



**INNOVATION AND DISTRIBUTED KNOWLEDGE BASES IN THE WINE
INDUSTRY OF BORDEAUX**

Competitiveness and knowledge complexity in a traditional product



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Cover picture (private):

The neo-Renaissance *château* of
Pichon-Longueville Baron. Pauillac, Bordeaux.

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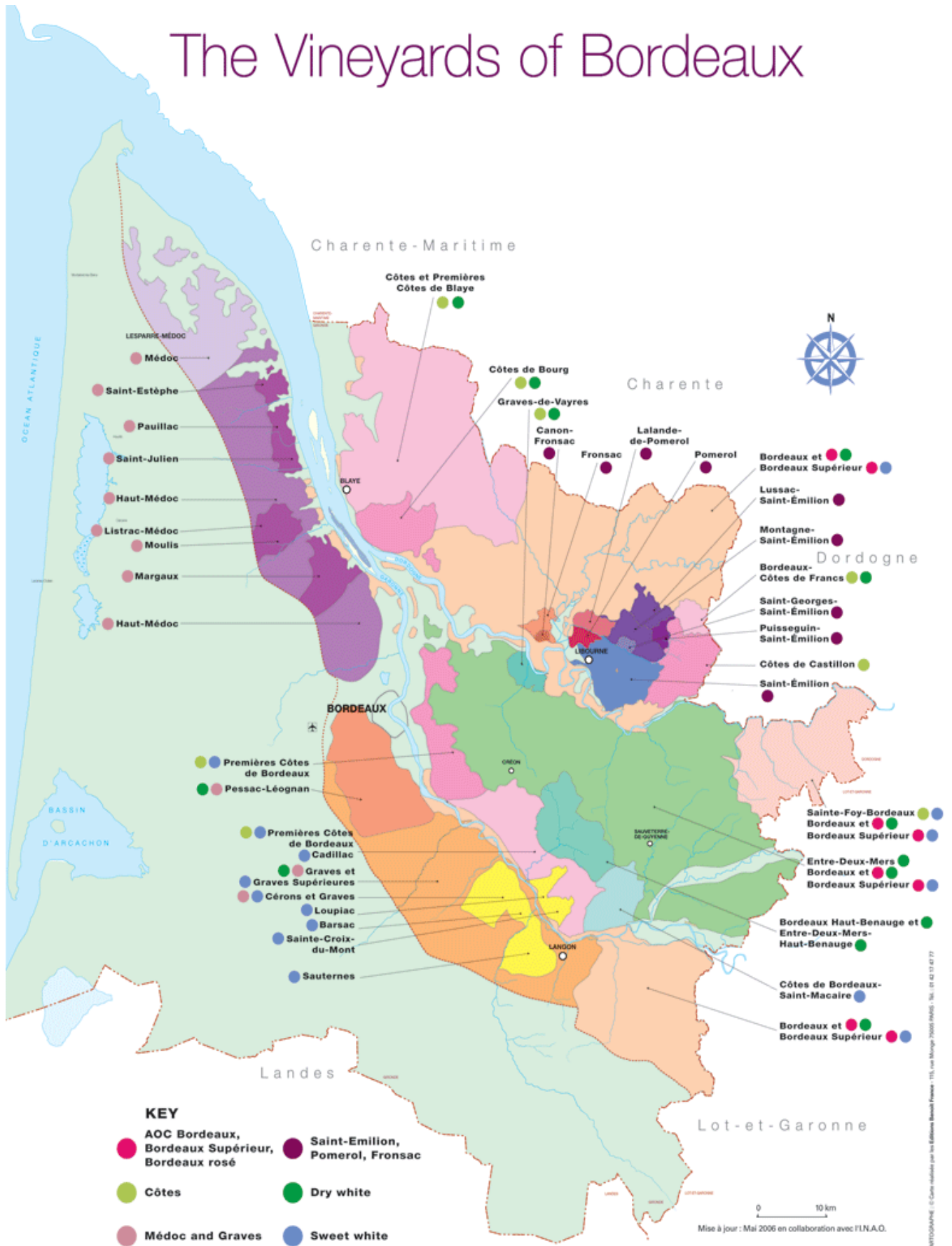
It has become increasingly clear the last decades that innovation is a key feature of competitive firms and industries. Despite an academic and political focus on technology-intensive industries as being the driving force of the economy, certain traditional low and medium-technology (LMT) industries have also managed to stay competitive for hundreds of years, without engaging in technology production or investing substantial capital in R&D. This study provides empirical evidence on the importance of distributed knowledge bases for understanding innovation and competitiveness in LMT industries.

The thesis takes form of an embedded case study of the high-end red wine industry of Bordeaux – a traditional LMT industry that has been the world leader in fine wine production for generations. On the background of 17 qualitative interviews, the distributed knowledge bases of the industry have been outlined. It is argued that the industry is in possession of considerable innovative capabilities due to its access to these knowledge bases, which lie spread across other industrial sectors. Thanks to a developed and structured cluster formation, the region's accumulated knowledge is made available to the industry, and the tacit knowledge-flows between the actors are stimulated. The industry's synthetic knowledge base along with the key role played by consultants, are seemingly the most important factors affecting the industry's absorptive capacity.

On the background of this case it is argued that LMT industries can be regarded as a knowledge intensive and dynamic part of a country's economy. The economy should be viewed as an interconnected system between industries in order to grasp what drives innovation and economic growth on a regional and national level. Furthermore, it is suggested that a combined view on the innovation process may enhance our understanding of some industries, as it is found in this case that new innovations are largely dependent on the distributed knowledge bases connecting, and being complementary, with the industry's synthetic knowledge base.

Keywords: *distributed knowledge bases - LMT - innovation - competitiveness - Bordeaux wine industry - cluster - regional innovation system*

The Vineyards of Bordeaux



Source: thewinespot.org.

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APPENDIX

1. Introduction

Understanding Innovation

Only a few hundred years ago the word *innovation* was dreaded throughout society. Conservative institutions such as the church, considered it an evil – a diversion from the established and a path to the unknown (Godin 18.10.10). Today innovation is a widely used term by firms and leaders all over the world to symbolise change, progress and prosperity.¹ However, innovation remains a misunderstood concept in some respects that might lead to disadvantageous approaches in managing and stimulating such a process. With this thesis I seek to contribute to the understanding of the complex nature of innovation in low and medium-technology industries, and to illuminate the interconnectedness between different sectors of the economy.

1.1 BACKGROUND

It is today widely argued that innovation is central in order to increase output and productivity in countries (OECD 2005:5) and thus being an important factor in stimulating competitiveness and economic growth. In this respect, the diffusion of technological knowledge is regarded by most as the key activity in fostering innovation (Fagerberg & Srholec 2007:1595-98; Tidd & Bessant 2009:5). This understanding of growth is probably an important reason for the increased focus on innovation-stimulating policy in firms and governments the past decade.²

The understanding of innovation as a linear process with its source in research and development activities (R&D), has for long been rejected by modern innovation studies (Balconi, Brusoni & Orsenigo 2010). Today innovation is commonly understood as a much more complex and interactive process between multiple knowledge bases, both internal and external (Kline & Rosenberg 1986). Despite this strong academic consensus, the principle seems to be neglected when discussing economic and societal development. Empirical research and innovation policy have mostly been engaged with industries that are characterised by high technological

¹ Can be illustrated by Barack Obama's *State of the Union* speech in 2011: "The first step to winning the future is encouraging American innovation". At the conclusion of his speech, he had used the word *innovate* and *innovation* 11 times in total (Zakaria, F. 2011. 'Innovate Better'. *Time Magazine*, June 13, 42-44).

² An example of this would be the Norwegian Government's policy-report from 2009: *Plan: Fra idé til verdi: Regjeringens plan for en helhetlig innovasjonspolitik*.

intensity, which have led to the promotion of research-intensive industries as the driving force of the economy (Hirsch-Kreinsen & Jacobson 2008:1-7). Low and medium-technology (LMT) sector is therefore often given a low priority when countries allocate their resources (Hirsch-Kreinsen, Jacobson & Robertson 2005:2).

Nevertheless, LMT firms and industries have managed to stay competitive for hundreds of years and are the biggest employers in manufacturing sector (Hirsch-Kreinsen et al. 2005:10). They also constitute the majority of countries' value-added and are doubtless an important part of the economy (Von Tunzelmann & Acha 2005:407). Innovation in such industries can rarely be measured through internal R&D alone, as this is not their main source of knowledge and learning. A broader view on innovation must therefore be asserted in order for managers, analysts and policy-makers to truly understand the interdependence of the economy and the mechanisms driving innovation in traditional industries (Robertson & Smith 2008a:93).

1.2 THE CASE

In order to better understand innovation and competitiveness in LMT industries, an empirical case study has been deemed necessary. Theorising and modelling are not sufficient means in understanding the complexity of the dynamics in such industries, and may be incapable of grasping the true essence of the innovation process (Robertson & Smith 2008a:101). It is assumed that learning and development are *not* exclusive for technology intensive industries, and that innovative capabilities also can be sustained with the help of a network of knowledge bases that originates from other actors and industries. By mapping the distributed knowledge bases of a selected LMT industry, it will be possible to assess the industry's innovative capabilities. This will give ground to further discuss the sector more generally.

Wine production has provided long-term growth for many countries and enabled successful entries of new industries across the world. It is an example of a worldwide sector providing positive economic development on a global scale (Smith 2007b:128). The case that will be studied in this thesis is the *high-end red wine industry of Bordeaux*. The making of wine in classic regions is often viewed as a traditionalistic and undynamic activity in terms of innovation (Ashenfelter 2008:174), a view that is strengthened by the wine producers' frequent review of themselves as such (Cazes 2011:9). This assumption goes hand-in-hand with the perception of the

wine industry as a resource-based industry (Kunc & Bas 2009), with low intramural R&D and therefore little learning and technological development (Wicken 2009:2). What makes Bordeaux an even more interesting case is the fact that it is a mature industry that is very competitive, and increasingly so. The industry has experienced an enormous growth in revenues the last 20 years (especially the last 10 years), as well as a growing global demand (Suckling 2011:16-19). Bordeaux is arguably the most successful industry in the high price segment of wine (Lawther 2010:6). This is true even when we regard the rise of modern high-quality wine production in other countries such as Chile, New Zealand, USA and Australia.

The role of innovation is proposed to be an important factor in maintaining the Bordeaux industry's competitiveness during the last decades of increased competition. Despite the fact that wine production is classified as a low-tech activity, it will be argued that such a definition is oversimplified and unfruitful, and that the notion of wine production as a resource-processing activity by far misses the more prominent features of the industry.

1.3 RESEARCH QUESTION

In order to describe the innovation process and capabilities of Bordeaux, the following research question has been set:

How does the high-end wine industry of Bordeaux acquire and process new knowledge?

In order to answer the research question, a mapping of the industry's knowledge bases will be necessary. It will also be important to determine the content of the knowledge made available to the industry, as this might be connected with the way it is acquired and processed. If the Bordeaux industry is found to be innovative, it will establish a ground to argue that high technology production must not necessarily coincide with innovation, and that other channels can be equally important for learning and development. In mapping the distributed knowledge bases it might be found that the technological component of the industry originates from other industrial sectors, which will crystalize links and dependent relationships between LMT and high-tech sector.

The objective of the research question is to contribute to academic and theoretical debates regarding: competitiveness of LMT industries, the interconnect- edness of the economy, regional knowledge transfers, management of innovation and growth stimulating policy-making.

1.4 THE CONSTRUCTION OF THIS THESIS

The introduction so far has been written in order to give the reader a general idea of why this research is both relevant and interesting, and how it will be approached. The next part of this thesis is a theoretical chapter that defines and explains the main concepts, key debates and literature contributions relevant to answer the research question in a deductive fashion. The chapter aims at outlining the development of academic literature on the nature of innovation in LMT industries, as well as former relevant and empirical research on knowledge and innovation in wine industries. Chapter 3 is a contextual chapter that seeks to engage the reader in the features of the industry. It describes the process of making wine, the history of Bordeaux and today's situation regarding the market and pricing. In chapter 4, the choice of case and methodological approach will be argued. Here the reader will get a full insight to the data collecting procedure and the practical aspects of the data collection. The use of method, the value of any collected data, limitations and biases will be a natural part of this chapter. It is written with the objective of making the research as transparent as possible in order to increase the reliability of the thesis. The empirical presentation in chapter 5 outlines the main developments in Bordeaux the past 20 years and the industry's most prominent knowledge bases. This serves as a background for the discussion in chapter 6, which objective is to link together the various sections of the thesis and discuss the empirical findings in light of relevant theory and previous wine research. Finally, a conclusion will sum up the study, followed by reflections on the limitations of this study and on further research.

2. Literature Review

The Theoretical Background

This chapter will begin with a definition of important terms used throughout the thesis, definitions that will be developed further in latter parts of the chapter. Following this, key concepts and academic debates will be outlined. This is done with the intent of defining the current research frontier, as well as creating a theoretical foundation on which to argue the choice of case and to discuss the empirical findings of this thesis.

2.1 DEFINITION OF KEY TERMS

Innovation	Joseph Schumpeter defined innovation as new combinations of existing resources. He distinguished between: new products, new methods of production, new sources of supply, exploitation of new markets and the reorganisation of business (Fagerberg 2005:6). Though innovation often means different things in different contexts, this thesis will treat innovation broadly, as defined by Schumpeter.
Knowledge and Learning	Knowledge is often the victim of definitional problems, but can in general terms be defined as understandable information, or as data that is presented in a form we can comprehend (Robertson & Smith 2008a:95-97). Knowledge is thus distinguishable from pure data and information, which can only appear as knowledge if they are placed in a meaningful context (Zack 1999:46). Knowledge is a resource that is available if one is able to absorb it, while learning is the process of absorbing this knowledge (Wicken 2009:2; Jacobsen & Thorsvik 2007:319).
Distributed Knowledge Bases	Distributed knowledge bases are "a set of knowledges/knowledge sources maintained across an economically and/or socially integrated set of agents and institutions". It can be situated in different intellectual, geographical, industrial and social locations (Robertson & Smith 2008a:100).
Cluster	"Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also cooperate" (Porter 2000:16).
Research and Development	Research and experimental development, or R&D for short, originally refers to: "[C]reative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (OECD 2002:30). Or formulated in a different way: "[T]he standard research and development activity devoted to increasing scientific or technical knowledge and the application of that knowledge to the creation of new and improved products and processes" (Hagedoorn 2002:477).
Competitiveness	The term competitiveness is here used as: "[T]he possession of the capabilities needed for sustained economic growth in an internationally competitive selection environment, in which environment there are others (countries, clusters, or individual firms, depending on level of analysis) that have an equivalent, but differentiated set of capabilities on their own" (Cantwell 2005:544).
Industry	A way to simplify the economy is to divide it in constituent markets. A group of firms that supply a selected market can be defined as the industry (Stiglitz 1993:396). When the Bordeaux wine industry is discussed in this thesis, it refers to the suppliers of the wine; the producers (or estates/châteaux).
Collaboration and Co-operation	Collaboration and co-operation are terms often used as synonyms in academic literature, though this has been criticised to a great extent the past ten years (Polenske 2004:1030). As the differentiation between the two terms has no impact on the argumentation made in this thesis, I have chosen to mostly encapsulate collaboration in the activity of co-operating, not separating the two for the sake of simplicity and readability. Co-operation will be used to describe the positive sharing of information between actors, firms or industries, but also including collaboration activities such as joint ventures, design, production and marketing (Ibid:1031).

2.2 INNOVATION AND COMPETITIVENESS

2.2.1 What Drives Economic Growth

One of the big challenges in the study of macro-economics has been to understand what factors stimulate economic growth, and to determine which policies can be implemented in order to increase competitiveness on a national scale. In this respect it has been a long-running discourse on whether resource-based economies are to be considered dynamic or not (Wicken 2009). Natural resources are often associated with industries that extract oil, metals, gas and similar raw material, but it is really "any commodity or factor which is provided by nature and not produced, or producible, by man" (Stiglitz cited by Wicken 2009:3). In the 50s, economist Robert Solow (1957) stated that technical change is an important factor for economic growth, and in later works argued that industries processing natural resources were undynamic – assuming that little or none technical change was taking place (Solow 1986). In contrast to product-manufacturing sector, these industries would not be pushed to innovate by the competitive forces of the market. Hence implying a low rate of R&D and learning (Wicken 2009:3-8). The discourse kept evolving and throughout the 90s it had been published extensive research on the *resource curse*, saying that natural resources can be harvested with little effort resulting in high income that, over time, reduces the dynamics of the economy (Sachs & Warner 1995). Product-manufacturing industries were therefore still viewed by many as the main drivers of innovation and economic growth (Stiglitz 1993:1000).

Today many oppose the view of resource-based sector as static (Matsuyama 1972; Robertson and Smith 2005; Wicken 2009; Hirsch-Kreinsen & Jacobson 2008; Giuliani, Morrison & Rabellotti 2011). They argue that technical change *is* taking place in such industries and that they can be perceived as dynamic and innovative due to their connection with other sectors of the economy. Treating the economy as if it all originates from one encompassing sector misses the interactive relationship across industries (Smith 2007a:50). By using quantitative indicators (e.g. patents and R&D data) in studies on growth in countries, many variables that are essential in order to explain industry-level dynamics are excluded (Castellacci 28.03.12). Neither are the demand conditions often found in product-manufacturing held to be the most important stimuli of innovative activity, as innovation is more dependent on the

localisation and utilisation of technological opportunities (Freeman et al. cited by Fagerberg 1988:361; Castellacci 2004:6).

2.2.2 Fostering Innovation

One of the fundamental assumptions in today's innovation studies is that innovation, and the diffusion of technology and technological knowledge, are the most important factors affecting the competitiveness of companies and industries (Fagerberg 1988; Fagerberg 2002:235), and thus the main sources of growth in countries' economy (OECD 2005:5; Smith 2007a:52-54; Fagerberg & Srholec 2007:1595-98). Innovation is closely interlinked with companies' comparative success, the acquisition of new market shares and new approaches to already established markets (Tidd & Bessant 2009:3-5). Innovation may also result in lower production costs and/or quality enhancement of products, which can increase profit and demand (Cantwell 2005:545). It follows from this reasoning that a country's comparative advantage will be in areas where learning and innovation are high (Fagerberg 1995:254).

In modern economics and innovation studies, the empirical research has mostly orbited around technology manufacturing industries (Martin 2012:9-10). R&D is often considered an important indicator for technology production, and because innovation is associated with technological change, R&D remains the most extensively used measurement for innovation in companies, industries and countries today (Smith 2005:157). Quantification is often perceived as something precise (Datta 2011:5), and could be why intramural R&D, along with patents, has been the primary measurement of innovation. But it is far from the only way to measure innovative activities. More detailed and thorough data can and should be collected. As a matter of fact, it is encouraged by the OECD (2005) to construct a more correct picture of firms' innovative capabilities than what is commonly done today using R&D indicators. Still, alternative sources of measurement are rarely taken into account by policy-makers and analysts (Smith 2005:154). A reason for this might be that the complexity of the innovation process is too unwieldy (OECD 2005:66), and so statistics become the most accessible and manageable data to work with. This would be unproblematic if one assumes that intramural R&D is synonymous with innovation, but that is at best controversial (Bender 2008:25; Balconi et al. 2010).

Internal R&D can without a doubt be an important factor in learning and innovation, and common logic will lead us to believe that if one conducts research,

one might develop new approaches, technologies or techniques. However, the traditional view on innovation as a linear movement³ – a process that springs out from R&D activities – has been almost uniformly criticised by modern innovation studies (Balconi et al. 2010:1), and in some cases discarded; starting with Kline and Rosenberg's *The Positive Sum Strategy* from 1986. Here they emphasise the importance of external sources of knowledge in the innovation process, and downplay the role of R&D to a mere problem-solving activity. It can thus be considered an innovation stimulating activity, rather than a spark plug or necessity for the process itself.

2.2.3 The OECD Classification

One factor that contributes to uphold the focus on technology intensive industries is the OECD's very own classification of industries based on technology content. The OECD (1984; 2002) has constructed a classification of technological activity in industries, measured as the ratio between R&D expenditure and output (Smith 2005:155; Hirsch-Kreinsen & Jacobson 2008:5-6). The categorisation can be outlined as follows:

Low-Medium-Technology	Medium-High-Technology	High-Technology
0-3 % (R&D/output)	3-5 % (R&D/output)	5 % + (R&D/output)

With the OECD's classification, R&D stands alone as the sole criterion for determining technology content in industries (Hatzichronoglou 1997:5; OECD 2011:181).⁴ The pharmaceutical and aircraft industries are examples of the most technological industries in the economy with an R&D-to-output ratio above 10 per cent, while resource-processing industries, such as food and beverage, are defined as low-technology (Smith 2005:157). High-technology sector in this respect only make up for approximately 3 per cent of a country's value-added (Von Tunzlemann & Acha 2005:407). The OECD classification can be seen as problematic because it fragments the economy. A fragmentation of the economy can easily result in a ranking of sectors

³ This view is best understood through *the linear model*, which started as a policy argument by Vannevar Bush (1945), where he stated that the American government must allocate resources to research activities in order to meet the challenges of tomorrow. Scientific research stands as the ultimate ground for development, and was argued as essential in medical and military industries especially. The "model" itself was not coined until later. For a further discussion of origin and relevance of the linear model see Balconi et al. 2010.

⁴ See a further critical discussion of this categorization in Hatzichronoglou 1997.

when discussing economic growth. For example, the EU's ambition of being a strong *knowledge economy* has resulted in a promotion of the Union's highly technological industries. One objective that has been set to accomplish the goal of a competitive knowledge economy has been to reach an R&D/GDP ratio of 3 per cent in the whole of the EU (Hirsch-Kreinsen & Jacobson 2008:5). Such a goal is of course a big incentive to promote high-tech sector. Because innovation is so tightly knitted to technological change, the OECD classification stands very strong as an indicator for academic and political interest. Thus we are forced to understand innovation in a framework that may not be applicable to the rest of the economy, and it will be difficult to explain dynamics in LMT industries by the same indicators that are used in evaluating high-tech sector isolated (Smith 2008:41; Robertson & Smith 2008a).

As both low and medium-technology sector contain similar characteristics that separate them from high-tech sector, they will be treated as *one* in this thesis under the abbreviation LMT. Both sectors consist of mature and established industries where the market usually changes more gently, and they are often dependent on resource-processing activity and not manufacturing alone (Von Tunzlemann & Acha 2005:408).

2.3 OTHER WAYS OF LEARNING

2.3.1 Open Innovation

In latter years numerous companies have focused more on stimulating knowledge bases that do *not* originate from inside the firm. This change of focus derives much from the theory of *open innovation* (Robertson & Smith 2008a:93). Open innovation positions itself as an antithesis to the linear model. Chesbrough (2006a:1) defines it as follows: "Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively". The theory of open innovation states clearly that knowledge bases located outside the company might as well be the core source of innovation in that firm (Chesbrough 2006a:2). Companies that are not aware of their distributed knowledge bases might miss important opportunities for innovation and development (Chesbrough 2003:36-37). The theory has traditionally been an argument for including users in development and innovation processes (Von Hippel 2005; Gassman, Henkel & Chesbrough 2010:2), and it is only in recent years that firms have used it to

justify searching for their own distributed knowledge bases (Robertson & Smith 2008a:93). Von Hippel (2005:2) and Chesbrough (2006b) argue that it is vital for companies to change their business models in order to adapt to the actual interconnected nature of the innovation process.

Industry Classification	Average direct R&D as % of output	Average acquired R&D intensity as % of direct R&D intensity
High-Tech	10,12	18,8
Medium-High-Tech	2,92	56,2
Low-Medium-Tech	0,6	194,2

Table 2.1: The relationship between direct and acquired R&D intensity. This table is constructed and shortened on the basis of numbers from the OECD (1999 and 2001, *Science and Industry Scoreboard*. OECD:Paris) as presented by Smith (2005:157).

Open innovation can contribute to explain the links between different parts of the economy and the impact external bases of knowledge can have. This is made even more evident in table 2.1, which shows that industries with low *intramural* R&D (LMT) often have a high *acquired* R&D intensity (external knowledge input). That means that it exists an apparent negative correlation between direct and acquired R&D.

2.3.2 Regional Patterns of Innovation

Research on regional innovation patterns supports the relevance of open innovation as a theory. The more innovative and knowledge intensive an economic activity is, the more the actors tend to cluster together within a geographical secluded area (Asheim & Gertler 2005:291). With the co-location of companies, suppliers and various other institutions, the pressure to innovate becomes prominent (Porter 2000:18). Clusters occur in all sorts of economies, but tend to be more developed in developed countries. The boundaries of a cluster do not easily coincide with traditional industrial classifications, because the cluster often consists of a mix of companies from different industries (Ibid.). Figure 2.1 illustrates the structures that are assumed to strengthen the competitiveness and connection between actors in a cluster formation.

A cluster can be viewed as an institutionalised infrastructure (Asheim & Gertler 2005:299), where geographical proximity enables certain types of knowledge (see chapter 2.3.4) to travel more easily between the various actors (Ibid:292). In LMT companies the close contact with suppliers can be an important reason for the

companies' technical change (Pavitt 1984:8). Castellacci (2008:980) goes even further by saying that:

Inter-sectoral exchanges, the set of input-output relationships in terms of advanced knowledge, material inputs and demand, constitute a factor crucial to enhance the competitiveness of the whole national system.

