market; product development and R&D; organization of the sector data; production and supply chain. Three critical "missing links" were highlighted from the analysis of these data. First of all, "*fileira*" was conceptually modelled as a strong requirement for the development of a virtual supply chain, supported by a technological platform. Secondly, it was recognized the need for a broad social platform including all the MAP stakeholders before the technological development, which was classified as a true entrepreneurial event and, pioneers were praised for the initiative. Moreover, an important distinction between several categories of farmers was carried out, as well as a distinction between a farmer and an entrepreneur.

The proposals concerning the research question coming from the missing links were cross-examined, in order to be developed a more robust conceptual basis. Firstly, the SC fundamentals were revisited confirming integration and co-ordination as the core mechanisms to design and manage business processes across intra- and inter-organisational boundaries of a network to select right action supported by adequate Information and Communication Technology (ICT). Secondly, the competitive environment was reviewed suggesting the need for a virtual SC network as a significant Operations Model, which was also properly defined and placed into the context previously determined for MAP, providing support for the Business Policy introduced in the first missing link. Thirdly, the factors to configure a network were introduced and, some of them were approached more in-depth, e.g. the relationships or the network structures. Thus, the network configuration factors operationalised the first part of the specification of collaborative processes, which addressed the second missing link concerning the need to formalise the enlarged social platform. Next, the third missing link raised the point about the operationalisation of the social platform, which was addressed in the subsection Technical Challenges of a Collaborative Network. The social platform and its social momentum were also modelled by considering the definition and role of enterprise knowledge relevant to the formation and operation of collaborative ventures.

After this exercise, it is strongly believed that a collaborative operations network implemented by a technological platform that should be owned by the social platform, which is already established, is adequate to satisfy the needs of the so-called "fileira" within the current context

of the MAP business, in Portugal. Thus, it appears to support an alternative relevant business policy, which is not evaluated as better than any other. Moreover, it is argued that the discussion, which was held, provides a significant basis to a credible, not ambiguous, effective approach to the specification of such an operations design because it provides supported guidance to address the research problem. To sum up, one might conclude, by arguing for Operations Management as a cornerstone to the mapping of the MAP sector together with the proposed co-evolution patterns between firms and with the dynamic capabilities that support the required transition, in order to target the creation and diffusion of adequate knowledge and so, to achieve sustainable competitive advantage. As a recommendation for further work it is believed that the expansion of the formulated principles might be easily turned into an inquiry tool to run an empirical test to a proposed solution.

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