As the costs are usually the same for the actors establishing the cluster, creative and new ways of distinguishing themselves are pushed, and the firms are forced to innovate (Porter 2000:24). Because of the knowledge transfers resulting from various types of spillovers, all actors may gain access to knowledge from other industries represented within the cluster. This is arguably an important way of accessing external knowledge bases.

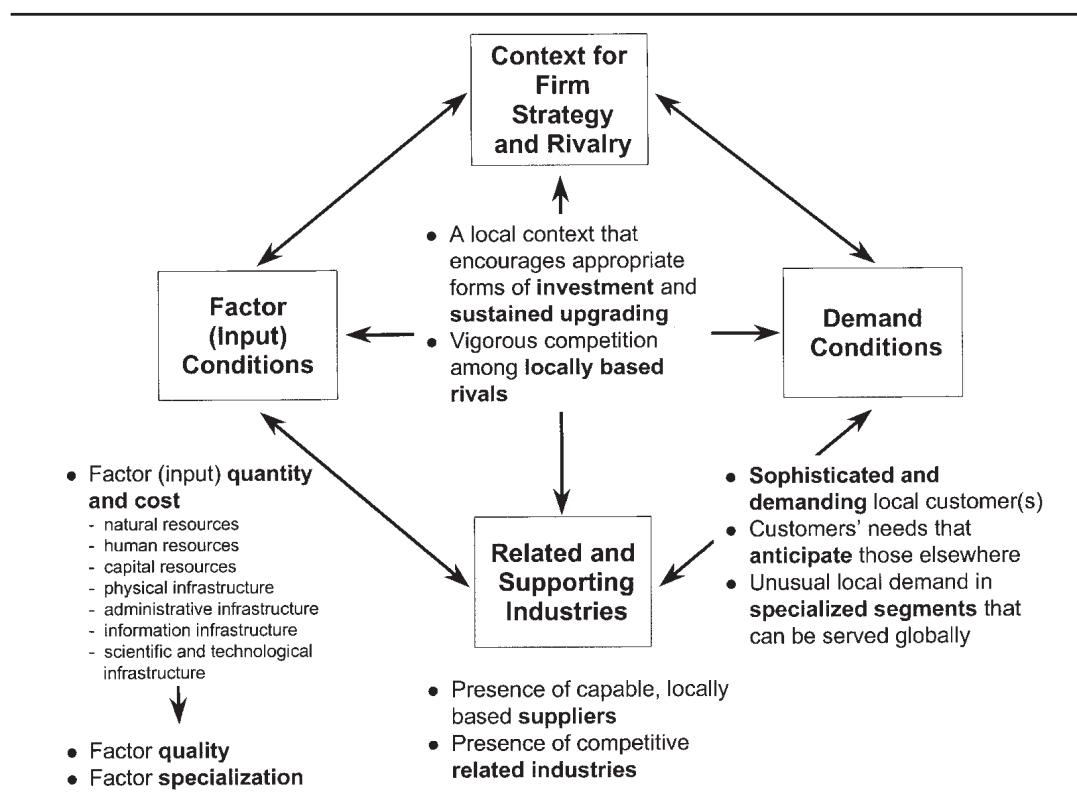


Figure 2.1: Sources of locational competitive advantage. Source: Porter 2000 (original illustration).

As the knowledge from one industry may be more valuable than knowledge from another, suppliers can be drawn toward certain *lead users* in order to tap in to these vital knowledge bases (Porter cited in Reve & Sasson 2012:45). Lead users, as defined by Von Hippel (1986), are actors that present strong needs in the market that will likely become general trends months or years later. For a supplier of technology it will be very valuable to be in contact with the lead users, especially when this user

represents a large user group. Not only for input on the future general user-needs and trends, but also for input on new product concepts and designs (Ibid.). It is therefore likely that suppliers will cluster around lead users in order to establish a strong and profitable relationship.

2.3.3 Distributed Knowledge Bases

By thinking in terms of cluster formations, we are given a visualised framework in understanding the somewhat abstract idea of knowledge transfer. To concretise the flows of knowledge even further, Smith (2008:102) divides the acquired knowledge in two basic forms: *embodied* and *disembodied*. Embodied flows of knowledge are knowledge incorporated in equipment, while disembodied flows of knowledge are knowledge acquired through literature, consultancy services, training, moving of personnel etc.

Embodied flows of knowledge are thought to be especially important for LMT sector (Pavitt 1984), and purchased technological equipment can be viewed as a "vehicle" for knowledge that can be absorbed by the buyer. High-tech sector is necessarily the main supplier of such knowledge to LMT industries. Performance developments in high-tech sector and the rapid diffusion of advanced technology to traditional industries can therefore appear as quality improvements and innovations in in the receiving sector (Smith 2008:102). This illustrates the link between the R&D intensive part of the economy and the non-R&D intensive one. Dietrichs (1995) shows this empirically with his study on Norwegian aquaculture, namely that the competitive ability of that industry has increased parallel with the capability to acquire and transform advanced technology from other industries.

Disembodied flows of knowledge might also be important to LMT industries. In recent innovation literature on wine industries, the importance of clustering to stimulate disembodied knowledge spillovers is stressed (Giuliani 2007). The use of consultants as well as research institutions in a geographical proximity of the industry seems to make up important knowledge bases for the producers. Successful knowledge implementation will also here show itself by the upgrading of existing technology, new methods of practice, new processes and by new technical functions (Smith 2008). Components as politics, property rights, rules and norms are often important in determining the industry's conservative approach to some of these activities (Ibid:23). The distributed knowledge bases of an industry can be located by

looking at formally structured co-operation and rational outsourcing, but they can also be found to be highly spread and unorganised, thus difficult to pinpoint (Robertson & Smith 2008b:3).

2.3.4 Different Types of Knowledge

So what type of knowledge is likely to be transferred in clusters? Asheim & Gertler (2005:292) argue that because explicit and codified knowledge is easy accessible by everyone, unique capabilities and products based on tacit knowledge input are most important in "innovation-based value creation". While tacit knowledge can be illustrated by the passing down of skills from teacher to apprentice, explicit knowledge can be formulated and passed on in the form of instructions (Von Hippel 1994:430). The cost associated with acquiring both tacit and explicit knowledge can be substantial, though it varies to a great extent dependent on context (Ibid:432).

A cluster would enhance tacit knowledge flows, as such knowledge is more easily transferred over short distances. An interacting cluster would permit actors to learn from observing, participating and dealing with other actors in that cluster (Asheim & Gertler 2005:292-93). Also, the movement of people and personnel can be seen as crucial for transferring tacit knowledge between industries and firms (Berg & Bruland 1998:13). A random person, after reading a book on wine production, would probably not manage to produce a bottle of wine – at least not a good bottle anyways – and the knowledge that lies in ones experience and observation over many years will be important in order to understand key activities within specific parts of the production (Nonaka 2007:135).

However, tacit and codified knowledge should not be viewed isolated, and the art of combining different types of knowledge is important (Jensen, Johnson, Lorenz & Lundvall 2007; Morlacchi & Nelson 2011). It is expressed a need to:

[...] reconcile and combine approaches to national innovation systems focusing on the role of formal processes of R&D in order to produce explicit and codified knowledge with those focusing on the learning from informal interaction within and between organisations resulting in competence-building often with tacit elements (Jensen, Johnson, Lorenz & Lundvall 2007:680).

Firms that combine explicit and tacit knowledge are held to be more innovative (Jensen et al. 2007:681). By looking at medical practice, Morlacchi and Nelson (2011) show that developments in this line of work are a result of the introduction of new technology, learning by experience and new scientific understanding. Which

component is more important differentiates from case to case, but the advancement in one type of knowledge is often interlinked with advancement in others.

Companies have an internal and previously accumulated set of knowledge before the acquisition of new types of knowledges. Asheim & Gertler (2005:295) divide these knowledge bases into *synthetical* and *analytical*. They both contain a mixture of tacit and codified knowledge. A synthetic knowledge base is common where innovation takes place through the application of existing knowledge, often in the response to solve specific problems that are presented by suppliers and costumers. The solution often comes as a result of applied research or incremental process or product innovation. Testing, experimentation and hands-on work are important activities in these industries. An analytical knowledge base is often the case for industries where training and practical skill seems to be important, and where knowledge creation often is based on formal models, codified science and rational processes. This in-house knowledge base, analytical or synthetic, dictates which activities that are outsourced, and in return also defines the industry's core competence (Pavitt 2005:93).

2.3.5 Absorptive Capacity

The idea that a company or industry needs an *a priori* knowledge base before new knowledge can be acquired, is deducted from the theory of *absorptive capacity*. Competitiveness and development depend on both access to knowledge *and* sufficient absorptive capacity (Fagerberg & Srholec 2007:1596). Cohen and Levinthal first formulated the theory of absorptive capacity in 1990. Both internal R&D and technical training of personnel are considered important to increase or maintain the level of absorptive capacity in the firm (Cohen & Levinthal 1990:129). The theory takes base in the thought that knowledge builds on previous knowledge – so called accumulative knowledge (Ibid.). Von Tunzelmann & Acha (2005:417) argue that innovative capabilities and adaption to new challenges can be triggered by practical and pragmatic approaches as well. Success and competitiveness are often conditioned on who can mobilize knowledge and technological skills (Tidd & Bessant 2009:4-5), but the acquisition does not necessarily need to be dependent on internal R&D (Zahra & George 2002). If LMT industries have a prior synthetic knowledge base, it would be a sufficient precondition to bestow them enough absorptive capacity to understand

how they can further increase their pool of knowledge through distributed knowledge bases.

Still, contact with the suppliers of external knowledge is vital in order to absorb it, and an internal as well as a good external line of communication is crucial (Cohen & Levinthal 1990:134). In general, competitive advantage may lie in accumulated firm-specific experience (Pavitt 2005:90). In a big company there is likely to be a variety of specialisations and knowledge in personnel, and some people may take the role of a *gatekeeper*. This is a person who is able to comprehend the external (often technical) knowledge and diffuse it within the company (Cohen & Levinthal 1990:132). She becomes a "knowledge implementer". However, relying on a small group of gatekeepers may not be sufficient. The distributed knowledge bases can be so scattered and act in such an unpredictable way, that a centralised and targeted group of people will not always manage to absorb the knowledge available to them (Ibid.). Gatekeepers with a broad knowledge background and extensive relationships with external and internal actors and companies, might be the key factor affecting the company or industry's overall absorptive capacity (Cohen & Levinthal 1990:133-34; Von Hippel 2005:93-107).

2.4 WHY LMT INDUSTRIES ARE IMPORTANT

As mentioned already, innovation is closely interlinked with competitiveness and economic growth, which have resulted in innovation-stimulating policy to become an important area of interest for scholars and policy-makers. Today most governments and companies have some sort of innovation policy, however, the focus on technology content leads to misguided priorities and "[the] current focus on fostering productivity growth via exciting high-tech breakthroughs misses a big part of what really drives innovation" (Datta 2011:237). Different dynamics between sectors of the economy are assumed and not sufficiently backed by empirical evidence (Wicken 2009:2). Technology content needs not to be viewed merely as development of new technological products, but also as new acquisition and use of technology. And is new technology really the only variable to push for innovation? In high-tech companies the production and commercialisation of technology are critical for comparative success and growth, while LMT companies are instead dependent on a strong financial fundament along with customer-loyalty secured by marketing (Von Tunzelmann & Acha 2005:419-25).

What is vital to understand about the LMT sector is that it is actually important regardless of its innovative capabilities. The sector is responsible for about 97 per cent of the economy's value-added in most European countries. It also typically accounts for 60 per cent of employees in manufacturing sector (Hirsch-Kreinsen et al. 2005:10; Von Tunzelmann & Acha 2005:407). LMT industries are thus not only making up an important sector, but are essential in order to understand employment and value generation (Robertson & Smith 2008a:93). The sector should also be of interest as it contains industries with low entry-barriers for new actors – industries that are very important for rapid growth and employment in developing countries (Giuliani, Morrison & Rabellotti 2011:3).

Despite the last years' financial turmoil, the world economy has been growing rapidly since the 1990's (ILO 2008). If the recession seen in some countries is overcome (Economist 2011a:93) it is logical to assume that the economy will start growing steadily again. In a growing democratic economy, the social situation usually becomes better and people's income increases. The question then becomes: what do they spend their money on? Excessive income is often spent in LMT industries as people still require low-tech products, but the demand for quality increases and inferior goods are often rejected (Stiglitz 1993:203; Stiglitz & Walsh 2006:106-7). The following was written in Ernst and Young's *Performance Preview* (Stone 2011:5): "If you are just competing on price, you get into a constant race to the bottom. [The] race to the top [is] the race to improve quality". LMT industries that produce products of high quality should expect to see an increase in demand when income rises. It becomes a question of income elasticity (Houthakker & Magee 1969). Normally, if the income goes up, consumption of superior goods will also go up (Stiglitz 1993:203-5). A high income elasticity means that if the income rises 10 per cent, we might see that the demand for a product rises 20 per cent in the same time span. This can show itself through a strengthened demand for better quality food, expensive furniture and more luxury items.

2.5 PREVIOUS RESEARCH ON LEARNING IN WINE INDUSTRIES

Various research on innovation in the wine industry have been conducted lately (Giuliani et al. 2011). This is probably much accredited to the emergence and success

of New World wine industries.⁵ The focus of the research has therefore generally been on technological catch-up and economic development of New World countries (Ibid.). Research on innovation in Old World countries, such as France, is very scarce. Luckily this does not mean that we cannot learn anything from research in the New World. On the contrary – it seems highly relevant for the case of Bordeaux. Though the industries have a different framework, they are the same in respects of production, and the results of New World innovation research may shed new light on the Old World, though the findings should not be generalised uncritically.

The New World differs from the Old World, and especially from Bordeaux, in many ways. New World wine industries are often synonymous with developing countries – countries that are still dependent on a big agricultural sector. Developing countries are expected to grow more exponentially than their leaders, and will reach the level of *best practice* quicker than it took the leaders to get there. This assumption derives from the thought that developing industries can utilise existing knowledge and technology already developed by the leaders (Giuliani et al. 2011:4-5). Usually when developing countries are discussed, the high-tech productions of China and India are mentioned as an obvious recipe for success, but traditional wine industries are also contributing with knowledge intensive activities, activities that enable the developing countries to catch up with the leaders (Ibid:1-3). New World wine industries have therefore been a key point of interest in wine related innovation studies.

In general, clustering of producers and institutions have been regarded as highly important for innovation in wine industries (Marsh & Shaw 2000:22; Giuliani 2007:139). In Australia, clustering has been the result in order to overcome financial transaction costs, such as costs of research and export. The will to overcome these obstacles brings producers together, where they quickly establish links with other parts of society (Marsh & Shaw 2002:22-24). In fact, Australia has today various institutions conducting R&D activities for the entire wine industry – R&D all producers are free to exploit (Ibid:37). The co-operation and openness seen in Australia the past decades may be *one* important factor explaining why the industry has been so internationally successful in the low to medium price range. On the other hand, the encompassing research institutions can today be seen as a problem (Aylward 2006). Now that the market has become more selective, educated and

⁵ In this context New World describes wine industries that are situated in countries relatively new to winemaking, such as Chile, Australia and New Zealand. Old World is the industries that are situated in traditional wine countries such as France, Italy and Germany.

money-spending, the all-industry R&D activities are not attractive for producers that want to develop wines in the high price segment. To do this, it is requested a need for more localised R&D in order to respond to the international demand for *terroir*-specific and individualistic wines (Ibid.). The transition from promoting low and medium priced wine to exclusive wine will probably prove to be a challenge for Australia in the years to come.

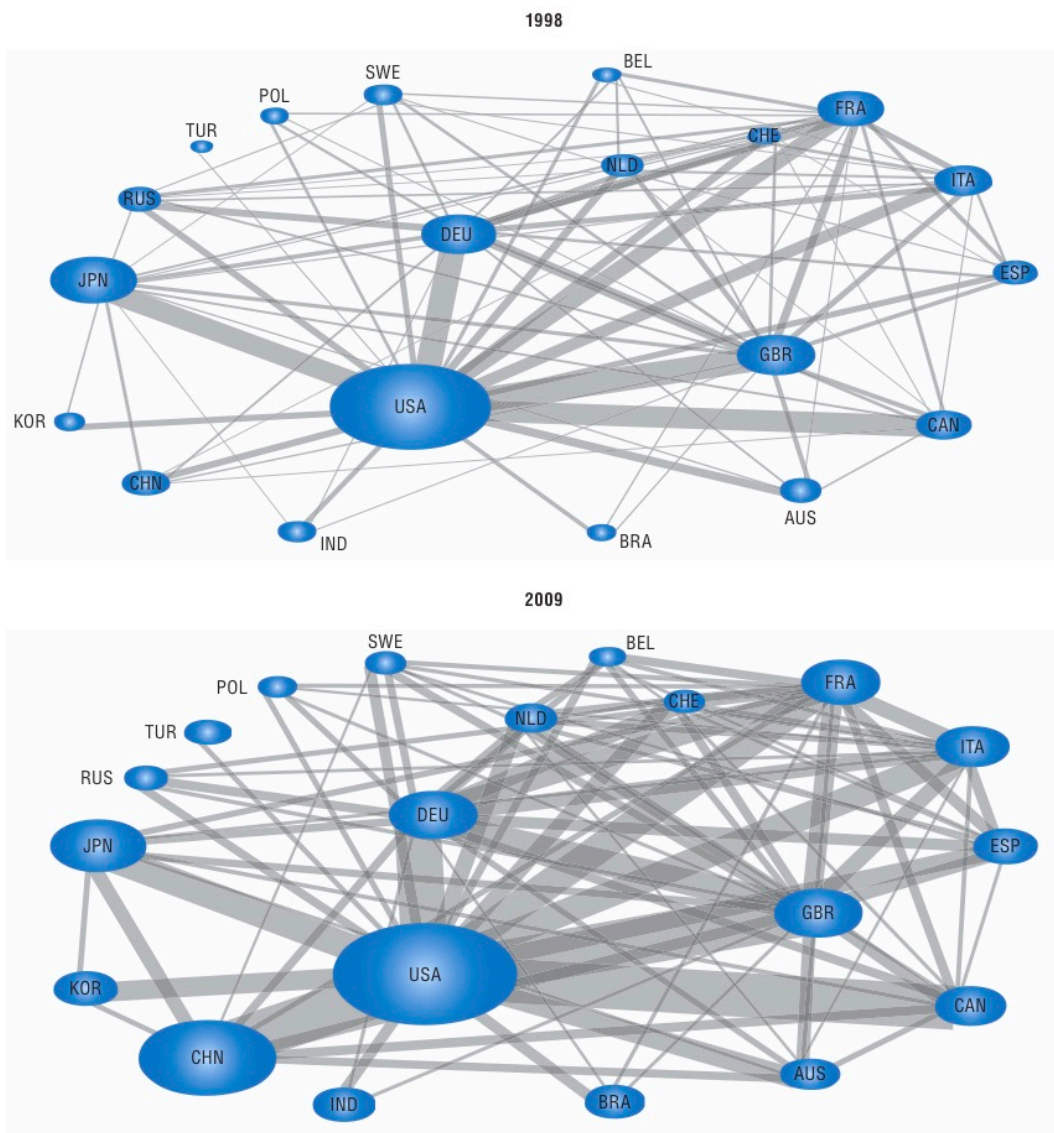


Figure 2.2: The increase in international scientific networking. Measuring scientific articles and co-authorship in 1998 and 2009. The numbers are based on whole counts. Source: OECD, calculations based on Scopus Custom Data, Elsevier, December 2010 (StatLink: <http://dx.doi.org/10.1787/888932485405>).

What can be stressed in the New World, is the role of local universities (Kunc & Tiffin 2011) and the international science community (Giuliani & Rabellotti 2011). The local universities are held accountable for the following contributions to development of wine industries (Kunc & Tiffin 2011:98-99): training skilled personnel in the winemaking process, industry-specific R&D, consultancy services and the facilitation of linkages between other parts and sectors of society. It is also argued that the role of universities and other local research institutions are gaining momentum because of the strong and expanding international networks of science, technology and innovation between institutions and firms in general (Giuliani & Rabellotti 2011:146). As we can see from figure 2.2, the latest OECD statistics show that universities have increased the scale and intensity of their international networks considerably the last 10 years. The figure insinuates a larger and more available pool of knowledge for the international science community.

2.6 CONCLUSIVE REMARKS

In sum, this chapter has argued that innovation is interlinked with competitiveness and technological change, but that the understanding of technology content in industries is too rigidly defined. An alternative view on innovation has been presented, based on the importance of distributed knowledge bases, which can also explain technological change in LMT sector.

Much has been written so far in this chapter about different ways to analytically approach innovation in LMT industries. Many models and approaches must be considered when studying innovation as the process can be explained from various points of departure. However, the empirical and analytical chapters of this thesis will largely focus on the concept of distributed knowledge bases and knowledge-flows in order to better understand the innovation process. Nevertheless, it has been necessary to outline the theoretical background for the structure of these knowledge bases, what types of knowledge that is likely to be transferred and how it can be absorbed, in order to truly be able to understand how various knowledge bases are acquired and processed in an industry such as Bordeaux.

The literature review has been used as a foundation for constructing this thesis' research question, in addition to the choice of case and methodological approach.

This chapter will inform the reader of the relevant history and context of the Bordeaux wine industry, and the main developments within prices and quality the last decades. To conclude, the unique features of the industry will be outlined.

3.1 THE BASICS OF WINEMAKING

The activities that are presented in the following sections have been shortened and simplified with the objective of making the reader better understand the empirical evidence in chapter 5. A more exhaustive list of activities and phases is presented in table 3.1.

The process of making red wine differs somewhat dependent on the style of wine made. However, a general pattern can be recognized from the vineyard and through the winery. The work in the vineyard is in theory quite "hands-on" and traditional, while the vinification is a more scientific and technological process where the grapes are converted into wine (Grainger & Tattersall 2005:48). After the grapes are picked in the vineyard, they are sorted to eliminate any bad fruit. Then they are destemmed and crushed in order to create a must. When the must is ready, it goes on to the fermentation phase (Ibid:54-56). The fermentation is the chemical process of converting the sugar in the grapes into alcohol. The process emits a substantial amount of heat and CO₂, which must be controlled as to not create a hazardous microenvironment in the winery or ruin the fermentation. Heat is needed for colour extraction, but if the heat of the vats reaches above 35 degrees Celcius, the yeast that was added to ignite the fermentation might cease to function. When fermenting the must, the solids (e.g. grape skins) rise to the surface of the juice and form a cap, but in order to extract colour, the solids must be in contact with the rest of the juice as much as possible. Different methods of managing this are used, namely pressing down the solids – *pigeage* – or pumping the juice over the "cap" – *remontage* (Ibid:50-58).

<i>Viticulture: main activities</i>	<i>Sub-activities</i>
Soils and soil management	Selection of vineyard sites; soil analysis, fertilisers and mineral additives to soil, chemical composition changes, fertiliser application methods, vineyard layout
Vine selection	Selection of grape varieties, propagation, grafting
Vine management	Trellising, supports, canopy management
Pruning	Selection of pruning principles, mechanical methods
Managing grape quality	Regulation of grape growth, effects of thinning, cooling, water control
Irrigation	Choice of methods, regulation of impacts, timing and frequency issues, drip and spray methods
Managing diseases and pests	Treatment of fungal, bacterial, parasitic and non-parasitic disorders
Harvesting	Sampling methods, harvesting criteria, harvesting methods, mechanical techniques
Transport and delivery	Cooling, storage, transport methods
Draining and pressing	Must (fermentable grape juice) control, maceration techniques, extraction of colour, freeze concentration
Fermentation	Yeast cultures, monitoring and control of fermentation sub-processes, acidity adjustment, malolactic fermentation
Wine handling	Clarification and stabilisation techniques, oxidation control, prevention of precipitation, identification and eradication of faults, filtration, oak and other maturation techniques
Bottling and packaging	Pumps, bottling lines, sterilisation, corks, sealing, design

Table 3.1: The main activities of viticulture. Source: Smith 2007b:134 (original table).

Post-fermentation maceration is sometimes conducted, meaning that the juice is left to soak with the skins in order to extract more colour, flavour and tannins (Bird 2010:90-93). Racking follows the fermentation (or maceration) and means the moving of juice from the fermentation vats to other vats, leaving sediments behind in the process. The wine is also racked during the maturation to clarify the juice even further. The sediments may then be subject to further pressing to extract more juice (Grainger & Tattersall 2005:58-61). Malolactic fermentation follows the alcoholic fermentation, but does not include the use of yeast. Here the rough malic acid is converted into softer tasting lactic acid. The process can be started by adding bacteria to the juice or by warming the vats. It can also be avoided by cooling (Margalit 2004:84-86). The final style of the wine is achieved by blending the different vats of fermented juice, usually by mixing different grapes or different parts of the vineyard. The maturation of the wine is the last stage of the process, and the wine is usually matured in wooden barrels where the wine rounds off and gains further complexity (Grainger & Tattersall 2005:60).

3.2 THE WINES OF BORDEAUX

3.2.1 A Brief History of the Bordeaux Region

Bordeaux is a French city located in the southwest of France with many vine growing sub-regions on the outskirts of the city center (see map at page v). The red wines of Bordeaux have for long had the pleasure of being discussed and mystified as some of the best in the world (Lawther 2010:5). The permitted grapes in a red Bordeaux blend are: *Cabernet Sauvignon*, *Merlot*, *Cabernet Franc*, *Petit Verdot*, *Carménère* and *Malbec*, the latter two being less used. The right bank wines of Saint-Émilion and Pomerol are known for their majority content of Merlot, while left bank producers usually have an overweight of Cabernet Sauvignon (Ibid:23). Even though a Bordeaux may vary somewhat in style, it is in general very recognisable on the palate as a medium to full-bodied oaked wine with firm tannins when young and often with hints of cassis, dark fruit, vanilla, tobacco, and sometimes even developing aromas of chocolate and truffles.

The Romans were the first to plant vines in Bordeaux around 100 bc. It was not until the 12th century that the commercialisation of Bordeaux wines began. The region was at the time under English rule, and the vine-growers had prioritised access to the major ports. This gave Bordeaux a head start to the international market compared to other continental wine regions. Initially the international market was England, but after Bordeaux came under French rule in the mid-15th century, the English market diminished. Instead, other markets in today's Germany, Holland and Ireland emerged (Brook 2007:21).

As Bordeaux began to be internationally recognised as a top wine region, the notion of *terroir* started to be widely discussed and it was held to be an important factor, if not the only factor, of making good Bordeaux (Van Leeuwen 2009:24-35). *Terroir* is a French word used to describe the geographical factors that have impact on the quality of the grapes. It has an implicit positive meaning symbolising the individuality and quality of a geographical secluded area (Vandour 2002:117-20). This meant that if a producer made a good bottle of wine, it could be explained by looking at the *terroir*. In Bordeaux, all of the top producers were attached to their own private estate and vine growing area. By analysing the *terroir* of the different vine growing parcels and tasting the wines, good and poor estates, or so-called *châteaux*, could be proclaimed. Already in the early 18th century, the top producers were

renowned by the name of their château, names that became synonymous with a certain quality (Brook 2007:22-23).

3.2.2 Reputation and Classification

Despite the early perception of quality, it was not until 1855 that a rigid classification was constructed, rating the top wine producing estates of the Médoc and Graves (see map at page v) based on their performance record and thus terroir (Markham 2009:22), ranging from 1st to 5th growth (*1-5. grand cru classé*). All of the growths were regarded as Bordeaux' best, though hierarchically differentiated from each other. The 1st growth segment consisted of the best producers in the region with châteaux: Lafite, Latour, Margaux and Haut-Brion.

The 1855 classification still stands today and has literally not changed in over 150 years. The only change worth mentioning was the promotion of Mouton Rothschild from a 2nd to a 1st growth, after decades of quality production and intense lobbying by the owner Baron Philippe de Rothschild (Brook 2007:21). The 1855 classification became an enormous market advantage for Bordeaux as an industry, and the producers suddenly received a "sign of approval", which enchanted the consuming market. This innovation became an important marketing tool. The other regions in France, such as Burgundy, had their *appellation contrôlée* – ranking vineyards based solely on terroir (Ibid:23) – but Bordeaux rated properties, and on that note became more exclusive than other regions of wine. Châteaux became brands.⁶ It must be mentioned in this regard that Bordeaux consists of 9000 producers, where the classified and famous estates only account for 5 per cent of the regions production. In other words, we are talking about a very small fraction of the general industry (Bouzdine-Chameeva 04.05.12).

Only châteaux from the Médoc and Graves were classified in 1855, but it still existed many excellent producers of red wine in the sub-regions of Saint-Émilion and Pomerol as well. Saint-Émilion and Pomerol have always had some of the most renowned producers in the world, for example châteaux: Pétrus, Cheval Blanc, Ausone, Pavie and Le Pin, to name a few. They easily achieve comparable prices to many of the top ranked Médoc châteaux (Decanter 2011b:142-43). Saint-Émilion is said to be where the first vines were planted in Bordeaux, and they now have their

⁶ Not all producers have their own "estate wine". It does exist many co-operatives. However, this is not the case for the high-end producers (CIVB 29.02.12).

own classification that was constructed in 1955.⁷ The system consists of three levels of recognition (from low to high quality): *grand cru classé*, *premier grand cru classé B* and *premier grand cru classé A*. The biggest difference between this system and the Médoc system is that in Saint-Émilion mobility is permitted; every 10 years the rankings are re-evaluated, which has been argued to be a motivating force for the producers to innovate in order to stay competitive (Lawther 2010:175). Pomerol still has no classification, which has seemingly not affected the region's popularity. Pomerol produces in very small quantities and the best wines are of great quality and highly sought after. The Graves however, has done like Saint-Émilion, and constructed their very own classification in 1953, as only *one* of its estates, Haut-Brion, made the 1855 classification. It now has its own *grand cru classé*, consisting of 16 estates, to separate the great chateaux from the others. The Graves classification is recognised in terms of low mobility (Crus Classés de Graves 23.09.11).

3.3 THE MARKET AND ECONOMIC DEVELOPMENT

3.3.1 The System of of Sales

It is not just the classification systems that are unique for Bordeaux, it is also the process of how the wines are sold. *Négociants*, which is French for merchants, are the traders of Bordeaux wine (Robinson 2006:92). About 100 négociants are involved with the grand cru market. They buy at an opening price from the château and sell with a 10-18 per cent margin. Négociants can sell the wine in two ways: directly from the cellar of the châteaux as bottled wine, or as *en primeur* (Lawther 2010:50). *En primeur* means trading the wine before it has been bottled (Robinson 2006:255), which in English is often called "buying futures". This means that the buyer can speculate in a wine's future while it is still being stored in casks at the respective château. This way of buying often turns out profitable for the consumer as the prices historically goes up after the wines are bottled. But it is a gamble, as the quality is yet not fully known. *En primeur* is also a preferred way of trading for many châteaux, because the income flow can be spread and thus give the producers fresh capital throughout the year.

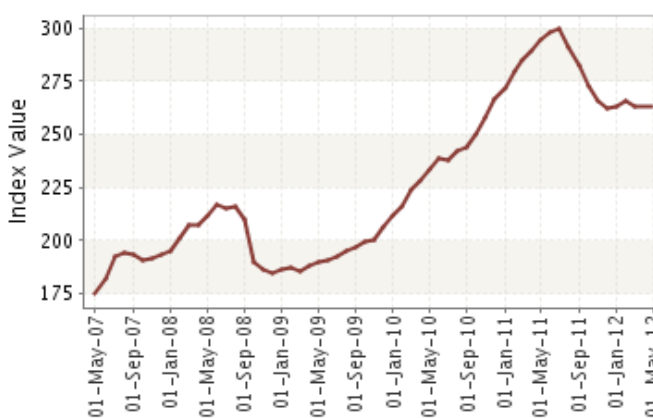
Earlier it was the négociants that dictated the price of the wine, but since the 1980s this has been done by the châteaux exclusively, though they are dependent on

⁷ Yes, exactly 100 years after the Médoc classification.

the négociants to accept the price (Lawther 2010:52-53). The *courtiers* entered the system of sales in the 80s and are professional brokers who establish a link between the producers and négociants. This was done after the quantity of traded wine became too great to process by the négociants alone, and after a period of serious trust issues between producers and négociants (Lawther 2010:46; Robinson 2006:92). Courtiers have their place on the ground, close to the estates, and provide confidence and efficiency between négociant and producer. They source the wine, take care of négociant payments and provide a smooth transaction. Courtiers are paid through a commission of each transaction, usually 2 per cent. The courtiers handle 75 per cent of the bottle sales and all of the en primeur sales (Lawther 2006:46).

3.3.2 Pricing and Demand

From the 1980s Americans were recognized as the biggest buyers of classified Bordeaux, much affected by the American wine critic Robert Parker Jr., who had a great impact on the wine world with the magazine *The Wine Advocate* and a 100-point system of scoring a wine's quality. This system rated the wines on a scale from 50-100 based on Parker's palate, and he continues to be, along with other critics, very influential also today. The Americans are not buying as much en primeur as they used to, but the overall market has been strengthened by Asia's interest for exclusive Bordeaux. In all, the demand for high-end Bordeaux is growing world-wide (Suckling 2011:16-19).



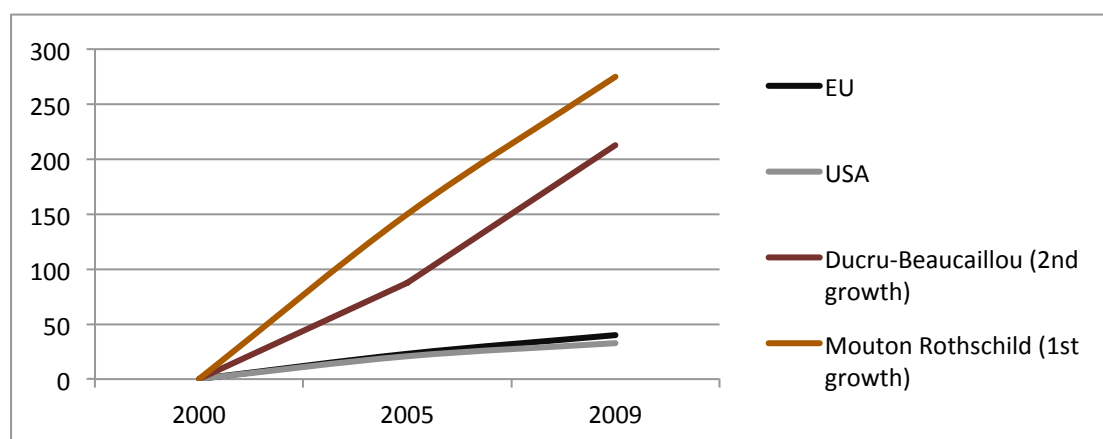
Graph 3.1: Price development for the most sought-after Bordeaux wines on the open market. 2007-2012. Source: Liv-Ex.com, Bordeaux 500 Index.

Because the producers are divided in geographical estates, the vineyards rarely decrease or increase in hectares. That means that the quantity produced stays pretty much the same.⁸ In other words, the supply of high-end Bordeaux is fairly static, and it is evident that it is demand that has increased

⁸ Though it may increase by buying neighbouring properties or planting new ground that was not used for vine growing before. Distributing a second label wine also permits the estate to use grapes that were not good enough for the first label earlier. The use of new technology to extract more juice from each grape can also be a possible way of increased production. Still, dramatic increase in hectares or litres produced is rare.

(Suckling 2011:16-19). It is therefore decided to allow the increase in price for *one* vintage over shorter time spans, to be regarded as an indicator of the increase in demand. Graph 3.1 shows an index that depicts the most traded Bordeaux' on the open market. 95 per cent of the index reflects the sales of reds. On average, the price of one vintage of a classified Bordeaux increases between 15 and 25 per cent each year (Bordeaux Vinhandel 11.10.11). If the whites are disregarded from the index in graph 3.1, it shows an average increase of 104 per cent for the reds the last 5 years (Liv-Ex 2012).

High-end Bordeaux can be argued to be a superior luxury good in the current market. The past years' income elasticity of demand is considered to be very high. While the gross national income (GNI) has increased in the EU with around 40 per cent the last decade, the price of a bottle Mouton Rothschild has increased almost 300 per cent from 2000-2009, as seen from graph 3.2.



Graph 3.2: Percentage increase of Gross National Income (GNI) in the USA and the EU, and release prices for two prominent Bordeaux châteaux measured in three "equally" good vintages. Source: OECD StatExtracts (generated 2011 on stats.oecd.org) & Decanter 2011a:24.

3.3.3 Competitiveness and the Importance of Quality

In the 1950s you could get a bottle of Mouton Rothschild for five times as much as the price of a basic Bordeaux, while today you are expected to pay 150 times as much (Decanter 2011a). Buyers are putting increasingly more money into red Bordeaux over other high-end wines. Why is this?

It has indeed been a quality increase in Bordeaux the past decades. We have seen three outstanding vintages the last ten years in 2005, 2009 and 2010 (four if we include 2000), together with five good vintages in 2001, 2003, 2004, 2006 and 2008, and only two vintages under "par" in 2002 and 2007 (Parker 31.09.11). Despite 2002

and 2007 being the worst of the best, they still received relatively high scores from wine critics (Ibid.). The entry of wine critics has played an important role in guiding buyer preferences, and today buyers of high-end wine tend to follow the scores of Parker, Robinson, Tanzer and other prominent wine critics in deciding what wine is of best value and quality (Lawther 2010:54). The professional assessment of quality is thought to have considerable effect on the retail price of high-end wine (Dubois & Nauges 2010:205). As the founder of *thewinedoctor.com*, Chris Kissack, so observantly "tweeted" (03.03.12):

Point inflation and price inflation. They go everywhere together, don't they? [Robert Parker] gives Smith-Haut-Lafitte 2009 100 points. Yesterday 60 GBP at [Fine and Rare Wines Ltd.], today 141 GBP. The consumers advocate.

Hence, quality, or at least the perception of quality, is important in order to be competitive in the high-end wine market. The buyers do not just buy expensive Bordeaux – they buy good expensive Bordeaux.

It is a considerable incentive for the châteaux to increase quality in order to enhance their reputation as a top producer (Landon & Smith 1997). The classifications still remain important, but the critics are guiding much more of the purchases now. Very few will spend money on a classified growth that Parker "only" gave 70 points. If good quality is upheld, a positive reputation will be gained for the producer who will get a bigger share of the income spent on high-quality Bordeaux. It then follows that if the producers in Bordeaux are maintaining high quality, the industry as a whole will probably attract more buyers and thus receive a larger part of the income spent on high-end wine. More competitive producers result in a more competitive industry.

The producers' pursuit of higher quality is presumably one of the main driving forces for innovation in the industry, as it increases both demand and competitiveness. However, not everyone agrees with this assumption. The well renowned economist Orley Ashenfelter (2008:174) argues that Bordeaux, as a wine producing industry, is undynamic. In his article that seeks to explain the quality development of red Bordeaux, he concludes that the weather conditions are the only factors affecting quality. He goes so far as to say that:

Red wines have been produced in the Bordeaux region of France in much the same way, for hundreds of years. [...] Quality differences have been considered a great mystery. [...] I show that the factors that affect fluctuations in wine vintage quality can be explained in a simple quantitative way.

Ashenfelter's premise for his study on quality in Bordeaux, namely that the industry has not developed in techniques or technology, is opposite from what will be argued in this thesis. The desire to quantify may in fact overshadow the reality of the industry. But Ashenfelter is not alone. There is arguably a wide-spread impression of Bordeaux as something old and traditional. This is of course true in many respects, and the industry has in fact made the same product using the same produce for generations. But it is much hidden beneath the traditional layers of the industry.

Various experts in the field of wine (Parker 2003:xiii; Grainger & Tattersall 2005:104) argue that global warming, weather and terroir alone cannot explain the quality increase we have seen in Bordeaux the past 30 years. Parker (2003:xiv-xx) mentions technology and technique upgrading as the most important factors for the strengthened quality, beside the stimuli provided by enhanced competition with up-and-coming wine industries. This has seemingly resulted in the ability to limit the poor outcomes of bad vintages and maximise those of the good. At a producer level this can be a crucial factor affecting estates' competitiveness within the industry. The increase in quality is actually disconnected with the 1855 classification of terroir, and the 1855 classification's validity is weakened. If we accept Dubois & Nauges' (2010:205) study, showing that quality assessments influence the retail price of Bordeaux wine, then multiple producers are now outperforming their ranking, which can be concluded from table 3.1. Châteaux like Palmer (3rd), Lynch-Bages (5th), Pontet-Canet (5th) and Grand-Puy-Lacoste (5th) are now considered to be on a much higher level than their ranking indicates in terms of quality and price. Some châteaux are also underperforming, such as Rauzan-Gassies (2nd) and Dufort-Vivens (2nd).

We must assume, in accordance with Parker, that other factors are causing the factual competitive mobility of the classified châteaux, such as new technology, new ways of exploiting the terroir and innovation. If we were to construct a new classification today based on average price, many producers would have been classified differently. As we see from table 3.1, the 1st growths are performing very consistent, and are attaining the highest prices, but from the 2nd to the 5th growth, we see a considerable restructuring of the original 1855 classification. The effect of branding and marketing on the *perception* of quality should also be taken into account to understand the current rankings, and not just the factual increase in quality. Executive director of Château Figeac in Saint-Émilion, Eric d'Aramon, describes the

effect of branding by saying: "We do not longer sell fermented grape juice, we sell a dream" (Decanter 2011a:56).

Château	Average GBP/case	Classification today	Classification 1855
<i>Latour</i>	4.620	1st	1st
<i>Lafite</i>	4.197	-	1st
<i>Margaux</i>	3.773	-	1st
<i>Mouton Rothschild</i>	2.941	-	1st
<i>Haut-Brion</i>	2.705	-	1st
<i>La Mission Haut-Brion</i>	2.225	-	New
<i>Palmer</i>	1.085	2nd	3rd
<i>Léoville-Las-Cases</i>	1.029	-	2nd
<i>Cos d'Estournel</i>	804	-	2nd
<i>Pape Clément</i>	686	-	New
<i>Montrose</i>	672	-	2nd
<i>Ducru-Beaucaillou</i>	664	-	2nd
<i>Pichon Lalande</i>	588	-	2nd
<i>Pichon Baron</i>	525	-	2nd
<i>Léoville Barton</i>	510	-	2nd
<i>Lynch-Bages</i>	502	-	5th
<i>Léoville Poyferre</i>	458	3rd	2nd
<i>Pontet-Canet</i>	423	-	5th
<i>Malescot St-Exupéry</i>	394	-	3rd
<i>Rauzan-Ségla</i>	386	-	2nd
<i>Haut-Bailly</i>	369	-	New
<i>Calon-Ségur</i>	357	-	3rd
<i>Lascombes</i>	348	-	2nd
<i>Smith Haut Lafitte</i>	329	-	New
<i>Beychevelle</i>	329	-	4th
<i>Cantenac Brown</i>	318	-	3rd
<i>Grand-Puy-Lacoste</i>	316	-	5th
<i>Branaire-Ducru</i>	311	-	4th
<i>Clerc Milon</i>	311	-	5th
<i>Duhart-Milon</i>	306	-	4th
<i>Giscours</i>	305	-	3rd
<i>La Lagune</i>	305	-	3rd
<i>Issan</i>	300	-	3rd
<i>St-Pierre</i>	295	4th	3rd
<i>Langoa Barton</i>	292	-	3rd
<i>Gruaud-Larose</i>	290	-	2nd
<i>Brane-Cantenac</i>	286	-	2nd
<i>Kirwan</i>	277	-	3rd
<i>Talbot</i>	274	-	4th
<i>Malartic-Lagravière</i>	266	-	New
<i>Domaine de Chevalier</i>	265	-	New
<i>Haut-Marbuzet</i>	254	-	New
<i>Prieuré-Lichine</i>	250	-	4th
<i>Lagrange</i>	246	5th	3rd
<i>Boyd-Cantenac</i>	239	-	3rd
<i>Sociando-Mallet</i>	233	-	New
<i>Ferrière</i>	226	-	3rd
<i>Marquis de Terme</i>	219	-	4th
<i>Armailhac</i>	216	-	5th
<i>Carbonnieux</i>	213	-	New
<i>Haut Bages Libéral</i>	209	-	5th
<i>Haut-Batailley</i>	208	-	5th
<i>Lafon-Rochet</i>	208	-	4th
<i>Durfort-Vivens</i>	206	-	2nd
<i>Tertre</i>	205	-	5th
<i>Rauzan-Gassies</i>	204	-	2nd
<i>Dauzac</i>	203	-	5th
<i>Cos Labory</i>	203	-	5th
<i>Batailley</i>	202	-	5th
<i>Grand-Puy-Ducasse</i>	201	-	5th

Table 3.1: Today's quality ranking. Only for the left bank (Médoc and Graves) châteaux. Price is given per case à 12 bottles exclusive taxes and commission fees. Estates in black are held to perform in line with the 1855 classification, while the ones marked in green are overperforming and those in red are underperforming. Source: Liv-Ex.com; Lawther 2010:306-7.

3.3.4 What Type of Industry is Bordeaux Really?

It is convenient to say that the Bordeaux high-end wine industry is nothing more than a resource-processing industry. And yes, in many ways it is true. But the industry possesses many characteristics that distinguish it from other processing industries. The objective of the high-end producers is not to make grapes ready for consumption; they wish to create a highly sophisticated and exclusive product – using grapes. It is more a process-manufacturing industry than a resource-processing industry, and the estates are producing a luxury good rather than a simple beverage. Everything attached to the estates, including the châteaux, the price and the marketing, are all projecting a luxury product.

The product that is made is unique with regards to which consumers it appeals to and the character of the item itself. Not many products change over time, but a high-end Bordeaux does. The content is the same, but the taste, colour and structure of a wine bought today will evolve considerably the next 10-100 years.⁹ Because of this it is also considered an investment product. As a matter of fact, the prices have gone so high for the best reds, that traditional buyers have problems acquiring the wine for consumption at all. The consumer wishes to drink the wine now or in the future, while the investor wishes to store it in order to sell it at a later time for a profit. It will enrich our understanding of high-end wine-making if we refer from regarding it as a pure agricultural resource-processing activity.

3.4 CONCLUSIVE REMARKS

It has been both an overall increase in quality and price the last 30 years. Innovation within techniques and technology, along with branding efforts, are assumed to be the main factors affecting the competitiveness for the individual estates and hence the industry. It has been argued in this chapter that the industry should be viewed as more than just a consortium of resource-processing companies. The industry appeal to an advanced market of investors and consumers, and the way the product is sold is very unique.

⁹ Given that the producer and vintage is of a high quality, and the wine is stored under optimal circumstances.

4. Methodology

The Choices of Design and Approach

Here the process of preparing and collecting data will be described thoroughly and reflectively, as will the procedure of design and analysis. This is done to assess the validity of this study, strengthen the reliability, and offer transparency to the reader. The chapter is written in a personal tone, where I regard my experiences and rationality as important guidelines for my approach, along with normative methodological literature.

4.1 THE CASE STUDY

4.1.1 Why a Case Study?

The case study can be viewed as a framework or a design with the objective of guiding the researcher through every stage of the project; from constructing the propositions to analysing the results. Both qualitative and quantitative method, as well as various data-collecting methods, can be used within this type of study. The research question set in this thesis favour a case study approach; the question seeks to increase our understanding of a contemporary system where the researcher does not have control of the behavioural elements (Yin 2009:11;19;25-26). Also, my choice of writing deductively with the objective of generalising my results to theoretical propositions is usually the starting point for choosing a case study (Cavaie 1996:235; Flyvbjerg 2006:228). As the boundary between phenomenon and context often is unclear, choosing a case will enable me to define and limit the phenomenon and analyse it through different sources of data (figure 4.2).

Distributed knowledge bases are per definition assumed to be located at various geographical, social, industrial and intellectual locations. By choosing a case and multiple sources of data, it is arguably a higher chance of picking up relevant data to seek out and describe the knowledge bases of the industry more completely (Smith 2008a:101). Other more limited approaches, such as a survey or document analysis have not been deemed applicable. I do not believe that such approaches alone can result in a better understanding of innovation. However, some quantitative simple-

counting data will be presented (McCracken 1988:28) as well as documentary data, but always in a wider context.

4.1.2 The Research Design

There is no exact recipe on how to execute a case study. It is therefore vital to have a project design based on the logic of the research. I have used the reviewed literature as a guide for designing and defining a set of sequences that will constitute the framework for this research – from start to finish (Yin 2009:25-27). This will make sure that the process always keeps its rational in the pursuit of answering the research question.

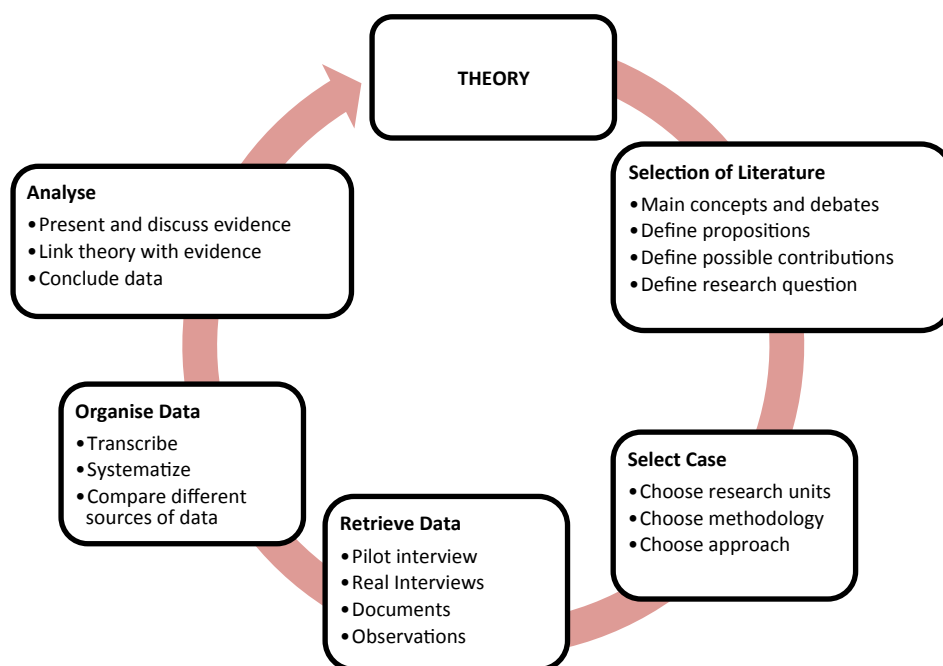


Figure 4.1: The research design of this thesis.

The research design is illustrated with figure 4.1. As has already been presented in chapter 2, I began by developing theory in order to guide the research design, the choice of case and to structure the empirical evidence in the following chapter. After the case was outlined on the background of the selected literature, it was possible to formulate a research question that aimed at providing new empirical knowledge to the reviewed theory. Following this, the units of analysis were carefully chosen so as to represent the case in the best possible way, before the different types of data collection methods were evaluated. Finally, after the data was collected, it was

organised, presented and analysed, with the objective of contributing back to the pool of literature from where the research once departed.

Though I have presented the research process as fairly static, there has been a lot of juggling between theories and empirical findings in order to make all parts fit together logically. It is only presented as linear to avoid confusing the reader and to provide a natural build-up of arguments.

4.1.3 Validity and Reliability

The terms validity and reliability actually belong in quantitative research and derives from a positivist approach. Qualitative research has adapted these terms some time ago to evaluate the quality of the collected data (Golafshani 2003:597-98). If we try to understand the researcher as an "instrument" (Patton, cited in Golafshani 2003:600) it becomes easier to translate the meaning from quantitative to qualitative research.

An overall assessment of validity should include the researcher's own evaluation of how well the data represent the phenomenon of the research (validity of data), if the different parts of the research logically fit together (overall validity), if the study can reflect the real-life phenomenon (internal validity) and to what extent the study can be used to generalise to other settings (external validity) (Punch 2005:29). I have tried to strengthen all of these considerations by selecting what I hold to be a representable selection of sub-units and respondents, and to strive for a structured and logic deduction from theory. I have also remained critical when evaluating and triangulating the evidence (see chapter 4.1.4).

To achieve high reliability, one must make sure that the research is consistent over time, meaning to what degree other researchers would achieve the same results given that they approach the unit of analysis as the previous researcher has done. Reliability also demands that the different sources used are consistent with each other. That means that the sources all work in the same direction (Punch 2005:95-96). This chapter itself is a way of achieving high reliability by critically arguing the choices that have been made and why.

4.1.4 Triangulation of Evidence

An advantage of case studies is that the researcher can choose between different sources of data, something that is not always easily done in pure historical, experimental or survey-oriented research. Triangulation of evidence is the use of

more than one source of data (Yin 2009:114-15). Many sources of data may be relevant to explain the process of innovation, and the convergence of different empirical sources can therefore strengthen the validity of data. As is seen from figure 4.2, the data collected in the area which all sources of data cover will have stronger validity as evidence than the parts covered by only one source. However, uncritical triangulation may also have its flaws and can result in a comparison of sources that might not represent the same aspect of the research unit or the research question, thus compromising the reliability of the study. As seen from figure 4.2, the parts of the sources that do not overlap may discredit the other sources if compared, and in truth they might not be comparable at all. Deciding what is relevant evidence is therefore important (Ragin & Amorosso 2011:133).

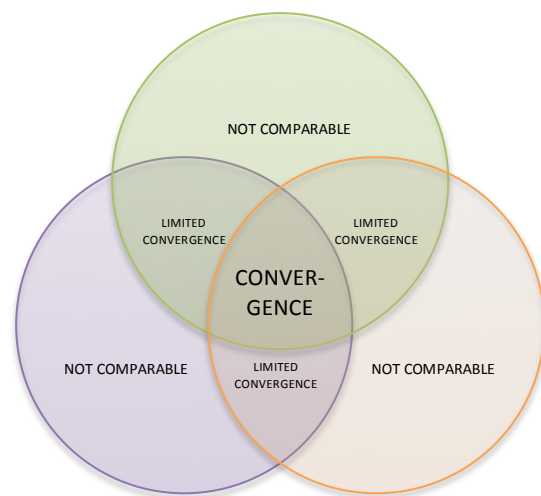


Figure 4.2: The convergence of three different data sources.

4.2 UNITS OF ANALYSIS AND DATA SOURCES

4.2.1 The Unit of Analysis

The high-end red wine industry of Bordeaux is my unit of analysis – the unit that I wish to say something about. As the wine producers are the suppliers constituting the industry, as it is defined in chapter 2.1, the study takes form of an embedded single case study, meaning there is one main unit of analysis accompanied with embedded sub-units (Yin 2009:30). It will be possible to say something about the industry by gathering data on a representative selection of producers (Giuliani 2007:147-53; Dietrichs & Smith 1994:3). It is assumed that the châteaux will provide information on recent developments, in-house technical knowledge, new apparatus, networks, employment and even the trends in the larger industry. They have therefore been selected as sub-units, and are my main sources of data.

The case of Bordeaux' red wine industry has been limited to the high price segment. This is done for various reasons. By limiting the definition of the industry,

the universe of sub-units will decrease, which will make the collected data more valid as they represent a larger part of the universe. It is also important to remember that Bordeaux is a large wine producing area, and as an entity it is not very successful. It is only the high-end part of the industry, viewed isolated, that is highly competitive international, and I believe this part to have features that separate it from the rest of the industry. I have set a minimum production capacity for the sub-units at approximately 60.000 bottles a year. High-end producers of Bordeaux usually do not have high production numbers, but if the producer makes less than 60.000 bottles a year, it is reason to believe that the estate might not compete in the marked on the same terms as the majority of the other estates, as their bottles are too rare, making the demand elasticity extremely high.

Number of inter-views with producers	6	3	1	1
Appellation	Médoc	Saint-Émilion	Graves	Pomerol
Sub-appellations	Pauillac, Margaux and Saint-Estèphe	-	Pessac-Léognan	-
Classifications	1st, 2nd, 3rd and 5th grand cru classé	Premier grand cru classé A and B	Grand cru classé	-

Table 4.3: Selection of sub-units. All high-end appellations are represented with special weight on the biggest classified regions of Médoc and Saint-Émilion.

I have studied 11 high-end red wine producers, representing the three grand cru classified appellations and Pomerol. The sub-units are spread on the appellations after I considered size and importance of the appellation. See table 4.3. Graves has the lowest number of classified producers and is therefore only represented once. Pomerol is also just represented once as it consists of many small producers, and some of the estates produce as little as 10.000 bottles a year (Brook 2007:458-522; Clarke 2006:143). Also, the possible effects the classification system has on the producer's will to innovate argue for an overweighing representation of the larger classified regions of Médoc and Saint-Émilion instead.

4.2.2 Selecting the Sources of Data

The interview is the main tool of qualitative research and is a good way to understand other people's perceptions of the situation they are in (Punch 2005:168). My selection of respondents consisted of general directors or department managers at the estates, as

I held them to be well informed on the different aspects of the production and industry relationships. In total I have spoken to 7 general directors (some of whom were also owners), 3 winemakers, 3 technical directors, 1 sales director and 2 public relations officers. Between one and two representatives from the châteaux were present at the interviews. If two people were present, it was for the sake of complementary expertise (eg. winemaker and public relations officer). It was important to have a high number of respondents, because it would make it easier to discover common features or deviations between the sub-units. Also since I have chosen a semi-structured approach where the interviewees are not expected to illuminate all themes as thoroughly.

Part from interviewing, I also used observation as a data-collecting tool. I was given a tour of the cellar before or after my interviews. This made it possible to see the technical equipment, the full production cycle and even the cellar team at work. It gave me a valuable opportunity to understand more of the process and to ask further targeted questions. The interviews were conducted over a period of one week, with approximately 3-4 interviews a day. The different vine-growing regions of Bordeaux lie far apart, so I had a rental car my entire stay.

It was crucial for me to get data on the unit of analysis from affiliated sources exogenous of the industry as well. Hence, I wanted to get direct input from the regional research institutions, but could unfortunately not, after multiple attempts, get an interview with representatives from the *University of Bordeaux*. However I was happy to be admitted for an interview with the leader of the *Wine and Spirit Business Research Group* at *Bordeaux Management School* (BEM). I got information on the technology suppliers from the estates, as the suppliers of the industry were yet to be identified. But I also spoke with two representatives from a supplier of innovative solutions to the Bordeaux wine market; the firm *E-Provenance*. To get insight to marketing and distribution, I also spoke with representatives from three négociant offices.

All in all my data sources consist of 17 interviews with 25 people, various books, booklets and web-pages and 11 winery and vineyard observations.

4.3 THE COLLECTION OF DATA

4.3.1 Experiences from a Pilot

As the interviews with the estates are considered this thesis' main source of data, a pilot interview was conducted in the vine-growing region of Wachau, Austria. I did this to test out my preliminary set approach, and see how it worked out in practice in the hope of uncovering any flaws (Yin 2009:92-95). I booked a one-hour meeting with the managing director at one of Wachau's top ten estates.

My initial thoughts for the meeting was to have an interactive and dynamic interview, where as much of the knowledge bases as possible would be revealed. I thought it would be a good idea to stage the interview at the same time we were touring the vineyards and the cellar for a combined observational purpose. I had formulated six questions in forehand, which were very concise and mainly targeted on co-operation, staff competence and recent developments. I chose a low number of questions in order to keep the respondent speaking freely.

After 50 minutes in the vineyard, the cellar was finally reached. Here the interviewee explained the winemaking process. As we had a very relaxed tone, the respondent actually controlled the conversation in many ways. When I asked questions it was often as an interruption of an on-going explanation of something else, and the interviewee answered respectfully and brief before returning to the previous topic of conversation. Many of my questions were also too closed. My relative unfamiliarity with central wine technology terms also came to be a big problem in my involvement in the conversation, and the information given to me on equipment and techniques quickly became overwhelming.

I decided to use a pen and a note pad to record the interview. That proved to be troubling. As the interview began pushing 1,5 hours instead of one, it became too much information to record and it was impossible to write anything except keywords. The thumbing between different pages of the pad to get to the prewritten questions was also very difficult and stopped the dynamics of the conversation. However, not all was catastrophic and I still believe that a semi-structured approach is the best way to go about. By not setting the frame of the interview too strict, the respondent illuminated important aspects I did not think of myself in forehand. The information, though not always relevant, was very useful and thoroughly elaborated. But it is all too obvious that this type of interview demands more control of the situation from the

researcher's side. The main challenge was the confusing mixture of observation and interview, the lack of a tape recorder and the shallow preparation prior to the visit, which really affected my abilities of leading the conversation.

4.3.2 Interview at the Châteaux

Thanks to the reviewed literature I felt I had a good idea of where to look for the main distributed knowledge bases. But the pilot taught me that there is probably many links that would be difficult to foresee. I therefore considered it important to avoid too many pre-fixed and closed questions when talking to the estates. If I were to ask too many specific questions, the respondents would probably answer these, but maybe avoid talking about other important aspects of their work. A broad and open interview guide would give the interviewee a possibility to weigh what they find important and to construct some of the framework themselves (McCracken 1988:40). Unstructured interviews in complex and unclear situations may provide rich information (Punch 2005:172). However, I needed to limit the theoretical area in some way, and in order to extract more relevant data I sent all my interviewees a 5-slide Power Point presentation in forehand to explain the objective of my research without going into too much detail.

I prepared thoroughly before the interviews by studying key terms in the wine production process in both French and English. I really came to understand the process of making red wine and acquired information on production facts, market positions, context and background of each producer interviewed. As the interviews were conducted in English, which is a second language for both the interviewee and myself, I pursued a clear use of terminology as well as an uncomplicated language (Punch 2005:176-78). I was never under the impression that there were any considerable misinterpretations from either side, and I returned the transcriptions for approval as well.

I largely tried to control the topics of the conversation, but did my best not to be leading. I started all interviews with an easy-answering question, which aim was to relax the interviewee (McCracken 1988:34) and to get their own take on how they produce wine – a question that also immediately made clear what aspects of the production the respondent emphasised. It gave me multiple facts I could follow up. I possessed a sheet with main topics and themes that I wanted to discuss, and could easily re-guide the conversation if it became too irrelevant. I also had specific

questions under each topic, but only as an orientation for myself; I checked off the sub-questions when I felt the interviewee had answered them sufficiently, and returned to the topic if I thought that too many sub-questions remained unanswered. The topics I chose to structure the conversation by was: technology, co-operation, employment, R&D, recent developments in production and market.

The interviews were arranged as a sit-down conversation at the interviewee's estate. The practical complications experienced at Wachau of walking around, made this choice very easy. In this way everybody could focus on the conversation, and I could easily use a tape recorder and had good enough control to ask follow-up questions. After the interview (or sometimes before), I asked for a tour of the cellar. This was never a problem, and usually the respondent themselves initiated it. I finished off by discussing general trends in the market, before asking estate-specific questions based on documentary data retrieved on the individual château in forehand. I always tried to get the interviewee to present examples if possible. Other than that, the respondent was free to discuss the themes and aspects of choice and could elaborate what was deemed as relevant. By doing this it was easy to determine what the interviewee implicitly held as important.

4.3.3 Interview with BEM, E-provenance and Négociants

BEM and E-Provenance are of a different character than the producers, and an interview as unstructured as the one conducted with the estates would probably not give me the information I was looking for. I shortly briefed the respondents on my research before conducting the interviews. I used the same techniques and procedures as with the estates, part from my questions being more targeted and closed. At BEM I wished to know more about their research, education, applied research, co-operations and links to research institutions national and abroad. At E-provenance I desired insight on technology development, market characteristics, competition amongst suppliers, business development, R&D, employment and networks. Both E-Provenance and BEM were interviewed at my first day of arrival, before I visited the châteaux. This proved to be good. Much of the information I got from these interviews was very enlightening, and made me rethink some parts of my interview guide for the châteaux.

Some of the interviews with the négociants were held in less ideal circumstances, but I have evaluated the information used in this thesis as reliable and

valid through convergence with other data sources, though some information I had to discard. The nature of the first communication was rather informal. There was no interview, only a loose conversation about topics of my choice. I met the representative in the evening in Bordeaux centre at a restaurant. This person did not have time to meet with me outside these hours. Regardless of the setting, the meeting made me able to see the most prominent controversies in the distribution chain and between the various parts of the sales system. I recorded all my thoughts and the information I had received when I returned to my hotel. I communicated with another representative by e-mail, as the respondent was not able to meet with me in Bordeaux. Here I was able to ask more targeted questions, and got concrete answers in return. This type of communication may have modified the respondent's way of expressing herself as the answers could be more thought-through due to the nature of e-mail communication. The last communication was with various employees at *Bordeaux Wine Bank Group*. This was done both by mail, and by two separate informal meetings in Bordeaux centre.

4.3.4 Observations and Document Analysis

I have gotten to know the industry well by just participating in wine events, talking to wine retailers in the city, going to wine museums or just by walking in proximity to the vineyards and watching the workers conducting their tasks. Wine is such a big part of the culture of the city, and you cannot really understand what the industry is about without spending time there. But apart from these constant "coincidental" observations, planned observations were also made. This was the observation of the estate wineries. The rationale behind asking permission to tour the cellar was to see the technological apparatus myself and to get a better impression of the process and the techniques used. I went along with a completely unstructured approach (Punch 2005:179-80). I did no pre-categorizing. I was observing to enhance my understanding, not to quantify or deliberately search for certain devices, though I knew what to expect on the background of the interviews, and I did simple counting of selected equipment. When I was back in my car I immediately recorded my impressions from the tour, and if there was anything in particular that caught my mind. I also took pictures with my phone at several occasions if there was some equipment or work I wished to remember in greater detail. The use of a video camera was

evaluated, but rejected as I thought it to disturb the talk with the guide and my own ability to "experience" the cellar.

I have gathered documentary evidence on all my sub-units, and on the industry as a whole. The documents have mostly been in the form of web-pages and have primarily been used to add or confirm the information received from the interviews or as background material in preparing for the interviews. I chose to use documents as a supplement because it is a less time consuming type of data collection and it had the potential of giving me very rich data (Punch 2005:184). I feel that reading documents as an additional source of data strengthened the validity of the evidence based on the concept of triangulation.

4.3.5 Access to the Sources of Data

It is a known fact that it can be very challenging to be admitted to many of the top châteaux as a visitor, and sometimes even impossible (Clarke 2006:60-61). Though many châteaux have a more welcoming profile now-a-days, it was nevertheless important to find a safe access to the respondents without ruining the opportunity by contacting them personally first.

In September I attended the *Bordeaux En Primeur Tasting*, which is held in the Oslo Opera House every year. Here many prominent châteaux are attending to present their wine to the Norwegian market. I was privileged enough to get in touch with the event-organiser, *Bordeaux Vinhandel*, a Norwegian wholesale merchant with the largest portfolio of high-end Bordeaux reds. After an hour I found myself in the company of four representatives of the firm, including the founder and CEO, and the Norwegian Managing Director. They immediately, and with great enthusiasm, agreed to help me establish contact with my châteaux of choice. They thus booked all my meetings with the estates through their Bordeaux department. *Bordeaux Vinhandel* is a part of the company *Bordeaux Wine Bank Group (BWB)*, which is a négociant and holding company with worldwide offices. The contact with BWB was vital for the data collection of this research. They established contact with the most important estates in Bordeaux – estates I never dreamed of getting admittance to. In fact, I was told that the schedule put up for me was indeed "extremely unique". By specifying which regions and types of châteaux that I wished to target, BWB made contact with the estates and made an overall schedule for my stay.

4.4 BIASES AND ETHICS

4.4.1 Possible Biases

I believe that certain biases are unavoidable when conducting research, especially when social interaction is part of the data collection. How I am perceived and the personal impact I have on the people I interact with will probably affect the information I attain. It is not easy to pinpoint all the possible biases, but I have strived to minimise the risk of the ones I see as most prominent.

I considered the following aspects before, during and after the data collection: flaws in the selection process of sub-units and data sources, influence on which data was extracted (e.g. leading questions), misinterpretations of the data, poorly articulated questions, bad evaluation of my own reflexivity and manipulation of events (Yin 2009:102). I tried my best to decrease the risk of these biases by being aware of them and assessing them in the different stages of my collection. My subjective feeling is that I have managed to minimise these biases to the extent this type of research allows. Some might describe the interview with an executive manager as an "elite interview", meaning that the interviewee and researcher consider themselves in a hierarchy to each other (Punch 2005:173). Issues of distrust may cause negative effects in an elite interview. Though a loose and informal conversation is challenging in itself, I tried toning down any perceived hierarchy between the respondent and myself (Ibid.). Therefore I always made an effort to look representative, tried to use French wine terms when I could, to come off as interested and make sure to follow proper etiquette.

The role of BWB can in some respects be deemed problematic (Hammersly & Atkison 2007:58-62). Without BWBs help, access to the top producers would be difficult and perhaps impossible. Even though it was a necessary contact to have made, possible downsides with this relationship must be outlined. Firstly, the producers contacted by BWB will most likely consider them an important partner, a view that might be extended to the character of the researcher – me. This means that the producers may not have shared business sensitive information with me if they see me as a part of BWB, or are afraid some firm-specific information might leak. Though I did not feel this was the case, one cannot reject the possibility that some information may have been withheld. Secondly, it might rise a "patron-client" relationship between the researcher and the contact. This can affect the independence

and autonomy of the researcher (Hamersley & Atkinson 2007:59). Despite the importance of not breaking BWB or the estates' trust, a "patron-client" relationship cannot be said to have existed in this case, and BWB respected my choices, approaches and conclusions fully.

Evaluating information on the web also has its challenges. I have made an effort to evaluate the context in which all documents were written, how they are intended read, for what means they are written and their relevance to my research (Punch 2005:185). All these factors have affected my perception of the data.

4.4.2 Ethical Considerations

Ethical concerns should very much be part of qualitative research because the researcher often involves herself with real persons (Punch 2005:276-77). To establish ethical standards is difficult because the ground on which to evaluate ethics is subjective and dependent on context (Blom 2011:7-9; Rindal 2011:10-13). However, Ragin & Amaroso (2009:81) mention some fairly obvious wrongs within social research: intentional publishing of fictional data, plagiarizing, mistreating people associated with the research or concealing known concerns. They argue (Ibid: 87-89), in line with the *Belmont Report*, that respect, informed consent, equal distribution of the research's benefits and burdens, and that of ensuring the well being of the involved parts is important in order to conduct ethical research. It is also stressed that the units of research must not be chosen by other reasons than that they be assumed the best sources to illuminate the case. I tried, following my best judgement, to avoid actions or choices that may be ethically questionable.

After my return from Bordeaux, I sent all interviews back for approval after they were transcribed as to not misquote or misunderstand any of the respondents. All but two transcriptions were approved, and over half wished to add or clarify information. I have insisted on anonymity for all the estates, even for the ones that agreed to be mentioned by name. I did this in order to get better data, as I thought they would open up more when they knew they would be untraceable, and to make sure I could analyse the data in the way I felt was correct, without limiting myself and having to worry about putting individual respondents in an unfortunate light. I have struggled extensively with avoiding linking the data directly up with a secluded area or classification where the estate might be recognised.

4.5 THE PROCESS OF ANALYSIS

McCracken (1988:42-48) defines different stages of the analysis process, where each new stage generates a higher level of generality. First the researcher must sort the material and treat the interviewees' utterance by transcribing. Then the material must be seen in light of the other interviews, previous literature and cultural context. The connection between these parts must be investigated before they are used to illuminate the theme of the thesis and the research question.

After I transcribed the interviews to get a clear overview of the data, I went into the text and highlighted the most obvious correlations. I did a word-recognition count to see which themes had been discussed the most, and also highlighted the deviant statements of the respondents. I wrote my own thoughts on the side of the text while reading, and worked thoroughly with the transcribed pages, not to miss out on anything. I went back to the pictures shot at the châteaux, which really helped me re-live the interview situation, the people and the tour, something that made my notes even more reflected. The information was then sorted under the main topics of the literature review. When the data from the interviews were organised, I added information from the other sources of data. I counted statements at some re-occurring topics to determine general tendencies. All in all, I have analysed in a fashion of *bricolage*, moving between various analytical techniques *ad hoc* (Kvale 2007:115), with categorisation being the most important one. Logic and rationality have again been vital factors in the interpretation of the data (Ibid:117).

During the work with the data, new themes and aspects emerged, which were not accounted for in the earlier parts of the thesis. I therefore went back to my literature review after the audio was transcribed in order to add relevant literature and themes that were not included from the start, as well as cutting out abundant and irrelevant contributions. In the analysis, I have made it an important issue in returning to the main unit of analysis – the industry. It is easy to be stuck in sub-unit level in embedded case studies (Yin 2009:52), something that would prevent me from seeing the bigger picture and answering the research question.

5. Empirical Results

The Knowledge Bases of Bordeaux

Because the distributed knowledge bases can show themselves as innovations in the receiving industry (Smith 2008), this chapter will give a descriptive presentation of the industry's main developments the last 20 years with regards to new techniques, technologies and processes. However, the latter parts of the chapter takes a more analytical form when the distributed knowledge bases of the industry are defined on the background of the prior outlined developments. The knowledge bases will be sorted by the form in which they are acquired by the industry; either as knowledge embodied in equipment or as disembodied flows of knowledge.



Figure 5.1: The most frequently emphasized words during the interviews. For illustrative purposes only.

5.1 KEY DEVELOPMENTS, TECHNIQUES AND TECHNOLOGIES

5.1.1 Soil and Vine Management

Proper management of the soil and vines is crucial in order to create good growing conditions and high-quality fruit. Close to all estates argue that the most important improvement in order to enhance the quality of the wine, is a better selection of good and mature grapes. Hence, a better selection is the main objective for most experiments, research and new efforts in the vineyard:

To ensure maturity, we [...] pick parts of the same block at different times. It all depends on the soil and the slope amongst a couple of other things. I mean, even if it's flat, some places are just more vigorous than others. [...] We are much more in the vineyard monitoring the blocks now than we were earlier. –*Owner, Pomerol*.

To attain information on the differences between parts of the soil, many estates have adapted some sort of advanced technology in monitoring their blocks. One château for example, uses a system of thousands GPS (*Global Positioning System*) sensors to assess the soil's resistivity. The system tracks the work that is done in the vineyard while giving the producer information on soil and water conditions the entire time up to harvest. This enables the estate to evaluate the development of individual parts of the plot, and pick them at different times to assure maximum maturity for all grapes. Other sophisticated ways were used to assess the soil's resistivity, and on the background of the information given, the producers separated the plots into "micro-plots", so to divide the vineyard into more homogenous areas:

We have made a map of our soil two years ago. By putting electrical impulsion in the soil, we get in return modified impulses. That enables us to determine water content. We can then cut the plots based on their characteristics. –*Winemaker, Graves*.

The most general applied technology used for monitoring the soil and to check the maturity of the vines, is by analysing the temperature of the plots with the help of infrared pictures. In all, eight châteaux are doing this. By knowing the temperature of the different parts of the plot, the producer can see which parts are maturing faster and need earlier picking. One winemaker in Graves has incorporated this technology into a very advanced system: "We use a satellite to take infrared pictures of the vineyard to see the growing and maturity of the vines. It is a quite new technique of measuring maturity".

5.1.2 Picking and Sorting

The châteaux rely heavily on chemical analysis to determine the maturity level of the grapes, and to select the right grapes at the right time. This is done at a laboratory. A representative sample from the vineyard gives the château information on the sugar and acidity levels.

Equally important to the implementation of new technology in the vineyard are past years advances with regards to pruning techniques together with the increased man-hours in the vineyard:

The major changes the last 20 years must be said to be vineyard improvements: Improving the wellbeing of microorganisms by opening the soils – improving the draining and helping them

to breath. We've also cut pesticides and minimize the use of artificial chemicals. We are now pruning more carefully as well. It's all a system of details. –*Technical Director, St. Estèphe*.

One managing director in Médoc stated that "it has been more changes in the way we work with the vines than new equipment". Evolution of vineyard management can therefore *not* be said to solely depend on new technological equipment, but also on more systematic and thorough work by the employees based on past experiences:

Pictures or not (infrared monitoring); if the *élevage* or your pruning is bad, you cannot make good wine. Rather it's about the evolution of small tings. Earlier we produced wine in an industrialised way with much technology. [...] This results in a slow cost of production, but if you are interested in making *great* wine you need people, not machines. [More labour] is usually more expensive, so one needs strong finances. [...] We have thrown out a lot of technology and do more work manually; it is probably the main reason for our increase in quality the past decade. –*Winemaker, Graves*.

Today the estates pick the grapes over a longer period of time than earlier. The different grape varieties and the different soils result in uneven ripening:

Even though your ripeness isn't my ripeness, a careful selection is needed. 20 years ago we started picking, and then finished as soon as possible, often within a week. Now we pick *a la carte*, and we often pick for over a month. –*Winemaker, St. Émilion*.

To determine the time of picking is much dependent on the analysis of the soil and grapes, but still the hands-on work seems to be equally important for deciding when to pick:

3-5 days up to harvest it is essential to taste the grapes. You can determine by analysis that you're where you want to be in acidity and sugar concentration, but the last days up to harvest the analysis doesn't really evolve, but the taste of the seeds does! –*Technical Director, St. Estèphe*.

Scientific knowledge on the quality of tannins is still lacking and the quality of the seeds, which can create harsh tannins, is difficult to monitor without manually tasting the grapes. The sub-region of Saint-Estèphe, which is known for their powerful and tannic wines, especially needs good tannins in making a balanced wine. All the châteaux want noticeable tannins, but they need them to be soft and well integrated with the rest of the wine, not bitter and green. So far, the best way to achieve this is by tasting the grapes and thus the seeds.

The concept of selection remains important, even after the grapes have been picked. A cluster will always contain bad grapes, leaves and stems. These unwanted parts of the cluster must be removed before the grapes are fermented:

We actually start our sorting in the vineyard by checking the clusters that are being picked directly. The crew can immediately see if the pickers are picking correctly (e.g. not too much leaves present or unripe clusters), so you have a very quick line of communication between the pickers and the sorters. 'Cause when you're in the winery it's too late, and it will create much extra labour. –*Owner, Pomerol*.

When the clusters are in the winery they usually go on to a sorting table. Ten of the estates have at least one sorting table, but most have double sorting tables. These are vibrating tables that help the staff to sort the grapes correctly. The first table is used to remove larger parts of the cluster that are not grapes, then the grapes are usually sent through a destemmer before they arrive at the second sorting table where a finer selection is carried out. It is not self-evident that a winery has this type of equipment as it is relatively expensive and requires the need for more workers as well. The most interesting observation though, was that four estates have implemented a so-called *optical sorting machine* in their line of production. The first prototypes of the optical sorting machine came out just three years ago, and is a machine that demands a substantial investment. As one managing director noted: "it was a 130.000 Euro purchase, and we are very privileged to have the money to buy this types of apparatus". Indeed, the optical sorting machine is quite unique:

Optical sorting tables are really high-end technology, and only the prestigious wineries are doing this. This solution is unlikely to be seen in many other food or agricultural related industries. –*Business Developer, E-Provence.*

What the optical sorting machine does is basically sending the grapes down a conveyor belt with a blue background. The machine takes pictures of the grapes and can determine unwanted objects by certain pre-set criteria (e.g. size and colour). The machine then discards flawed grapes by sending a concentrated beam of air through some of its many nozzles. This pushes the flawed grapes away from the remaining mixture.

5.1.3 Fermentation and Pressing

After the sorting, the grapes go on to be fermented. To increase quality, the majority of the producers argue the importance of separating the micro-plots and grape varieties when fermenting:

It is vital to put what is homogenous in *one* tank. I use to say: "small is beautiful" – I'll rather have small vats where I can work with old Merlot in one and Cabernet in another. This is probably the most important thing we do. –*Winemaker, St. Émilion.*

The vats that are used at the various estates differentiate a lot, and come in wood, cement and stainless steel. In the 60s, two of the first growers, Châteaux Haut-Brion and Latour, began using stainless steel vats and started a trend amongst the other high-end producers in the following decades. However, some kept their wooden vats, and today it is no consensus between the estates on what are the best materials, or if it

even matters at all. The form of the vat is either straight and cylindrical, or they narrow in at the top – creating something similar to a pyramid or cone shape. The vats that narrow in are the ones most estates seem to prefer. This has to do with the extraction of colour and tannin. If you have a narrow top on the vat, the cap of solids will become dense when it elevates, making the submergence of the cap easier when the juice is pumped over. In the cylindrical vats the ligaments spread more easily and result in a less efficient submergence. Most of the vats at the estates are in stainless steel. One winery has just returned to concrete vats after many years on steel, and another estate uses a mix:

I have these old concrete vats. I also have wood and steel. I've conducted experiments with all types of material and don't really see the big deal. I have never noticed a difference, so I use them all. –*Managing Director, St. Émilion.*

Even though the types of material might not have a big effect the finished product, other aspects have been taken into consideration when choosing which tanks to use:

In 2000 we went from wood to stainless steel tanks. It's mostly a question of hygiene. By choosing wood you take a risk with microorganisms that love to live in wood. Managing the temperature is also much more easy with the new vats, not to mention cleaning. –*Technical Director, St. Estéphe.*

This brings us to another big development the past decades, and is actually the reason why the trend of stainless steel vats became so popular in the first place; all vats are now temperature controlled, which means that it is no longer a need to cool off the tanks manually. The temperature is also controlled much more efficiently and correctly than earlier. Today, even the wooden vats can be installed with a system of temperature control. Six estates say this is one of the most important general improvements in the wineries the past decades, and it is now internalised across the industry.

Seven of the châteaux use pumping-over as the method of submerging the cap. However, a couple of the estates said that they are very careful with locking in techniques at the winery as every vintage is different: "Sometimes we push down, sometimes we pump over, sometimes both, sometimes we use one method for Cabernet and one for Merlot" (Winemaker, St. Émilion). Pumping-over has the benefit of airing the must when it is transported, but has been criticised and avoided by some as it creates unnecessary heat and pressure to the must. The latter consideration may very well be the reason for the estates' recent fondness of *gravity*. Gravity means that the juice is taken from the vat and transported to a higher level in the winery without being pumped, to then be put back again to the vat from the top, thus submerging the

cap. Hence, the must theoretically suffers less harm. This is not a straightforward process to implement: "Gravity demands a change of the whole system, and usually a brand new winery" (Head of R&D, Pauillac). Seven of the estates that were interviewed have now adapted to the concept of gravity. However, some scepticism regarding this concept still exist:

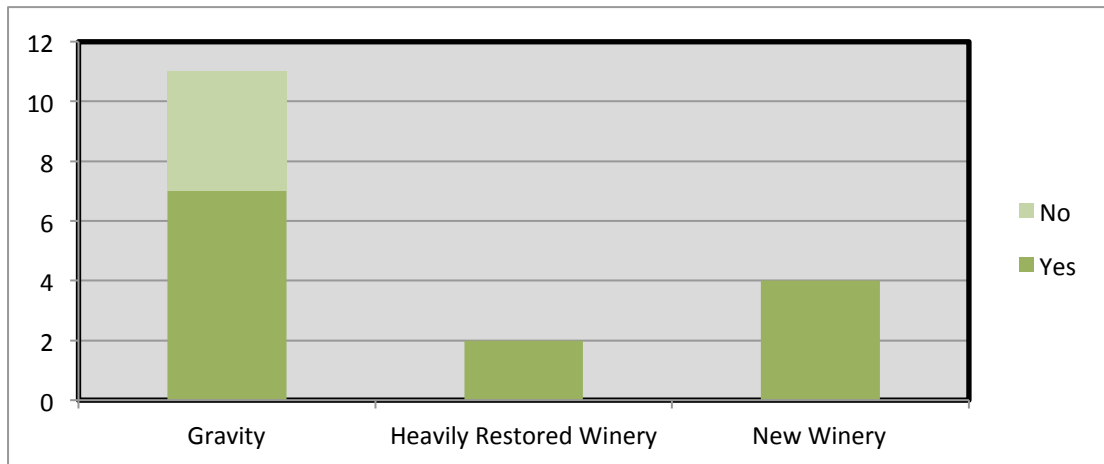
We don't use gravity. I like to stay rational, and can't really see the recent fondness of gravity. There is something strange; the grapes fall down using gravity, often up to three metres above the cap. There is still an impact. I am not convinced traditional pumping is any worse. [...] Obviously we use very light pumps and are concerned with the impact of the berries, but the change to gravity would affect so many of our processes – today I am very happy with the system [as it is]. –*Technical Director, St. Estèphe.*

Again, the producers are in a situation where they are all aware of the new knowledge, but choose not to adapt based on their own conviction and experience. It is very difficult to prove it exists a correlation between gravity and quality. This uncertainty, combined with high costs and substantial reorganisation of the winery, have stopped some estates from implementing such a system.

After the must is fermented, the maceration and malolactic fermentation begin. When this is over the must is pressed. The majority of the producers use a *horizontal pneumatic press*. This press fills a rubber bag/blade with air and presses the must with low pressure. It is probably the most sophisticated pressing equipment commercially available on the market today.

5.1.4 Organising the Winery

The layout of the winery and its processional connection to the vineyard is of great importance in order to secure a rational way of working. It also reduces the risk of errors and the risk of damage to equipment and personnel, provides good working conditions and enables future adaptations of new techniques and systems. Bordeaux revealed a large amount of new or heavily restored wineries. Six of the estates have renewed or built a new winery in the past 10 years. The new wineries are, modestly expressed, monumental and built in a very modern style with the newest technological equipment and clever architectonic solutions. One important reason for the heavy upgrading is the adaption to the concept of gravity. Five of the seven estates (71%) that now use gravity have also renewed their winery substantially. See graph 5.1. In all, six wineries are new or restored with *one* estate starting the building of a new winery in 2012 (unfinished winery is not depicted in graph).



Graph 5.1: Implementation of a gravity-based system of production, and new or heavily restored wineries the last 1-10 years.

The concept of gravity demands a high distance to the ceiling, conveyor belts or elevation systems and a rearrangement of equipment. One estate has taken the concept even further by excluding pumping mechanisms completely from the *entire* line of production:

[...] We probably have the most modern winery in the world since we have the ability to conduct the vinification from the harvesting to the bottle without any pumping at all. We use only the flow of gravity. –*Managing Director, St. Estéphe.*

The system of gravity has triggered some estates to build new wineries, but it is certainly not the only change that has happened in the winery. The place is now much more spacious than earlier, and the humidity and temperature in the various areas of the winery are controlled using different material textures, levels and ventilation systems. This creates natural drafts and temperature zones without the use of heating equipment. The new wineries demand little heating and electricity, and one winery actually run on 100 per cent solar power, while another one has attained a prestigious environmental classification. The new buildings have also been built with considerations to the working conditions of the employees. Since it is difficult to get qualified staff, the châteaux are very preoccupied with avoiding injuries and bettering the conditions for their workers, for example by optimising the lighting in the cellars: "We have three special developed light settings here. These settings will give the workers optimal light when operating the cellar, in addition to one setting for visits and one for safety" (Managing Director, Pauillac).

5.1.5 Marketing and Sales

After the wine is bottled it is to be exported to the market. It is here the négociants take over:

Making wine and selling wine require different skills. There was a traditional separation between these two professions in Bordeaux, and is much of the reason for its historical success. [...] This separation is not as clear any longer. The estates must now combine two professions [...]. Before they were farmers, now you can see one brother doing the marketing and another tending the vineyard. –*Professor, BEM.*

Much of the increased activity on the marketing front is triggered by the developing and expanding market. As the supply of Bordeaux high-end wine is pretty static, the top estates are increasingly interested in getting in closer contact with the consumers and preserving the wine's quality throughout the distribution chain:

Honestly, the increasing market is becoming a problem for us. [...] The key issue for us has been to be more targeted on which parts of the market we supply and that the wine maintains its quality on the way. –*Sales Director, St. Émilion.*

The majority of the respondents had "just come back from Asia", and traveling has become a vital part of the new effort in communicating directly with the consumers and the new markets:

It has become increasingly important that the producers deal with the market themselves the last 15 years. I am physically in Asia every month, and we were the first to open a representative office in Asia three years ago. We have now been followed by three other [high-end châteaux]. –*Managing Director, St. Estèphe.*

Before, if you look at who was traveling around the world, you could maybe write down 15 names. After the last 5-6 years you can easily count as much as 200 representatives travelling all over the world promoting their wine. –*Managing Director, St. Émilion.*

But why are the producers traveling so much when the system of négociants is so rigid? The main reason for the increase in travel is to make consumers aware of the brand, as well as gaining enough knowledge about the market to instruct the négociants where they wish their wines to be distributed and how. It is obvious that the relationship towards the négociants is more dictating now than earlier, and indications of a turmoil is visible:

We are demanding higher standards of our négociants. We have actually fired many of them, and rather distribute more cases to the ones we are happy with. [...] We visit them at their offices and get to know their way of working. If we don't like it and they don't wish to change, then that is fine and we just distribute more to the rest. –*Sales Director, St. Émilion.*

Wine is easily ruined by shipping and transportation because of the lack of temperature control. By knowing the négociants better, and securing that the handling of the wine is done properly, the estate can ensure quality all the way to the consumer:

Did you know that the majority of Bordeaux wine that is sold in Bordeaux comes from the States? It is shipped abroad when it's sold en primeur, and imported back by the town retailers later on. The chance of bad bottles is considerable because of this. –*Négociant*.

This year (2012) one of the first growers, Latour, pulled out of the en primeur system, and stated that they now wish to release the wines directly from the château when they are approaching their "drinking window", or when the estate itself sees it fit. This is a move away from the mainstream, a differentiation, leading the way once again (as was done for stainless steel tanks). The château is pulling out because they have lost faith in the sustainability of the en primeur system, and because by holding on to the bottles themselves, they can more easily guarantee provenance and the quality of the wine (Liv-Ex 24.04.12). The latter concern, ensuring unspoiled wines in the consuming market, has been of increased importance for the high-end estates. It now exists shipping companies and other firms that can help guarantee a temperature controlled shipping to prevent spoilage. An example of such a company is *E-Provenance* that provides a solution to this problem by offering an information system based on radio-frequency identification (RFID) temperature tags that are placed on the cases or the pallet that is to be transported. This gives data feedback and constructs a system of information for the seller and buyer to use. The négociant office Bordeaux Wine Bank (BWB) is basing their whole business model on guaranteeing proper storage and provenance through this type of technology and service. As an investor, these wines will make sure for an easy re-sell, and for the traditional consumers it guarantees an undamaged wine.¹⁰ The technology is in rapid development:

The new RFID tags have the capabilities to record data up to 15 years instead of the earlier capability of 9 months. We are able to deploy humidity data and the sensor is able to work with NFC (Near Field Communication). The tags are smaller and the consumers can read NFC with their mobile. –*Ingenieur, E-Provenance*.

More types of technological solutions are being extensively used in promoting the industry's wines. Another example would be the wine retailer *Max Bordeaux* in the centre of Bordeaux, who attaches QR-codes¹¹ on the wines they sell to give the buyer immediate access to tasting notes and information. Multiple retailers and restaurants are also beginning to give private customers the opportunity to taste wines before buying, by placing the wines in an air-tight machine that injects a layer of

¹⁰ The wine can of course be damaged in other ways than by temperature fluctuations, such as by oxidation and flawed cork.

¹¹ *Quick Response Codes*. Can be read with a smart phone and will direct you to a web page or similar.

nitrogen on top of the wine after pouring. The wine can then stay in the machine for up to 20 days without going bad. Max Bordeaux uses multiple such machines, and is able to offer all the high-end Bordeaux châteaux, which retail for hundreds of Euros, by the glass. This is an important innovation in doing exclusive wine more available for the consumer. The producers themselves are also concerned with reaching a broader consumer group, and all the châteaux now have so-called *second labels*. This is wine that often consists of grapes from younger vines at the estates, and is sold considerably cheaper than the château's main wine. In addition to expanding the consuming market and making money on the lesser vines, it also increases the quality of the main wine as the estate can now afford to be even more selective of what goes into the first label, as the lesser grapes provide income as well. The producers have also dramatically upgraded their websites and are active in various social media. It is no longer than 5-10 years ago when the majority of the producers did not even have a website.

5.2 DISEMBODIED KNOWLEDGE BASES

In this sub-chapter the disembodied knowledge bases of the industry are outlined on the background of the industry's recent developments presented above. The suppliers of knowledge are grouped together based on their features and what type of knowledge they provide to the industry.

5.2.1 Internal R&D and Laboratories

It is no surprise that the intramural R&D intensity in Bordeaux seems to be low, as has already been suggested in chapter 2 (Smith 2005). Only four of the estates have their own laboratory or research department, and hence a structured approach for R&D. The departments are fairly small with approximately 1-2 employed researchers. One department being an exception with 8 employed researchers, but this department is doing research on behalf of multiple estates through a large international wine group. All departments have multiple projects running, and the largest R&D department has an average of 20 projects a year:

The last years we have mainly focused on tannins, but we also do research on: water, soil analysis, optical grape control, cork variations, aromas of barrel during ageing, pesticide and oxygenation during all stages of production. Most important still is maturity control of the berries, which we have followed since 1986. –*Head of R&D, Pauillac.*

The research conducted at the R&D departments is mostly of a chemical and oenological character and is done in laboratories. The remaining châteaux that do not have their own laboratory, are all using various independent laboratories within the Bordeaux region, or through laboratories affiliated with consultants or educational institutions. The primary task of the laboratories is to control the maturity of the grapes and to run sample tests from different vineyard plots. The reason some châteaux do not have an internal laboratory is not that they cannot afford it, more than that they feel the payoff is poor:

We used to have one (internal laboratory), but I've stopped that. Because if you have a lab, you will never be in front of the research. You cannot keep the development up as the bigger labs and technology companies. –*Managing Director, St. Estèphe.*

You know, it's too difficult to stay up to date. Equipment and knowledge changes so fast, so it's easier to partner up with somebody who can follow these changes. –*Managing Director, St. Émilien.*

We certainly get the impression that the availability of new knowledge is high, and that many estates feel it necessary to outsource much of the R&D activities. This is the type of rational outsourcing which is mentioned by Robertson and Smith (2008b:3), and many châteaux view an internal laboratory as something that will prevent them from getting the best knowledge available.

The other main activity for the R&D departments is testing and experimenting with new techniques and equipment. This is also done where an R&D department is absent; multiple estates are actually in the possession of other, less prestigious châteaux, which they use as a test site for new equipment and processes. Only if it is successful there, will they think of implementing it to the main estate. Testing different types of machines and tasting the results are very big parts of the development activities in order to determine the best purchase with the aim of enhancing quality and efficiency:

We know many people have worked here before us. Sometimes they didn't have the scientific knowledge as we do, but through experiments they made good decisions. We do a lot of experiments, but always with respect to what we already have. So we want to test it, re-test it and test it again before we decide to change anything. –*Head of R&D, Margaux.*

It is essential for the producers that new techniques and technology do not compromise the quality or consistency of the wine. The estates are unwilling to gamble on new methods of production if they are not absolutely certain of the positive effects. As was said by a technical director in Saint-Estèphe: "We manage 95 hectares. Once you've decided to change something it has such an impact on everything". This

focus on testing and experimenting indicate that the industry is based on a synthetic knowledge base (Asheim & Gertler 2005:295).

Three of the four R&D departments are at châteaux that have some of the highest "price-per-case-average" of all the estates interviewed. The remaining fourth estate is part of a financially strong wine group; in other words, very economically strong estates and market leaders. They all hold their financial situation as the key reason for their effort in the field of R&D, and they also express a certain collective responsibility for the development of the industry in its entirety. One department is conducting environmental research on behalf of their own estates, but at the same time co-operate with the CIVB in similar studies for the whole of the industry, and sharing their own experience and results in doing this. In fact, privacy of the research results seems of less importance:

We know we will have first-hand results of the research, benefit directly from this and be able to make use of it very quickly in our cellar. But most of the time we don't want our results to be private. We recognise our privileged position in the industry and want to contribute to research on this field. Each producer has a different terroir, and the challenge to apply the new research to the individual estate is a challenge no matter the general knowledge. –*Head of R&D, Margaux.*

Even though the R&D departments conduct a lot of analysis and experiments, the implicit objective of the departments is to be up to date on new techniques and developments in wine and vine and thus taking the role of a gatekeeper (Cohen & Levinthal 1990) – knowledgeable of external research and testing theories against the estate's own line of production:

This department was established in 1999 in order to have someone to be in contact with the research front and new knowledge, and to do experiments and test new techniques we might be interested in. –*Head of R&D, Margaux.*

5.2.2 Regional Research and Educational Institutions

Just as Kunc & Tiffin (2011) discovered in New World wine industries, also in Bordeaux does research institutions work closely with the producers and contribute to problem solving and exploration of new techniques and processes. When the interviewees were asked to explicitly name the research institutions they had current or past affiliation with, three institutions were mentioned. They were (sorted by frequency): The University of Bordeaux, BSA and BEM.

Université de Bordeaux

It is one educational institution that all of the estates have some kind of affiliation with – the University of Bordeaux. More precisely the *Faculté d'Oenologie*, which was founded in 1880. Historically the Faculty has been immensely important in stimulating innovation and providing new knowledge for the Bordeaux' wine industry. Louis Pasteur, an early professor at the Faculty, found microorganisms to be the reason why wine went bad, and is by many viewed as the father of micro-biology and the founder of scientific oenology (Robinson 2006:92). Since then the Faculty has contributed to much new insight in wine production, for example by enhancing the scientific understanding of the fermentation process and introducing the concept of malolactic fermentation (Patchell 2011:60-64). The Faculty does not only conduct general research, but a great deal of applied research as well, and the estates often turn to the Faculty for laboratory analysis, research projects or advice. As was said by a managing director in Saint-Émilion: "When the task becomes too immense for my own lab, I turn to the Faculty". The importance of the *Faculté d'Oenologie* cannot be overstated, and it should be considered the biggest supplier of viticultural knowledge to the industry. All the five first growths make unified investments in research projects of their choosing – funds that usually find their way to the Faculty. This is done well aware of the fact that the University will publish the research, so that the results based on the first growths' investment are accessible for the whole industry. One of the first growths also finances a PhD every third year at the *Faculté d'Oenologie*. However, the co-operation between the estates and the University is not always official. Even though many châteaux participate in joint research projects with the institution, a couple of estates wish to keep the contact informal:

I am very careful with any written agreement with research institutions. We could have contracts, but I prefer not to. But we do indeed co-operate – just no contracts. –*Technical Director, St. Estèphe.*

We collaborate much with l'Enita (now BSA) and the University. Not formal though. But I am for example still in frequent contact with my old professor [at the *Faculté d'Oenologie*]. –*Owner, Pomerol.*

Bordeaux Science Agro (BSA - former ENITAB)

BSA was mentioned explicitly as a problem solver at five estates. It is a public educational institution that specialises in agricultural research and technology transfer. It has 12 research units, where multiple of these units exclusively conduct research on vine and wine. It is under the authority of the French government and is governed by

a board of directors. The chairman of the board that administrates this institution is Bernard Farges, who is also president of the *Union of Wine AOC Bordeaux* and *Bordeaux Supérieur*. The institution thus has a natural connection with the whole Bordeaux industry, including the low-end.

Bordeaux École de Management (BEM)

BEM is also an important actor in wine research, though they have a different role than the University and BSA. BEM is conducting research on the marketing and management of wine. BEM has a transversal team consisting of different academic backgrounds. BEMs general research on the wine sector started just 10 years ago, and today the Wine & Spirit Business Research Group consists of 14 researchers. They have projects on: wine marketing and economy of wine, distribution channels and online sales, wine supply chain/logistics and wine tourism, investment in wine as well as on the social aspects of wine management.

We collaborate with many SMEs (small and medium enterprises) of the wine sector in Bordeaux, and certainly with famous great châteaux and wine merchants. Most of them have long-standing tradition of working with specialised consulting companies on marketing issues.
–Professor, BEM.

After the estates' increased effort within marketing and communication the past decade, the importance of BEM and other analysis companies is likely to grow even further.

Institut National de la Recherche Agronomique (INRA)

This institution was not mentioned explicitly by any of the interviewees, but is still assumed to be an important actor in the industry (see chapter 5.2.3). INRA is a public research institute. It primarily conducts applied research on competitive and sustainable agriculture and is under authority of the French Government. The institution is national, but has a separate research centre in Bordeaux to support the agricultural industry of the region, where one field of research is on vine and wine. It separates itself from the character of the other institutions mentioned, as it is not per definition an educational institution.¹²

¹² Though it offers training and other forms of education in partnership with the University of Bordeaux.

5.2.3 A Research Cluster

INRA is represented in an even bigger institution along with the University of Bordeaux, BEM and BSA. That institution is *Institute des Sciences de la Vigne et du Vin* (ISVV).

ISVV was founded in 2002 by various political institutions of the Aquitaine region, the French Ministry of Higher Education, the EU, CIVB (see chapter 5.2.5) and INRA. In 2009 it opened its brand new 10.000 square metre building complex at the site of INRA and is the largest R&D-centre for wine in Europe. ISVV was created to gather and organise the effort in research on vine and wine in Bordeaux:

A lot of knowledge exists in the Bordeaux wine industry and I think the government wanted to co-ordinate this in ISVV. The industry goes back 500 years, and so does the knowledge, so it is nice to gather all the accumulated knowledge at one place. The knowledge is still spread, but at least it's an attempt to gather it. –*Professor, BEM.*

ISVV has its own research projects, where they gather scholars from various institutions in Bordeaux. They also offer PhD programmes. A research institution can apply to have their projects financed by the institution, and if the application goes through these projects also become part of the ISVV portfolio. This is an easier way for small actors to get funds compared to applying through the national system for grants. The institutions and departments that constitute ISVV are:

- Bordeaux 1 University (Sciences & Technology)
- Bordeaux 2 Victor Segalen University (Health & Life Sciences)
- Bordeaux 3 Montesquieu University (Humanities)
- Bordeaux 4 Michel de Montaigne University (Law & Economics)
- INRA
- BSA
- BEM

In addition to these members, ISVV co-operate with several national and international research institutions, laboratories and universities on project basis.

ISVV came up in many of the interviews as a key partner for research activities. ISVV is now financing a large part of the research on wine in Bordeaux:

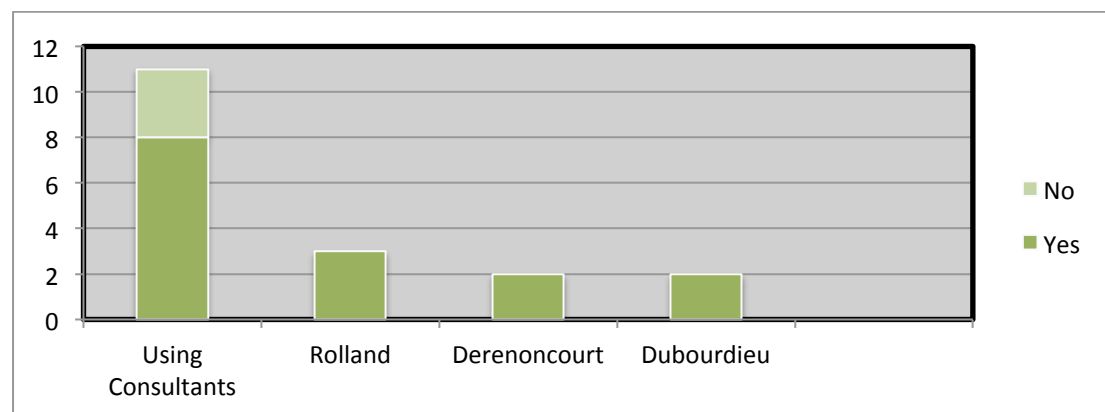
If we would like to apply for money [for our projects], we should go through the ISVV. ISVV gets plenty of money from the region, and so ISVV can pretty much decide which projects goes through. –*Professor, BEM.*

The ISVV is therefore the spearhead of a common research and development effort for the whole industry. What is unique is that it does not only offer general wine knowledge to the whole national wine industry, as has been argued to be the case of a similar effort in Australia (Aylward 2006), but it offers region specific knowledge

deducted from a broader knowledge base of regional, national and international co-operation. If we take Aylward's (2006) study into account, it will give ground to argue that the ISVV may very well be an important reason for the Bordeaux estates' success in maintaining individuality and consistency. By providing region-specific R&D that is held to better express terroir and typicality, it satisfies the sophisticated wine consumers.

5.2.4 Consultants

The use of consultants is very common at the estates. Three consultants were repeatedly mentioned at the interviews: Michel Rolland, Denis Dubourdieu and Stéphane Derenoncourt.



Graph 5.2: Eight of the estates have permanent consultants and some of them even have multiple ones. Rolland is used at three different estates, and Derenoncourt and Dubourdieu are used at two different estates each. Other consultants are also used in addition to these three names.

Consultants can work on different aspects of the winemaking. Some are hired to give advice on the whole process and some only for vineyard management or *ad hoc* activities:

We don't have a consultant, but we probably will. [...] I would love to have somebody who can work with us on the blend (making the final blend mixing different varieties and plots). It is good to work with someone that is not used to taste the wine every day. Your palate quickly becomes immune to your own wine. –*Technical Director, St. Estèphe.*

The estates may work with consultants for different reasons, but one obvious reason is to broaden their knowledge by benchmarking and comparing themselves to other producers in the same region or abroad. The consultants travel all over the world and have many employers, so they have the possibility of comparing how different estates conduct their vinification, and in this way tailor and relate a larger set of knowledge

bases to the individual châteaux. This is difficult for the estates to do themselves: "I have enough to do with my own château, and have no time looking to the neighbour to see what he is doing. A consultant can contribute with such insight" (Managing Director, Pauillac). The consultant also has highly upgraded knowledge on the newest techniques and wine equipment:

People use consultants to increase quality. To become fully up to date in the vineyard or in the vinification process, consultancy can provide good and reflected advice. –*Managing Director, St. Émilion.*

The [infrared] pictures from satellites (to determine temperature of the vines) were actually Mr. Rolland who first presented to me. He just came back from Napa (California) where he'd seen this technology being used. –*Winemaker, Graves.*

So, who are these infamous consultants?

- Rolland is probably the best-known consultant, owning multiple vineyards himself and conducting analysis for hundreds of estates in his Bordeaux situated laboratory. He has his background from oenology studies in Bordeaux and advises over one hundred producers worldwide (New York Times 2006).
- Derenoncourt started his consultant activities in the late 90s and has no academic background. He started as a vineyard worker and worked his way in to the system from that. He mainly does consulting in Bordeaux, but is also hired by many US estates (Jancis Robinson 2004).
- Dubourdieu is currently a professor at the Faculté d'Oenologie and is an active publisher of research both through the ISVV and the University. He consults mainly in Bordeaux, and, as Rolland, is also in possession of his own vineyards and a laboratory (Decanter 2004).

Two of these individuals are thus from an oenological background and one is self-taught. The now deceased and famous professor Émile Peynaud started the trend by consulting the châteaux while conducting research at the Faculty, and today there are multiple such consultants operating in Bordeaux in addition to Dubourdieu (Decanter 2004). The consultants should be regarded as local superstars in the industry, and they are assumed to be some of the highest paid individuals in the wine world (Jefford 09.04.12). What is interesting is that the portfolio of these three names largely consists of well-renowned châteaux, or rising stars. It is tempting to consider these consultants as vital gatekeepers for the high-end industry, contributing to a higher absorptive capacity (Cohen & Levinthal 1990; Von Hippel 2005).

5.2.5 Négociants, CIVB and UGCB

The négociant is an essential partner and adviser on marketing and sales for the producers. Négociants develop new approaches to the consumers and are finding new ways to sell the wine. The brokers, as the link between the négociants and the châteaux, are also held to be of importance:

[...] without these "witnesses", the [négociant system] might be different. The brokers are much closer to the château than the négociants, and his advice on the market and pricing is very trustworthy. –*Technical Director, St. Estèphe.*

Like the consultants, the brokers have a broad experience with different châteaux in both the low and high-end parts, and can therefore give reflected information on pricing strategies and other aspects of the sales.

Négociants and brokers are not the only actors giving input on marketing. In addition to BEM, other schools and institutes are also involved in market research:

I heard that château Latour had hired higher graduate students from one of the most well-renowned business schools in Paris in order to develop new marketing strategies. –*Négociant.*

The intensity of using such partners is determined by how involved and preoccupied the individual estate is with marketing issues outside the relationship with the négociants. The estate that was most concerned with marketing and négociant relations bought as much as ten market analysis a year from external analytical institutions, while some bought none.

Le Conseil Interprofessionnel du Vin de Bordeaux (CIVB) is a managerial interest group consisting of négociants and producers, and also works much with marketing and branding. They are financed by the government and through member fees. CIVB works in favour of Bordeaux wine as a whole and wishes to improve the industry's market standing, as well as stimulate quality improvements for the regions producers by for example introducing yield regulations. CIVB provides weather, pest and disease monitoring and distributes technical information to the producers (Patchell 2011:60-64). They are constantly funding research for the industry, and are especially engaged with BEM and ISVV.

While the CIVB is preoccupied with the entire industry, *Union des Grand Crus de Bordeaux (UGCB)* is also strongly engaged in marketing, but only on behalf of the classified estates within the group. This is also an organisation based on membership, and its objective is to organise promotional events and targeted marketing – mostly towards the international market. Approximately 60 events are arranged a year, usually in the form of tastings.

5.2.6 Workers and other Wine Estates

Most of the disembodied knowledge bases that have been presented so far are supplied by local actors operating within the Bordeaux region. In other words, we are seeing considerable signs of a cluster formation surrounding the Bordeaux industry (Porter 2000; Asheim & Gertler 2005; Pavitt 1984). But multiple estates, particularly those with their own research department, do conduct joint research projects with institutes abroad. As expressed by a head of R&D in Margaux: "We have a very interesting collaboration with a research institution in Switzerland, because they do a lot of work on vineyard protection". However, most far-reaching are the research institutions in Bordeaux, which have a vast amount of partners national and abroad, just as suggested by Giuliani & Rabelotti (2011). The Faculté d'Oenology for example, has permanent partnerships/projects on wine, with universities in Terragone, Verona, Lisbon, Geisenheim, Pécs, Santiago, Stellenbosch, Davis, Adélaïde and Udine. This network makes sure of an international intern exchange. All châteaux accept a considerable number of interns a year. They are mostly from Bordeaux, but some are also from abroad:

Every year we have 5-6 students from around the world: Stellenbosch, Adélaïde, you name it. Some from France. We have many experiments here, and they participate in these. –*Managing Director, St. Émilion.*

Another way the châteaux can learn is from their neighbouring châteaux and from estates in other wine industries. Having worked or being educated in another industry will almost certainly give them a diverse experience that can help them develop their work in Bordeaux:

After I finished my studies in Bordeaux, I moved to Burgundy and worked under some of the best winemakers there. I understood that in Burgundy you work with the lees a lot, and when I moved back to Bordeaux, I thought maybe I should do that. But I don't view myself as an innovator. My grandfather did the same thing, then we stopped, now I'm doing it again. –*Managing Director, St. Émilion.*

As the turnover in employment is extremely low, some of the châteaux have consciously employed winemakers or directors from abroad, for the same reason they hire consultants:

My right hand man is from Hungary. The fact that he has never worked in Bordeaux enables him to view the production here without any predisposition. [...] it is important to have somebody here with an open mind and experience from elsewhere. –*Managing Director, St. Estèphe.*

Foreign employees are easier to get a hold of if the château is part of a bigger wine group or if they have ventures abroad. All but one estate are either involved in wine

production through different estates abroad, own multiple estates in Bordeaux or are part of a national or international wine or luxury group. Little over half of the estates have some sort of venture in the New World. New people "on the floor" along with new owner structures, can be important in explaining changes at the estates. Following Berg & Bruland's (1998) study, the movement of people between industries and across borders is sure to enhance the flows of tacit knowledge to the industry.

5.2.7 Summing Up

We see that much of the disembodied knowledge is located amongst regional actors, who form a cluster around the industry. While the knowledge relating to marketing is spread unevenly on multiple actors including the industry itself, the research on vine and wine is largely provided by regional research institutions – with Faculté d'Oenologie and ISVV being of special importance. The French government is very visible and contributes in providing a structured region-specific research effort within Bordeaux.

The consultants are suggested to have an immensely important role in the cluster by being a key gatekeeper for the industry, keeping the distributed knowledge bases available, and maintaining the industry's high absorptive capacity. The internal R&D departments can also be assumed to play a similar role as a gatekeeper, but without the ability of comparability as possessed by the consultant. Finally, experiments and testing must be mentioned as a prominent effort from the estates in hitting decisions regarding the implementation of new equipment and techniques – thus being a prominent entry-barrier for the implementation of new knowledge in the industry.

5.3 EMBODIED KNOWLEDGE

In this sub-chapter the embodied knowledge bases of the industry are outlined. Also here based on the background of the industry's recent developments presented in chapter 5.1. The suppliers are grouped by what type of technology they provide to the estates.

5.3.1 Manufacturers of Winemaking Apparatus

The winemaking process is definitely technological, though the producers of Bordeaux do not develop any technology themselves. The estates are purchasers of fixed and finished technological solutions and apparatus. Bucher Vaslin is seemingly the biggest deliverer of technological winemaking equipment to the high-end Bordeaux estates. It is a Swiss company with subsidiaries in France (three in Bordeaux) and the US, and delivers solutions all over the world with the objective of providing tools and service to the winemaker. Bucher Vaslin markets itself as a technology supplier with high oenological knowledge, and being close to the needs of the winemaker. In fact, the company has worked particularly close with two of the estates interviewed for this thesis, where the estates have been encouraged to respond on the functionality of prototypes given to them. Bucher Vaslin evaluated the feedback in the completion of the apparatus. This gives us reason to argue that the Bordeaux high-end fraction does have features that can characterise it as a lead user (Von Hippel 1986). Bucher Vaslin was without doubt the brand that embossed the majority of the destemmers, sorting tables, conveyor belts, presses and pumps found in the estates' cellars. The company is also one of the developers of the optical sorting machine and is responsible for the construction of the pneumatic horizontal press. Bucher Vaslin is part of *Bucher Industries*, which delivers a full range of agricultural equipment and apparatus all over the world, and have over 7.900 employees. German *Willmes* and French *Pellnc* should also be mentioned as important suppliers of winemaking apparatus, though were not mentioned by the respondents or observed during the data collection. They are, as Bucher Vaslin, high-tech companies per definition (Bucher Vaslin 2012b).

5.3.2 Manufacturers of Commercially Available Technology

All estates were familiar with the adaption of certain sophisticated commercially available technology, like GPS systems, electromagnetic impulsion devices or infrared pictures. These types of products are made by high-tech companies from different parts of the world, and the estates do not partake in the development of the technology. One winemaker from Graves expressed the use of infrared pictures as "a system that was already developed, which we just bought as any other available product". The technological tools are originally developed for other activities, but are

adapted for new means in the industry. For example was the measurement of soil resistivity found at one château, adapted from mining exploration.

Many solutions and pre-manufactured technological components have been installed as part of a bigger design and architectural process. Where new wineries have been built, architects have been in direct contact with multiple suppliers of technological equipment, and the solutions are tailored by the architect in collaboration with the châteaux and suppliers. One estate had worked closely with the producer of their vats in order to custom design it based on the requests of the château's technical staff. The same staff also had their saying in how the new winery would best be organised in order to rationally carry out the vinification. The architects have of course a wide contact base with other industries in order to reach the objectives of, for example, an environmental friendly building or a system of gravity:

The technology for the elevator is actually taken from the theatre business, and consist of the same mechanisms that elevate scene decorations and personnel up on scene level from the basement. During the building [of the new winery], we've worked with engineering, pharmaceutical, food and fish businesses. –*Managing Director, St. Estèphe.*

But the architects are not just working as gatekeepers (Cohen & Levinthal 1990), creating a link between high-tech suppliers and the producers; they are themselves coming up with very interesting solutions in order to build environmentally friendly and to use as little energy as possible due to the choice of material and design.

5.3.3 Manufacturers of Technology for use in Marketing and Sales

The development in marketing has resulted in many new technological solutions. In the pursue to guarantee provenance we now find RFID, NFC and information databases:

The technology we use was [developed] in the pharmaceutical industry to control shipments of drugs. Produced in Germany. [...] The database we've designed ourselves. [...] For our NFC solutions we have partnered with a pure technology company in England. –*Business Developer and Engineer, E-Provenance.*

The connection between the château and the traditional consumer is also shortened by using QR-tags and social media platforms. Suppliers of technologies in marketing are many, and can primarily be traced back to the software and infotech industry. However, many of the technologies are developed across various traditional borders of industries, as the enomatic machine (wine preserving system) that has an advanced information system along with the infusion of gas and temperature control. Primarily it is the retailers and négociants that implement and use the technological equipment

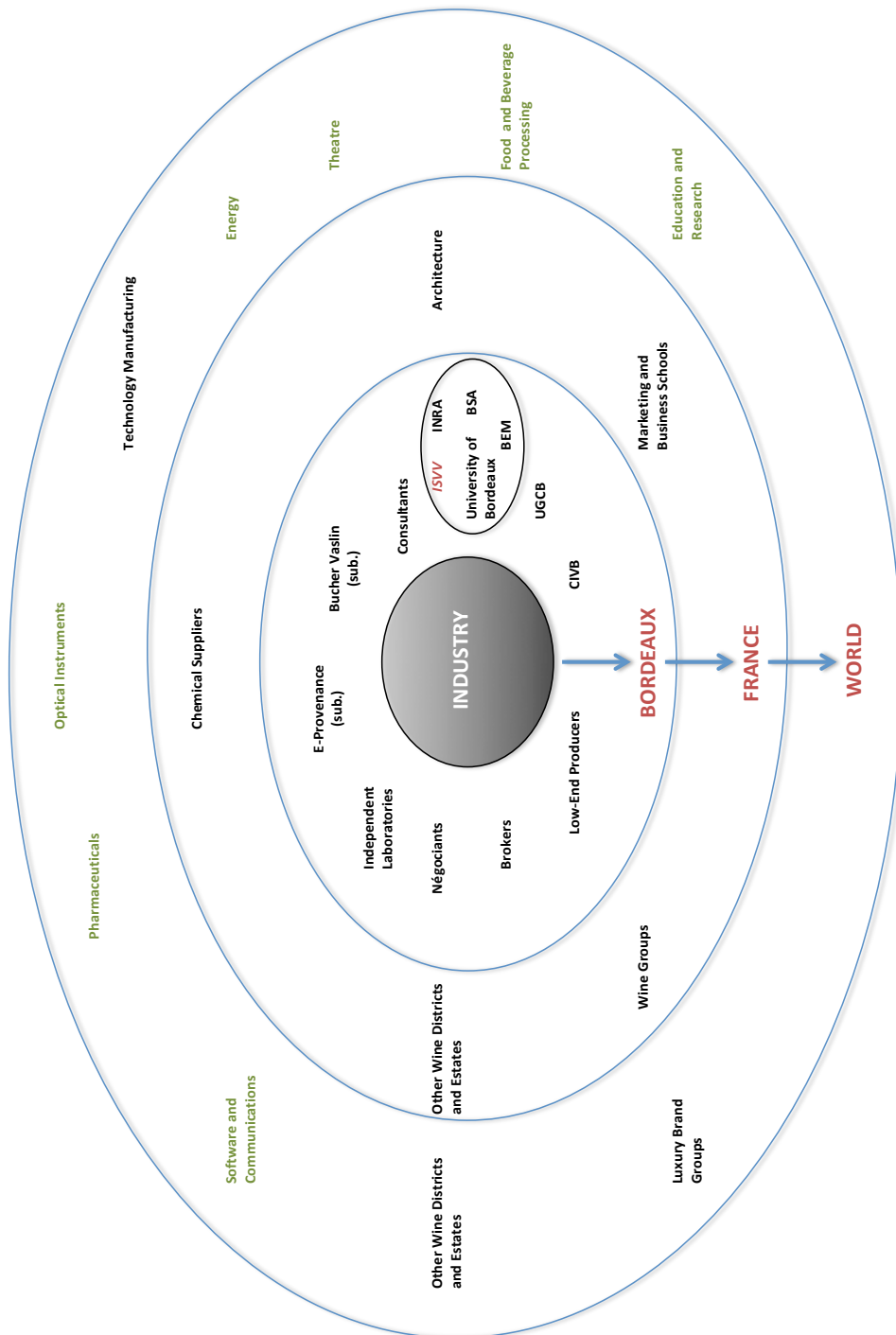


Figure 5.2: The location of the industry's distributed knowledge bases. The inner circle marks the cluster. The industry has direct access to the knowledge bases marked in black, while the larger knowledge bases of the related industries, in green, are accessed indirectly through the knowledge bases marked in black.

in marketing and sales, and it is from them the industry acquire the new solutions on how to sell and market their wines more efficiently. However, the production of the equipment is spread across the entire world, only linked to the industry via actors or subsidiaries within the cluster.

In addition to all of this, CIVB is at the moment pushing for the development of a way to measure radioactivity of the wine in bottles, so that the authenticity of the wine can be determined, as fake bottles have become an increased problem the past years. They are working close with physicists to commercialise this type of measuring.

5.3.4 Summing Up

The Bordeaux high-end industry is suggested to be a lead user in winemaking apparatus (Von Hippel 1986) based on of the fact that some estates are in close dialog with suppliers; testing prototypes and providing feedback. Because the suppliers are present in the cluster through subsidiaries, it gives us a reason to argue the industry's importance to these technology manufacturers. Regarding technology where the industry is *not* defined as the end users, these manufacturers are usually exogenous of the cluster. *Négociants*, architects, consultants and various other actors in the cluster establish the links to these industries. By outlining the embodied knowledge flows, it is obvious that links between different sectors of the economy exist (Smith 2005; 2008), and this might be a reason to argue that the industry's technological component is exogenous. It has been presented multiple examples on how developments in high-tech show themselves as innovation in the industry (Pavitt 1984).

Figure 5.2 shows the distributed knowledge bases that have been located by the empirical evidence presented in this chapter. The knowledge bases are mostly supplied by actors within the region, while the national system seems to be of less importance. The knowledge bases in green represent general industries of origin, often not having a direct line of connection with the industry. The knowledge bases in black are more specific and are directly in contact with the industry, and representing, or being in direct contact with, the international industries marked in green.

5.4 THE INTERNAL KNOWLEDGE BASE

It seems as if many of the past years developments in the high-end wine industry have been dependent on a broad set of distributed knowledge bases. None the less, it is still

a truth to the traditional view of the industry. It is no doubt that the experience-based knowledge of the employees at the estates is essential in the process of making high quality wine. As Nonaka (2007) has argued, they possess a certain deeper understanding of winemaking after years of experience, in which the knowledge cannot be expressed explicitly: "If there would be a recipe book, there would be no need for a winemaker" (Managing Director, St. Émilion). For example; knowing the behaviour of different plots and feeling the resistance when squeezing a grape gives the winemaker information that can only be understood in context with her previous knowledge and experience. The only way to know the terroir and the wine is to interact with it:

In the pumping over (remontage) I insist that my staff are to manually take part in the process. It is so that they can smell the juice when it is pumped back to the vat. Then they can smell if something is off [...]. Traditional hands-on approaches are good for expressing the terroir. New technology to express the terroir we gladly welcome, but this is a rarity. –*Winemaker, Graves.*

Hence, tacit knowledge and experience must be treated as something real and highly relevant when discussing the Bordeaux industry. This is stimulated by the nature of employment where the turnover is extremely low, and the workers usually stay their whole career. A managing director went so far as to say that: "I would actually prefer if people quit more often". A big challenge is getting educated vineyard workers for the châteaux. But the type of work allows an approach based on learning-by-doing, and the character of the knowledge the workers gain does not necessarily require previous education:

We have problems finding enough educated people to work for us, so we hire people with courage and will, and they learn, over time. Even if they were educated, they would still have to be able to make "our" wine, and that must be learned anyway. –*Winemaker, Graves.*

The vineyard workers are usually from the Bordeaux area and typically from the sub-appellation itself. It is not unusual that the worker's father had worked there before him, and his father before that. A managing director illuminated this by pointing out that at his estate "you can find up to five different people working, whom are from the same family". And even though many of the châteaux value the input from consultants, they also said that low turnover in employment is of key importance in making such consistent and high quality wine. One respondent pointed out that: "new processes and truly great innovation have nothing to do with capital or research, but deducts from a worker who thinks of better and easier ways to conduct his tasks".

The employees' tacit knowledge along with generations of learning a trade and a life-long commitment to *one* château, must necessarily result in a substantial pool of personal accumulated knowledge (Nonaka 2007). This strengthens the industry's innovative capabilities (Von Tunzelmann & Acha 2005:417).

5.5 CONCLUSIVE REMARKS

The Bordeaux region makes up a large and complex web of knowledge bases and supportive functions that guarantees substantial input to the high-end wine industry. It can definitely be argued to be a localised cluster formation in Bordeaux, where the industry connects with multiple knowledge bases. In addition to the distributed knowledge bases, an internal knowledge base that can be defined as synthetic (Asheim & Gertler 2005) is held to be of great importance for the way new knowledge is processed. It must be noted that only the knowledge bases found on the basis of this research alone are described in this chapter and depicted in figure 5.2, and it should not be viewed as an exhaustive list of the industry's knowledge bases.

This chapter has provided us with an overview of the suppliers of knowledge to the Bordeaux high-end wine industry and what type of knowledge that is required and done available. However, much is still unclear regarding how these knowledge bases are structured and implemented in the industry. The discussion in the following chapter will take aim at clarifying how the knowledge bases are transferred and implemented, and how they are processed for innovation.

6. Discussion

Knowledge Structure and Innovation in Bordeaux

In this chapter the empirical findings will be further discussed in context with the theory reviewed in chapter 2, with the aim of answering the research question set in chapter 1.

This chapter is less divided in sub-chapters compared to the previous parts of the thesis. It is done so that the discussion will flow better and for the arguments to be more connected. 6.1 deals with the structure of the distributed knowledge bases and the key features of the cluster. The distributed knowledge bases will be discussed based on content: namely as scientific input, technological input and marketing-related input. 6.2 and 6.3 are constructed on the background of this thesis' research question: "How does the high-end wine industry of Bordeaux *acquire* and *process* new knowledge?". Chapter 6.2 discusses how the industry acquires new knowledge, while chapter 6.3 presents a model on how the knowledge bases are processed for innovation.

6.1 THE BORDEAUX CLUSTER – STRUCTURE AND CONTENT

There are different systems in which innovation can be analysed (Edquist 2005), with a regional system approach being just one. The Bordeaux wine industry can be said to be a part of both a sectorial, technological and national innovation system, but the strength of the connections in the Bordeaux cluster urges us to treat the industry as a regional system of innovation. However in doing that, we are also downplaying the connections we have seen across other levels. The borders of the various systems have become very clear when locating the distributed knowledge bases, but at the same time unclear by seeing the links various suppliers have established with each others across these borders. Nevertheless, the regional ties seem to be the strongest and most prominent features of the industry, and it is primarily through this system that Bordeaux will be understood.

Many actors, supplying the industry with different types of input, are present in the Bordeaux cluster, making their knowledge available. Especially visible is the sub-clustering of research institutions organised under the umbrella of ISVV. The wine industry itself has no reason to invest large in intramural R&D when regional

research institutions and laboratories provide such extensive scientific input, which in turn enhances the scientific understanding of oenology in the industry. This goes to show that these institutions are as important in Bordeaux as they are held to be in New World wine industries (Kunc & Tiffin 2011; Giuliani & Rabellotti 2011). The French government is greatly supporting the industry by laying down the institutional infrastructure of regional wine research. This regional infrastructure is essential for the targeted and efficient knowledge flows, and accumulation of scientific knowledge in the industry and cluster alike. So, even though the producers themselves do not feel that the French government is involved with their day-to-day operations, the government is highly important for making the distributed knowledge bases of the industry available.

The technological knowledge bases, as the scientific ones, are also found outside the industry itself. But in this case the knowledge originates from even further away – outside the cluster. Still, the suppliers are almost consequently represented within the region through a subsidiary, and in this way establish a position in the cluster. The wine industry purchases technological equipment from different high-tech manufacturing industries that specialise in everything from hydraulics to optics. The technology is often purchased in that of a finished and pre-manufactured product. What is perhaps more interesting is that the industry adapts various *black boxed* technologies, like GPS or infra-red monitoring, to new functions or areas of use. They thus redefine the technology. This redefinition can in itself be viewed as innovation.

The process of acquiring winemaking equipment differs from the general black boxed technology purchases, and in many cases the industry is consulted and given prototypes for testing. This has to do with the purpose of the equipment. In contrast with pre-manufactured technology, wine equipment is directly affecting the viticulture and the industry's synthetic knowledge base (Asheim & Gertler 2005). The suppliers of such equipment cannot just sell in their product without being in touch with the winemaker's knowledge base – the estate's needs and the equipment's place in the winemaking process. As Bucher Vaslin writes on their web site:

A reliable know-how and a permanent network of field contacts enable Bucher Vaslin to find technologically-adapted and economically effective answers to winemakers' requirements all over the world (Bucher Vaslin 2012b).

Here it exists a more interactive relationship between the suppliers and the industry. Based on the data collected, the Bordeaux high-end industry can be viewed as a lead user regarding equipment and technology targeted at winemaking in particular. The

industry definitely has the money and competence to be the first users of new winemaking technology. Firms like Bucher Vaslin know this and are dependent on the expertise of the lead users in order to be competitive themselves (Von Hippel 1986).

A large pool of market related knowledge is guaranteed for the industry. Analysis agencies, BEM and other educational institutions and suppliers of market technology are all contributing with knowledge input to the UGCB, CIVB, châteaux and négociants. The knowledge bases relating to marketing are more scattered than the scientific ones, and do not seem to be structured by a similar framework. This might have something to do with the industry's long-time focus on quality enhancement, whereas the direct involvement in sales and marketing is a new turn for the industry, and it thus exists a less developed approach for this effort. In large, the general industry's interest in marketing is maintained by the CIVB and the UGCB, apart from that of the producers and négociants, who act fairly autonomous.

In accordance with the theory presented by Porter (2000), the separation between the industries of the cluster is vague. Négociants, for example, could easily have been argued to be a part of the Bordeaux high-end wine industry, even though it has been treated as exogenous of the industry in this thesis. It is little doubt that various sectors of the economy are drawn upon in order for the industry to acquire the best knowledge available, and the actors of the cluster are so internalised that even many of the high-tech suppliers are describing themselves as part of the industry. Most of the high-tech companies that were mentioned in the interviews, despite originating from abroad, are represented within the region of Bordeaux. Even E-Provenance, who makes its product in Germany and is an American company, feels it is important to be physically present in the Bordeaux region. The fact that Bordeaux is so internally open, but still so closed towards outsiders, makes the geographical proximity between suppliers and the industry important for the innovative and competitive capabilities of both parts. A regional establishment of business partners is needed in order for the suppliers to get passed the barrier the négociant system represents with regards to their influence on the producers' marketing and sales strategies. Also the conservativeness of the industry presents a barrier for outsiders in establishing direct and credible contact with actors within. Following Pavitt (1984), the importance for technology suppliers to be present in the cluster should be stressed, and in Bordeaux a presence seems vital for the suppliers in order to gain legitimacy as

well as for the industry's technical development. The empirical evidence in this thesis supports the notion of clusters serving as a key enabler of business and knowledge transfer to the industry of Bordeaux (Asheim & Gertler 2005:292-93; Castellacci 2008:980). This deviates from the study of Marsh & Shaw (2002:22-24) who's research on Australia showed that the main reason for clustering was to overcome financial obstacles. In Bordeaux the high-end industry is financially very strong and it is more likely that their role as a lead user is more important for the cluster formation and co-operation seen from this study.

As mentioned already, the Bordeaux cluster is internally very open, and one could imagine that another cluster would be characterised by more fierce competition between the producers. It seems as once you are "in", you can immediately harvest the fruits of a mutual fruitful relationship between actors. As a contrast, the external openness of the cluster is very closed and conservative. It is difficult for suppliers and new actors to be accepted by the industry as one of full value unless they are a part of the cluster. Once part of the cluster, the actor is seemingly a part of the internal solidarity and strive to maintain the position as the best vine-growing region in the world. It is pride and the region's strong sense of tradition that contribute to uphold the barrier against external actors. The general tendency in Bordeaux is that people speak together openly and share their challenges and experiences. Many of the château-owners also manage other estates in the region, and an open communication between these was of course even greater than that of the competing châteaux. This modifies Porter's proposition of "vigorous competition between locally based rivals" (2000), however, the stimuli of a cluster to push firms to innovate as the need for differentiation is high, seems to be true also for Bordeaux. The need to differentiate in quality is important, but the internal rivalry that figure 2.1 suggests does not seem that prominent. The most obvious explanation for this is the solidarity expressed by the respondents and their feeling of being part of an entity. Also, the common sense of pride and tradition that pervade the cluster, in combination with the explicit belief of many that it is the producer's knowledge of terroir that is the main factor of success. In other words, the producers do not believe the availability of information and knowledge from the distributed knowledge bases are the most important factors for success, rather than it is the art of combining the new knowledge with the estate's personal character and terroir that remains critical. This will be discussed further in chapter 6.3.

The industry's connection with the various actors in the cluster ensures a link with all types of industries – either directly or indirectly (see figure 5.2). The industry deals directly with some of the technology suppliers in the cluster through subsidiaries and thus has a non-fragmented line of connection with these industries. The same goes for the industry's connection to the regional research institutions and négociants. In addition to these links, it exists extended links that goes via the industry's direct connections. The ISVV, for example, is in contact with related agricultural and chemical industries such as the pesticide industry, and thus creates a link between that industry and the wine industry by co-operating and communicating directly with both.¹³ The individual research institutions also partake in collaborations and joint research activities with similar institutions in other geographical parts of the educational sector. Large oenology networks make sure the research institutions keep in touch with each other, true to the trend of a closer international connection of science depicted in figure 2.2. The producers themselves also sometimes co-operate directly with universities and firms abroad, which is mostly as a result of joint estate ownership. An owner of a Bordeaux château is often managing estates abroad as well, and can therefore harvest the knowledge acquired through the regional co-operation of those estates.

Even though the industry consists of some estate-driven R&D departments, the main research is done at the research and educational institutions. With the exception of *one* R&D department (the largest one), the primary task of the departments is to be updated on what the universities do and what is new at the international research frontier. On the background of this information they decide what experiments they should best conduct. To really understand how the industry relates to R&D, we must separate the "R" from the "D" (Chesbrough 2003:11). In the case of Bordeaux we see that the R is usually conducted outside the industry while the D is done within. The theories of open innovation (Chesbrough 2003a) and distributed knowledge bases (Robertson & Smith 2008a) are thus the main explanatory factors on how the different types of knowledge bases are related to the industry. And it looks like the cluster itself is a major competitive advantage for Bordeaux as the industry does not need to directly maintain their scientific and technological knowledge bases. In accordance with Porter's prediction (2000), the cluster in Bordeaux is developed, advanced and rigid. Also, the fact that the cluster offers so industry-specific and

¹³ It can be assumed that the Bordeaux industry also have direct contact with the pesticide industry.

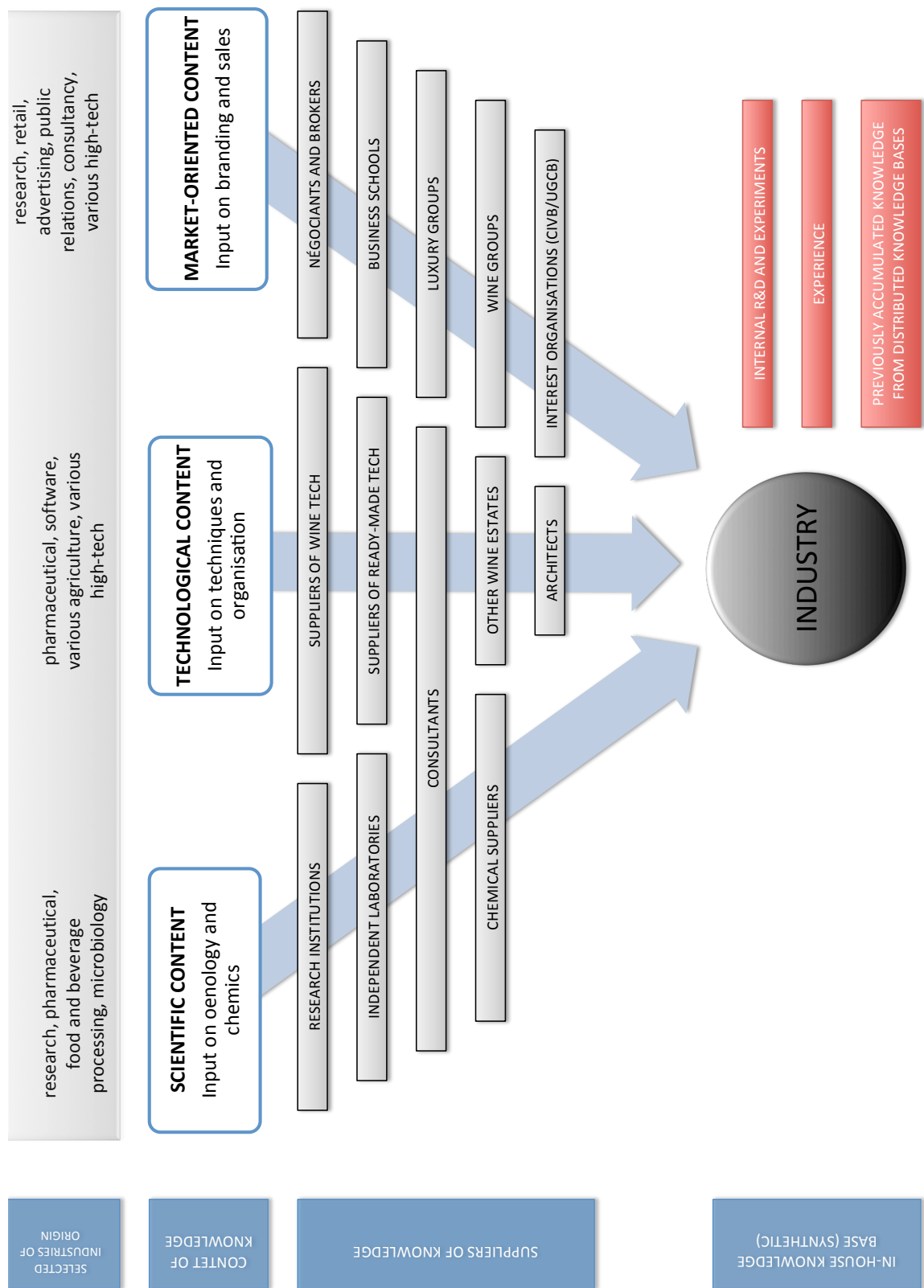


Figure 6.1: An illustration of the general knowledge structure in Bordeaux. Sorted by the main types of knowledge input to the industry. Reversed transfer of knowledge from industry to suppliers is also assumed to exist, though not depicted.

regional knowledge, complements Aylward's (2006) argument on why Australia will have a hard time establishing a position in the high-price segment of wine – namely because the R&D effort and the cluster are too general, covering the country as a whole and thus not satisfying consumer demands of terroir and typicality. In Bordeaux the cluster satisfies these demands, which is probably essential in explaining the industry's competitiveness in the high-end segment.

To easier visualise the cluster and the structure of the knowledge, figure 6.1 has been constructed. It is made on the information in figure 5.1, but here only the direct suppliers of the various types of knowledge input are depicted. The figure depicts the general flow of knowledge to the industry sorted by the content of the knowledge. Also depicted is a selection of connected industries delivering the knowledge. A special notion should be made to the in-house knowledge bases in the figure, as these affect how the distributed knowledge bases are acquired and processed, as will be argued in the latter parts of this chapter.

6.2 THE TRANSFER AND ACQUISITION OF NEW KNOWLEDGE

6.2.1 Transfer of Tacit Knowledge

As proposed by the reviewed literature, the cluster stimulates tacit knowledge spillovers and innovation by enabling learning through observing, participating and dealing directly with relevant actors (Asheim & Gertler 2005). It was found many examples of learning through this type of interaction, which have been important for the development of individual estates:

We went over to [a neighbouring château] to look at how they illuminated their cellar. We brought with us a Lux meter to measure the brightness at the settings we thought was good for us, and used this information to set our own light settings in our cellar. –*Managing Director, Pauillac.*

This quote really illustrates the openness of the industry, even between direct competitors. But it is not only "coincidental" contact between the competition that enable tacit knowledge transfer. Forums and institutional infrastructure (Asheim & Gertler 2005:299) make sure that tacit knowledge is done widely available for the actors within the cluster. Many seminars and meeting forums are staged in the region during a year. For example *ViniTech*, which is a big happening in Bordeaux that also attracts professionals from outside the cluster. Here producers of wine technology come to show off their newest products and developments. This is held every 1-2

years, last time in December 2010, and next time in November 2012. Suppliers, producers and other interested parties may attend this fair and get in close encounter with each other. Awards are also handed out during this fair, amongst others for "best innovation" (ViniTech 2012). A handful of other events for actors to meet are arranged. BEM puts together workshops for professionals three times a year, and *innovation mornings*, which is held more frequently. Approximately 60-70 people show up at these events, representing different parts of the cluster. The attendees are divided in approximately four groups where they can discuss developments and challenges together. The innovation mornings are arranged with *Inno'Vin*. *Inno'Vin* itself is quite interesting, and is a self-proclaimed cluster that derives from the ISVV. They describe their role as follows:

Inno'vin is born from the desire of all actors of the wine industry in Aquitaine to mobilize around issues related to R&D. Its primary objective is to organize the business combination based on innovative projects in collaboration with research centers and through experiments. This unique structure in France aims to bring together all players of the wine industry around issues related to innovation: companies producing and marketing wines, companies who provide goods and services, research laboratories and experimental centers (Inno'Vin 2012, translated by translate.google.com and cross-checked by ordnett.no).

Inno'Vin is an institution that stimulates contact between the various actors of the region. The *Faculté d'Oenology* also has various seminars, and offers tastings and lectures for vine-growers and cellar workers that do not have a scientific background. The Faculty has been doing this since 1949. Not any less important, the Faculty educates vineyard workers and oenologists, just as other educational institutions in Bordeaux; BEM has graduate and MBA programs relating to wine management, and INRA also train individuals for the wine business, but with a more agricultural focus. Thus all actors, from suppliers to untrained vineyard workers, have forums and structures that keep them in touch with each other, which theoretically enable the pick-up of knowledge through structured and unstructured spillovers (Giuliani 2007; Porter 2000; Asheim & Gertler 2005), something that has certainly affected moves of technical change and innovation in the industry (Pavitt 1984; Smith 2008). The normative aspect of open innovation is easily seen in Bordeaux, where the will and intensity of knowledge sharing looks to be high. This is nothing new for Bordeaux, and has been a part of the industry's culture for hundreds of years, which can be assumed to be the case for other similar industries as well. The industry has for a long time been aware of the benefits of learning through external knowledge bases. Hence,

Chesbrough's (2006b) definition of open innovation as a "paradigm shift" might be somewhat dramatic.

Apart from the structures that have been mentioned above, movement of workers and trainees from the educational institutions and other wine estates – national and abroad – is of great interest as theory holds this to be an important way of transferring tacit knowledge (Berg & Bruland 1998). Indeed, many respondents emphasised the importance of getting a hold of workers that were not yet "blinded" by the way wine was made in Bordeaux, and multiple examples of innovations due to the input from workers with experience from other wine industries were mentioned during the interviews. Some workers had moved from other wine regions into the industry for work, usually via an estate with some connection to the Bordeaux region through joint ownership. But a organised exchange of students – internships – is also largely institutionalised, and all estates accept multiple internships each year. They mainly come from the University of Bordeaux, but also from the University's partners in oenological research. People from South Africa, Spain, USA and various other countries can come and work in Bordeaux, just as workers in Bordeaux can have their internships in other French wine regions or abroad. The Wine MBA at BEM offers the same possibility for their students as the teaching and internships take place all over the world, where they visit different regions as part of their education.

In addition to getting input from outside Bordeaux, the increase in travel is an apparent effort from the producers to understand more of the market they operate, and it gives them new knowledge in deciding their marketing strategies. The producers' increasing interest in a more transparent négociant business has also provided them with a greater deal of insight to the system of distribution and sales than was the case earlier.

Movement of work force may be an important reason for acquiring knowledge (Berg & Bruland 1998), but tapping into local experienced workers' knowledge base is perhaps an even greater source of innovation for the Bordeaux industry. This coincides with Pavitt (2005) who says that firm-specific experience is important for competitive success and innovation. Even though the low turnover in employment and the established structures of the industry quickly can be associated with inertia and resistance towards change (Hannan & Freeman 1984), in Bordeaux this looks to be outweighed by the pros of extremely good estate-specific knowledge and understanding of the terroir – an understanding that was described as a major success

factor in most of the interviews. Experience helps to implement more relevant knowledge and improvements based on years of experience. Cases of "bottom-up" innovation in the industry were many:

Funny enough the real important innovation isn't about having capital at all. We can have done a lot earlier had we just thought about it. The big developments in how we do things have come from a worker who is just fed up with a way of working. –*Sales Director, St. Émilien.*

By experience in the vineyard and with equipment, the worker can take note of flaws and disadvantageous routines and functions, which can lead to new processes or alterations.

It is not a sufficient precondition that the knowledge is available in order to be acquired, it must be implemented as well. Here the consultants of Bordeaux play an immensely important part. It would not be false to characterise the consultants as people who stimulate and enable tacit knowledge transfer, but the truth is that they serve an even greater role for the industry, and that is by relating and tailoring the vast amount of available knowledge to the individual châteaux. It was very interesting to find consultants operating in nearly all the top châteaux, and often the same consultants. Firstly, they can be regarded as gatekeepers (Cohen & Levinthal 1990), being in contact with a large number of high-end producers in Bordeaux and similar winemaking industries (such as Napa, California), distributing and tailoring knowledge when advising individual estates. Secondly, they are competent to interpret scientific, professional and technological knowledge, and are in broad contact with suppliers. They can therefore advise on the whole process of winemaking. Finally, they taste a lot of similar types of wine, and have a highly sophisticated palate, though not monotonous. They can therefore be very valuable to the winemaker in the blending process as they have a wide experience of tasting similar style wines, knowing typicality and benchmarking the wine to other châteaux. The consultants often have a scientific background and a broad perspective on winemaking, which enable them to easily relate relevant developments and techniques to the estate in question. Consultants along with the workers and the internal R&D departments should be considered important factors when assessing the absorptive capacity of the industry (Von Tunzelmann & Acha 2005; Cohen & Levinthal 1990; Von Hippel 2005).

The use of consultants is not just regarded as a general trend in the whole of Bordeaux, but the evidence of this study suggests that it might be, on the background

of the consultants ability of acquiring and distributing relevant knowledge, an important factor affecting competitiveness of the high-end industry in particular; being *one* factor to affect success of producers in the high-end compared to: other producers in high-end, the low-end part of the industry, and other high-end wine industries. Even though this statement needs comparative research in order to gain any momentum, the consultants are certainly attaining new information, constantly being updated, conducting analysis, comparing similar businesses, sorting knowledge and giving relevant advice. They seem to be the most important individual point of contact the actors of the industry and cluster have with each other, and an essential contact point for information on developments in other winemaking regions.

There is much evidence of tacit knowledge flows taking place within the cluster – being enhanced by features only a cluster can provide. Many strong structures exist within the cluster for stimulating human interaction on both science, technology and marketing, which has already been suggested by Robertson & Smith (2008b). The distributed knowledge bases do not seem to be scattered in the sense of geographical location, nor in the sense of their interaction with the industry. However, it must be expected that not all links and connections have been captured by this study.

6.2.2 Transfer of Codified Knowledge

The industry has access to distributed knowledge bases through codified transfers as well as tacit ones (Von Hippel 1994). It exists web forums for professionals in which to communicate, and magazines dealing with everything from wine technology to marketing. One technical director said the following:

I follow particularly *Oenologist Review*. Some magazines are from Bordeaux, but most are national or international (showing me a handful of magazines lying spread across his desk): I have *Vine and Wine*, something about wine aging, about cork, whatever. It exists many specialist magazines which focuses on different aspects of winemaking, and we need to follow them broadly as we do not wish to be tied within any dogma or path.

Magazines are definitely a way to get input on new developments, but also a possibility to get more input on your competitors. One respondent followed his statement on his estate's sorting procedure by saying humorous that: "Château Latour does the same. I saw it in a magazine". Even though this was meant as a funny comment, it illustrates a way the actors of the industry get input on what the other estates are doing. Not just through human interaction, but through codified information as well. Especially within marketing, an aspect the producers were more

secretive about towards each other than any other information, the magazines can provide insight. The knowledge on marketing is viewed as more general input that does not need to connect with any experience-based knowledge in order to be implemented, which seems to be the main reason for less sharing between the producers regarding this type of knowledge. Codified knowledge through magazines is therefore important in this respect. As high-end Bordeaux estates are some of the biggest authorities on wine – portrait interviews and reviews are often found on them in all international wine magazines, and the magazines are also a common medium for the industry's marketing efforts toward the larger market of consumers.

If we look beyond popular and professional magazines, research reports must be assumed to be a way of attaining codified knowledge. All research from the regional institutions are published, and much of the private research at the estates also ends up to be public. It exists web portals that can be accessed by professionals, newsletters and commercially available journals that can be used in spreading the knowledge. Input on new technology and techniques can also be retrieved through supplier websites and brochures.

Codified knowledge is important, but does not really stand out as a unique feature of the industry. The access to codified knowledge does not differentiate Bordeaux from any other specialised industry. It is the tacit knowledge flows, that the cluster permits by proximity of actors and infrastructure that are utterly prominent in explaining what type of knowledge is attained and how it is acquired. The many examples of tacit knowledge spillovers in combination with the acquisition of codified knowledge are vital variables in strengthening the competitive character of the industry (Jensen et al. 2007:681).

6.3 PROCESSING THE KNOWLEDGE FOR INNOVATION

6.3.1 A Conservative Implementation of New Knowledge

The distributed knowledge bases in the cluster are visible and widely available for both the high and low-end part of the industry. It alone cannot explain the different success between low and high-end. Market conditions along with experience and a sense of identity are in this respect where high-end most likely separates itself from other parts of the region, and perhaps also from other high-end wine industries. The low turnover in employment, the strong finances, the gatekeepers (consultants,

workers, architects and R&D departments), the role as a lead user and the frequent execution of experiments, are all important factors in explaining the industry's ability to maintain the world's most individualistic wines and the best possible exploitation of the various terroirs. The focus on quality above any other business related factor is vital for success, and is only possible because of the good financial stability at the châteaux. Thus the main reason to innovate is to enhance the quality of the product, in addition to bettering the marketing conditions or the employees' working conditions, rather than lower costs of production. It exists a complex quality assurance system, where the industry at all times seeks to increase, secure and control the quality aspect of production and reputation.

It is a noticeable contrast in Bordeaux between the proud tradition of the château, and the large amount of new developments in technology and techniques. One would expect to discover conservative attitudes within the industry – and one does. However, the industry seems very aware of the conservatism and inertia that exist, and confront them by being very open to new input. The search for scientific and technological understanding of winemaking is grand, and in this respect the industry is not conservative. But it *is* conservative in implementing the new changes or accepting new knowledge as superior to its own experience-based knowledge, and the industry is in this way somewhat *path dependent* (Redding 2002). The reputation of the industry has been built up through hundreds of years, and it seems as if the fear of compromising the wines' character and style stands strong in the industry. The industry is therefore extremely cautious in implementing changes, and if it does, the changes have been tested in line with the individual château's philosophy and style. If the change is adapted, it is by the choice of the individual estate, and is by no means a unanimous change across the industry, though some innovations can turn out as strong trends. It exists an inertia in adapting to new changes. But on the other hand, as a lead user (Von Hippel 1986) and with its active search for new knowledge, it looks as though the industry has longer time to process new knowledge before others catch up. That the cluster is so developed and efficient, along with the active use of consultants, help the industry to make quick and smart decisions relative to its competition.

The consultant Dubourdieu describes the conservative attitude of the industry beautifully when he says: "[...] In instincts we are sceptics, descendants of the Enlightenment, and not ready for a new war of religion. [We] omit the magic potions"

(Decanter 2004). Many developments in Bordeaux are not done on the background of new scientific knowledge alone, but on the background of experience and experiments. The scientific knowledge sometimes comes years later. Technology can be viewed as a tool to help the winemaker, and not as a critical part of the production cycle, but it helps the winemaker to increase quality. This approach to new knowledge corresponds with Asheim & Gertler's (2005) notion that a synthetic understanding of industries' fundamental knowledge base must in some cases be adapted in order to understand the character of their absorptive capacity and process of innovation.

6.3.2 A Combined View on Innovation

Bordeaux is a place of mysticism and philosophy, and it is really something unscientific in the way wine is made. Science and technology are of course a part of it all, but the experience, taste, history and identity are an equally large part of the equation leading to innovation, and cannot be ignored. The only chance for technological or scientific knowledge to be implemented is if they serve the reputation of the industry, the quality of the wine, environmental considerations or the well being of the employees.

Following the research of Morelacchi & Nelson (2011) on medical practices, innovation in the case of Bordeaux is also triggered by a combination of different types of knowledge. The big developments the last decades in Bordeaux can be explained by combining three types of knowledge bases:

1. New technology
2. New scientific evidence
3. Experience

Figure 6.2 illustrates how these different types of knowledge bases are connected in the process of innovation. Figure 6.3 and 6.4 (page 88) illustrate concrete examples from the Bordeaux high-end wine industry where the model in figure 6.2 is adapted as a framework. Different types of knowledge bases and innovations have played important roles in some of the industry's larger developments such as improving quality and reputation.

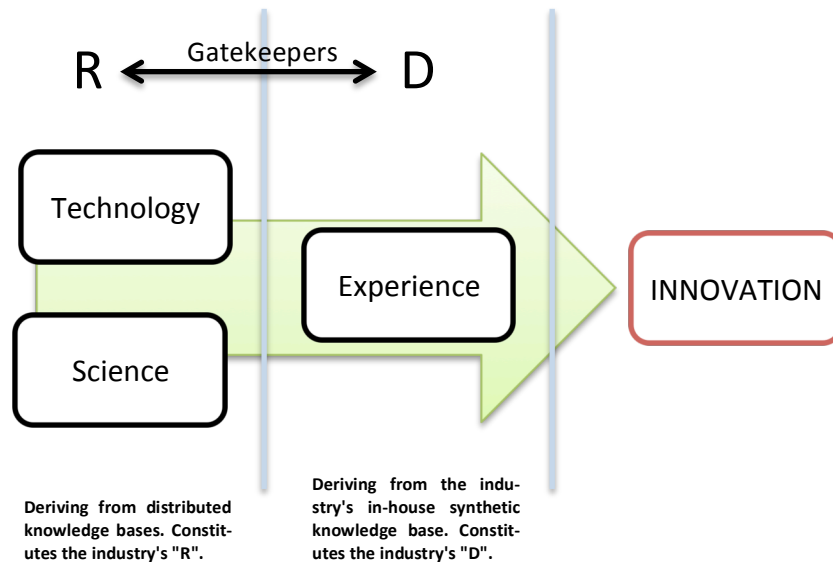


Figure 6.2: Types of knowledge bases taking part in the process of new innovations. Knowledge is done available for the industry through new technology and new scientific evidence, but must connect with the industry's experience-based accumulated knowledge with the help of gatekeepers.

The distributed knowledge bases provide important input for the industry, yes, but are not held to be the sole criterion for the degree of innovation and competitiveness. The distributed knowledge bases meet the inertia of the industry and connect with the synthetic knowledge base of the industry with the help of gatekeepers. The competitiveness and nature of development and innovation in Bordeaux can likely be explained through this complex interaction between knowledges, and inertia may in fact be the industry's largest competitive asset (Pavitt 2005). The most prominent developments in Bordeaux should not be viewed as something triggered by one major new innovation, rather than the combination of multiple small innovations from various sectors. This model can help us to explain different forms of innovation in Bordeaux, and perhaps in other industries where knowledge based on experience and tacit knowledge is grand. However, this model has primarily been used to explain innovations within production and marketing, and it will probably not work as well in explaining organisational developments caused by for example bottom-up initiatives and new organisational structures.

As seen from the examples in figure 6.3 and 6.4, the major developments in marketing and quality have been a combination of various knowledges and innovations, coming from various knowledge bases and originating from various types of industries. As illustrated by figure 6.3; even though an estate is doing lots of

analysis, they cannot escape tasting the seeds to determine the exact time of harvesting.

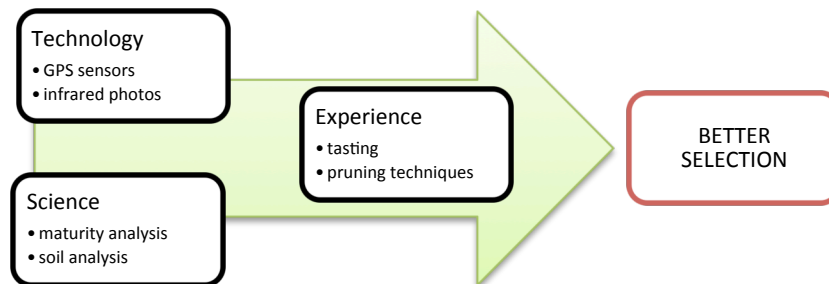


Figure 6.3: Components affecting better selection of grapes.

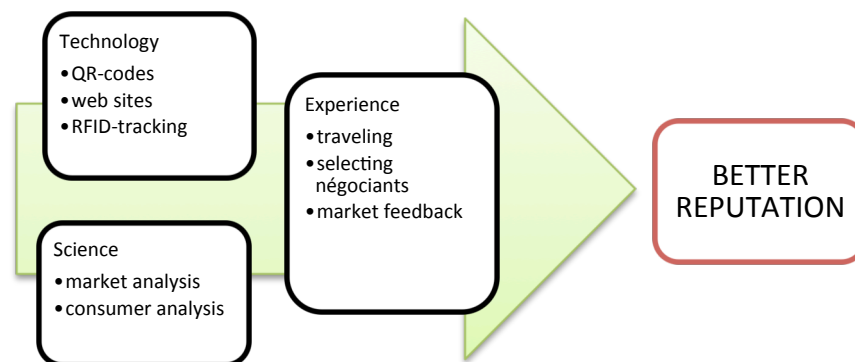


Figure 6.4: Components affecting improvement in branding and marketing.

On a different note, it can be underlined that it has in some cases been found a close connection between new technology and new processes. This can be viewed causally when the implementation of new technology results in new techniques and organisation of production, as was the case with the introduction of the concept of gravity. The new wineries that have been built are all constructed to be increasingly roomy, to meet the conditions of both the workers and any future technological implementation of grand proportions. On the other hand, as already mentioned, new requirements from the workers may also push for new technology. With this said, it will be no further attempt to determine what affects the movement of the three types of knowledges in figure 6.2.

6.3.3 Technology Content and Innovation

The empirical evidence of this case is urging us to view innovation as not being synonymous with "technological innovation", and not necessarily to be associated directly with internal R&D expenditure. While the distributed knowledge bases are providing the industry's "R", the industry itself is responsible for their own "D". Thus combining the external scientific and technological knowledge with their internal experience-based knowledge. While the distributed knowledge bases are done available through the cluster, the industry is guarding their own accumulated knowledge and using this as an entry approval barrier prior to implementing external knowledge.

Bordeaux is an example of an industry where the OECD classification comes short in providing us with any fruitful description on innovativeness. Technology intensity is too narrowly defined. It exists a complex knowledge system in Bordeaux, which is only visible by accepting that the industry is tightly connected to other parts of the economy. Hence measuring the industry's technology content through intramural R&D loses its relevance. What indeed does low-tech really mean? The industry is absolutely using some very sophisticated technology. However, as LMT is referring to the industry not producing any technology, than that is absolutely correct. But to draw a direct line between low R&D and low technology intensity looks to be too simplifying. The high-tech suppliers are represented in the cluster and are dependent on selling their technological apparatus. Even more, they are dependent on input from this high-end part of the industry as a lead user, to get expert feedback on their equipment. This is important for the competitiveness of technology suppliers such as Bucher Vaslin. Bordeaux needs the best technological and scientific knowledge to be the most competitive wine industry in the world; just as the technology suppliers and scientific institutions need input from the best oenological practices to be the most competitive in *their* line of industry. The interconnectedness of the economy is very real and very visible in the Bordeaux cluster, where all actors can thrive on mutual connections, where all are dependent on each other to be the best they can be, and where all can make use of their competitive advantages.

7.1 MAIN FINDINGS AND CONTRIBUTIONS

With emphasis on qualitative interviews, the distributed knowledge bases of the industry have been mapped based on the most prominent developments the past 20 years. This has been done in order to answer *how the high-end wine industry of Bordeaux acquire and process new knowledge.*

Acquisition of knowledge

It is concluded that a large part of the industry's distributed knowledge bases is made available through a cluster formation within the region of Bordeaux. The hard science and technology developments are mostly done outside the industry, but nevertheless appear to the industry through the cluster. Forums and institutional infrastructure lay the ground on which the actors in the cluster can communicate and share experiences, thus enabling tacit knowledge transfers. The industry's role as a lead user may be an important reason for the clustering of suppliers around the industry, and a reason for the industry's continuous success and consistency of its product, compared to that of their competition. The industry is suggested to be successful due to the cluster's developed character, along with the industry's high absorptive capacity. Another pertinent reason for its competitiveness is the consultants. They are assumed to be the single most important gatekeeper for the industry, and contribute to the high-end's absorptive capacity by relating various specialised knowledge bases to the unique needs of the individual estates.

Processing knowledge

It exists a considerable degree of inertia and slowness in the innovation process caused by the large amount of experience-based knowledge in the industry – tacit knowledge accumulated over the past 500 years – upheld by tradition, an externally closed cluster, low turnover in employment and generations of vineyard workers. The industry has for such a long time been ahead of competition through experimenting and an understanding of their unique terroirs. New knowledge and processes are therefore met with a great deal of rationality, where the superiority of a new technology, technique or process must be thoroughly proven before it is adapted. This

is arguably why such high consistency and quality of the wines have been maintained. Hence, new developments are often a result of the distributed knowledge bases connecting with the industry's previously accumulated knowledge. This process seems to be a fortunate entry-barrier for innovation in the industry. A large part of the major developments the past 20 years can be explained as a combination of new technological, new scientific and experience-based knowledge.

Theoretical Conclusions

This case has showed that innovation is not just about technological innovation. Neither is technology content necessarily the same as the manufacturing of technological products. Industries can be argued to be innovative and knowledge intensive due to their connection with other parts of the economy and adapting to technical knowledge originating from outside the industry. It is difficult to see the industry of Bordeaux, and probably other agricultural industries, as innovative by looking at patents, manufacturing or research data. But by thinking in the lines of distributed knowledge bases, and by accepting that a connection between different industries exists, it will become easier to understand dynamics, innovation and technological change. This is suspected to be especially true in LMT sector and where the industry's absorptive capacity is based on a synthetic knowledge base.

7.2 POLICY, IMPLICATIONS AND FURTHER RESEARCH

It is hard to imagine that LMT sector will lose its relevance in the economy, and the high-end fraction of this will probably be more important as the demand for higher quality goods increase. A political promotion of industries based on technology content measured in R&D numbers fails to consider the relationship different parts of the economy have with each other on a micro and meso level. A cluster, like in Bordeaux, can increase competitiveness and knowledge input for all actors, even those from high-tech sector, and it should be viewed as a regional system of comparative advantages. The French government seems to have understood this regional dynamic by encouraging clustering and laying down important institutional infrastructure, especially regarding the region's research efforts. The understanding of similar industries as "resource-processing" or as "low-tech" might be incapable of grasping the true features of the industry and how the innovation process is carried

out. Those terms are therefore not deemed analytical usable in similar cases, based on the study in this thesis.

However, it is some obvious implications for this case, which limits the possibility of comparing it with other LMT industries. Firstly, it is naïve to presume that a similar band of consumers and investors exist in other LMT industries. The way in which Bordeaux wines are traded is more similar to stock speculation rather than traditional purchase behaviour. Secondly, the industry can be characterised by a duality, and can be seen both as a luxury-goods manufacturer and as a resource-processing manufacturer, whereas the definitions isolated cannot depict the industry sufficiently. In regards to the market, high-end Bordeaux is a luxury item, in regards to production it is an agricultural and resource-processed item. Development in marketing can easily be seen alongside the development of other luxury merchandise as clothes and jewellery, while development in production is more dependent on scientific knowledge bases.

Further research that would confirm or discard the implications of this research, is a similar case on the low-end part of the Bordeaux industry, enabling comparative empirical conclusions. This would remove the high-end "privileges", and it would also give ground to compare the two parts of the regional industry and say something about the differences in accessing and processing the knowledge in the cluster. Another case that would be interesting is to study a direct competitor of the high-end industry of Bordeaux, prominently Napa Valley, in order to see if similar patterns can be detected and if anything can be said about the competitiveness in comparison to Bordeaux. With enough cases, it would eventually be ground to compare empirical data from Old World up against New World; a study that can result in advise on how to manage development and maintenance for both up-and-coming wine industries and established ones.

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APPENDIX 1 - power-point sent to the respondents prior to visit

The Mapping of
Distributed Knowledge
Bases in Bordeaux

A Quick Overview of
a Research Project

Christian Thomas Guttormsen
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Mail: christian.guttormsen@hotmail.com

This slide features a title in red text on the left and a subtitle in black text on the right. The background is a light brown color with a faint hexagonal pattern. A green rectangular box is positioned at the top right of the slide.

The Theoretical Background
(The reason for doing this)

- It is argued by various economists that industries with a low spending on research & development (R&D) activities, are less innovative and dynamic than other sectors of the economy.
- Highly sophisticated and technological industries has therefore achieved the role as the driving force of the economy.
- This research project will argue that such a view is incorrect.
- It will be argued that industries with low R&D-spending still can be perceived as dynamic and innovative, as their knowledge originates from other places than internal R&D alone -- for example through the purchase of technological equipment, learning-by-doing, cooperation with knowledge institutions or cooperation with other producers and industries.

This slide features a title in red text at the top. The background is a light brown color with a faint hexagonal pattern. A green rectangular box is positioned at the top right of the slide.

Objective

and the hypothetical results of the research

- The objective is to map the knowledge bases of the high-end competitive part of Bordeaux' red wine industry.
- This is done in order to show that "low-tech" industries actually are a very important part of the economy. The industry is also thought to be important for the survival of "high-tech" industries itself.
- The research will likely conclude the Bordeaux wine industry to be an important, successful and innovative part of the economy.

Basic Information

- The research project is carried out in the form of a master thesis at the Centre for Technology, Innovation and Culture (TIK), University of Oslo. The thesis has the duration of 1 year and will be finished in June 2012.
- The research will be an academic contribution to industry- and innovation research, and will be a part of a bigger international academic debate regarding innovation in wine industries.

Practical Aspects

- There will be conducted between 8-12 qualitative interviews. The interviews will be done in the form of a conversation, which will take approximately 45 minutes.
- All interviewees will remain anonymous throughout the written paper so that it is impossible to link any information up to the individual châteaux.
- The interviews will seek to cover the vinification process, with a focus on the fermentation process.
- The questions in the interview will deal with the châteaux use of technology, cooperation with other institutions and producers, technical employees, research activities and openness.

Practical Aspects

- All interviews will be sent in return to be approved by the interviewees.
- The participating châteaux may be sent a copy of the finished research if they wish.

APPENDIX 2 - Driving Schedule (anonymous)

MONDAY	Time	Driving time	Contact
<i>Leave from hotel</i>	* 07.30	Pick up car at St. Jean Railway	
		20 min.	
BEM 1	*09.00	20 min.	x
E-Provenance	*11.15	50 min.	x
Laboratory (Ch. Médoc A)	*15.00	1 h.	
Max Bordeaux (Retailer)	*18.00		
<i>END: -----</i>			
TUESDAY			
<i>Leave from hotel</i>	* 10.00	45 min.	
Estate (Ch. St. Emilion A)	*11.00	5 min.	x
Wine Museum CIVB	*13.00	1 h. 15 min.	
Négociant	*16.00		x
<i>END: -----</i>			
WEDNESDAY			
<i>Leave from hotel</i>	* 07.30	1 h. 15 min.	
Estate (Ch. Médoc B)	CANCELLED	16 min.	x
Estate (Ch. Médoc C)	*10.30	40 min.	x
Estate (Ch. Médoc D)	*14.00	17 min.	x
Estate (Ch. Médoc E)	*16.00		x
<i>END: -----</i>			
THURSDAY			
<i>Leave the hotel</i>	* 08.00	1 h. 15 min.	
Estate (Ch. Médoc F)	*09.30	10 min.	x
Estate (Ch. Médoc G)	*10.45	1 h. 30 min.	x
Estate (Ch. Graves A)	*14.00	16 min.	x
BEM 2	CANCELLED		
<i>END: -----</i>			
FRIDAY			
<i>Leave the hotel</i>	* 08.00	40 min.	
Estate (Ch. St. Emilion B)	*09.00	15 min.	x
Estate (Pomerol A)	*14.15	15 min.	x
Estate (St. Emilion C)	*16.00	45 min.	x
Deliver car	*18.00		
TGV to Paris	*19.00		

APPENDIX 3 - Questions

EMBODIED KNOWLEDGE - **TECHNOLOGY**

How do you conduct your main activities of vinification?

- What technological apparatus is most important in the stages you mentioned?
- Are the tech suppliers mainly from Bordeaux, other parts of France or international?
- How many different suppliers deliver technology to you?
- Have you ever modified, or redefined the use of a technological apparatus?

What has been the latest upgrade or change in technology made by your estate?

- What has been your two most important technological purchases the last 30 years?
- Do you think this technology is as important to other Bordeaux producers?

DISEMBODIED KNOWLEDGE - **NETWORK**

How and in what degree do your estate use consultants?

- What types of services can be bought by the consulting sector?

Do you co-operate with other châteaux?

- Do you co-operate with any universities or research institutions (L'enita etc.)?
- In which fields? What do you get out from such collaborations?
- Is it important to be aware of changes made in the mass-producing part of Bordeaux or other parts of the World?
- What's your most important effort in order to stay up to date in wine production?
- It is often said that the French government have substantial politics on the organization of the French wine industry. Do you feel this is true, if so, in what way do they impact the way you conduct research, production or business?

ABSORPTIVE CAPACITY - **EMPLOYMENT**

What are the backgrounds of the technical employees working here?

- How many employees have competence to operate the technical apparatuses at this estate?
- How many employees have competence to fix broken apparatus?
- What would you say is the approximate time of employment of your technical staff?
- Does your technical staff go through any post-employment training?
- Where did your employees work before?
- Where do they go after they quit at your estate?

INHOUSE KNOWLEDGE - **R&D**

Do you conduct any R&D yourself?

- In what area?
- Do you co-operate with any other institutions or agencies in research activities?
- How many are employed with R&D?
- Can you estimate your budget?

SUCCESS - MARKETING

How important do you think marketing is in order to be economically successful?

- What has been your biggest effort in meeting the changing market: growing Asian demand, the rise of New World and the economic downturn in Europe?

FINAL CONSIDERATIONS

- When you consider the process of making wine: What are the main skill needed in-house, and what are the main skill needed from outside?
- How important do you think terroir is versus the skill to exploit it.
- Have any technological equipment substantially changed the way your estate think of wine production?

Questions - BEM

COLLABORATION

- What are the main areas of research within your department?
- Do you co-operate with research or education institutions outside the region of Bordeaux?
- What type of co-operation?
- Do you ever conduct research in collaboration with any of the producers in Bordeaux?
- What type of co-operation?
- Are you ever assigned research projects on the request of producers?

ISVV

Contracted between the French Ministry of Research and Higher Education and the Aquitaine Region.

- Through ISVV you co-operate with many other research and education institutions. Is this co-operation important? Why?
- In what ISVV projects are BEM involved now?
- What do you think was the governments motive to found ISVV?
- Can you think of any other ways the government impact the way the wine industry and related research is organized or conducted?

ACADEMIC INSIGHT

- What will you say are the most important factors causing the rising prices of high quality Bordeaux?
- What are the most important skills in order to be competitive in the high-end Bordeaux market?
- Is there any of the skills mentioned that the estate normally doesn't have in-house, and thus need to acquire from elsewhere?
- Why is the mass-producing part of Bordeaux arguably less competitive than the high-end market?

- What do you think is needed today to be successful in the Bordeaux industry?
- How important to you think it is to be well-informed and users of new technology?

MVS

- What is the goal of this programme, and what does a typical student do after he or she finish the MVS?
- Where are the students typically from?
- At the programme the student can spend up to 15 month at a wine company. What type of companies are these?
- What do the student achieve by staying at one of these companies?
- Why do you think the companies agree to pay the students tuition fees?
- I understand that the MVS has a partnership with the Faculty of Oenology. In what way do the faculty contribute to education of the students?

MBA

- Can you please explain the goal of this MBA?
- What are the typical background of the students that apply?
- The MBA is seemingly very international. What do you feel is the strength such an organization of the programme?
- Do the students work close with other research institutions or producers during there education? In what way?
- What usually happens to the students after they finish their MBA?

Questions - E-Provenance

General

- In your words, what is e-provenance?
- What makes eProvenance important in the trading of fine wines?
- E-provenance is not just about one technology, it's more of a system of information. What competencies are needed in your employees to run this type of system?

Technical

- There are many forms of RFID today, but you have redefined the use of this technology somewhat. What was the main challenges in developing this type of system? Technical and businesswise.
- Did/do you collaborate in R&D activities with other institutions? Who? In what field?
- Do you ever hire consultants? For what purpose?
- In which aspects of your business do you see possibilities for further technological development?
- How do you go about in pursuing this development?

Business

- How have the industry responded to e-provenance?
- Was it difficult to implement this system of tracking in the market?
- Your products appeal to buyers, producers, merchants and many others. And I know you have many partners within these groups, BWB being one. Can you say something about what you get out of such close partnerships?
- Do your partners ever affect the way you think about business or development?
- Where lies the next possibilities of business development?
- Do you feel like you have any direct competitors? Why?

The Industry

- The wine industry is getting more and more competitive. What should be Bordeaux' primary efforts in dealing with the changing market of wine?
- How important do you feel the industry's innovative and technological development is in this regard?
- How important is branding?

- Your business has managed to unite consumers, investors, producers and other companies in the industry. Is the industry generally open and receptive, or is this unique?
- Is communication and collective learning in a industry important in order to overcome common obstacles and increase competitiveness?