THE ROLE OF THE HUB-FIRM IN DEVELOPING INNOVATION CAPABILITIES:

CONSIDERING THE FRENCH WINE INDUSTRY CLUSTER FROM A RESOURCE ORCHESTRATION LENS

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Abstract

Purpose – This paper explores how hub-firms in a regional industrial cluster orchestrate resources to enhance the innovation capabilities of member firms and how this role changes as innovation projects develop. The work advances our understanding of how innovation-oriented clusters can drive the collaboration process, support the development of member capabilities, and achieve desired outcomes.

Design/methodology/approach – The research utilises exploratory case studies within an innovation cluster, where a hub-firm brings together different players for specific innovation projects. Using resource orchestration theory, the paper analyses six project cases to reveal the shifting roles and activities related to structuring, bundling and leveraging different resources for innovation capabilities particularly associated with improved quality and reputation for the firms and region.

Findings – The study reveals the important role played by the cluster hub-firm in structuring, bundling, and leveraging resources to create and fund project teams. After project formation, a team member takes the role of an orchestrator to bundle further and then leverage the resources to achieve desired outcomes for the team and the region.

Research limitations/implications – This research enhances understanding of the hub-firm's role in a regional cluster not only in orchestrating resources to create collaborative innovation projects but how the role shifts over time. The work advances our understanding of how innovation-oriented clusters can drive the collaboration process, support the development of member capabilities, and achieve successful outcomes. There are implications for practitioners for participating in and further improving the innovative collaborative process.

Originality/value – This research enhances understanding of the hub-firm's role in a regional cluster not only in orchestrating resources to create collaborative innovation projects but how the role shifts over time.

Keywords: Regional cluster, hub-firm, innovation, resource orchestration theory, wine industry, Bordeaux wines

Paper type: Research paper

INTRODUCTION

Introduction

The industrial cluster, a popular concept within the technology sector, is considered a primary mechanism for industrial innovation and regional economic development (Hsieh-Sheng, 2011; Mattsson, 2009; Porter, 2000). While innovation is perceived to be an interactive and inherently complex process of introducing something new (presumably better) that is intrinsically dependent on context and circumstances (Mattsson, 2009), the industrial cluster is considered as a means to generate innovation in the industry by connecting companies, suppliers, government bodies, academic institutions and other associated institutions that could compete and cooperate (Mattsson, 2009; Porter, 2000).

Early research (Rothwell and Dodgson, 1991; Tidd, 1995) emphasised the crucial role of regional industrial clusters in sustaining competitiveness. The regional characteristics created by universities, research and educational institutions, and other interrelated knowledge or technology providers boost the innovation capabilities of the regional industry through knowledge spillovers and intensive personal contacts among cluster members facilitated by geographical proximity (Hsieh-Sheng, 2011; Porter, 2000). Porter (1998) stated that regional clusters can achieve more efficient resource allocation by integrating business processes across their members (Gattorna, 2016), enabling them to innovate faster. Agglomeration of regional economic activities, driven by a cluster, contributes to increased job creation, patenting, and new business formation (Speldekamp et al., 2020; Delgado et al., 2014; Feldman et al., 2005; Porter, 2003).

Despite the importance of regional industrial clusters in improving the competitiveness of an industry or region, their role remains only partially examined, particularly going beyond the technology sector. Previous literature has described the functioning of the cluster, the qualities of the actors needed for collaboration in the cluster, and the benefits of joining an industrial cluster, though less focus has been on the role of the lead actor that orchestrates resources among cluster members (Liu et al., 2019; Bittencourt et al., 2021). However, if the leader or key player in the cluster, referred to as ‘hub-firm’ in this paper, creates an environment of distrust among cluster members, it may result in cluster failures or poor performance of cluster members (Kramer and Pfitzer, 2016; Porter and Kramer, 2011). Our study further investigates this argument and lends insight into how the hub-firm role is critical for finding the right members with shared values and aligned interests and encouraging innovation. *Thus, this paper aims to understand how the hub-firm in the regional industrial cluster orchestrates resources to enhance the innovation capabilities of the member firms*. Our research demonstrates ‘how’ the hub-firm facilitates the creation of shared value between heterogeneous players, leading to

diverse outcomes for members that jointly undertake longitudinal innovation projects. This broad aim implies the following research questions:

- How does the hub-firm orchestrate resources to develop the capabilities of the members involved with innovation projects?
- How does the role of orchestrating resources change as the innovation project develops?

This study builds on Liu et al.'s (2019) work where the focus is on the 'hub-firm' and a community of firms that work collaboratively to orchestrate supply chain activities in order to build a sustainable competitive advantage. The regional industrial cluster, in the context of this research, goes beyond the supply chain network (Liu et al., 2019) to include extended heterogeneous actors (firms and governmental bodies, research centres and academic institutions, producers and suppliers, manufacturers and service providers) for enhancing the firm and sector performance.

The theoretical support for the study is provided by resource orchestration theory (Sirmon et al., 2011; Chadwick et al., 2015; Liu et al., 2016; Gong et al., 2018), which suggests that not possessing but orchestrating a 'strategic resource portfolio' results in an enhanced performance driven by synergistic capabilities and, finally, contributes to a sustained competitive advantage of firms.

Thus, we contribute to the literature by examining how the hub-firm and members of a regional industrial cluster drive innovation through multiple collaborative projects in the Bordeaux wine industry. This industry is particularly interesting to study as wine industry innovations are complex and sophisticated. According to Doloreux and Lord-Tarte (2013), these innovations depend on scientific knowledge for technological development in areas such as fermentation, winemaking, vine growing and soil management, as well as on business, markets, and managerial knowledge for wine sales and commercialisation (Smith, 2007). Furthermore, this knowledge is produced interactively with wine producers, suppliers and research organisations (Velluzzi, 2010; Giuliani and Bell, 2005; Zhang and Li, 2010).

The hub-firm in our paper, *Inno'vin*, was created to link research and industry and further contribute to the development of the industry. A comprehensive empirical investigation of innovation projects supported by *Inno'vin* allowed us to examine the resource orchestration activities, the shifting role of the hub-firm activities from *Inno'vin* to other lead actors as the innovation project progresses, the emerging capabilities, and the resulting outcomes.

The research presented in this paper also enhances understanding of how the hub-firm's role within a regional cluster shifts over time. Building on resource orchestration theory, the paper goes beyond the analysis of 'what' drives competitiveness and answer 'how' the innovation-oriented cluster develops

individual and regional innovation capabilities to improve the competitiveness of cluster members and the cluster as a whole. We demonstrate how the hub-firm initiates the structuring and bundling activities between cluster members to drive the collaboration process, leverage resources to support the development of member capabilities, and generate successful outcomes.

The following section provides a brief overview of the research on industrial clusters and innovation. The subsequent section includes background on the resources orchestration theory followed by the case study setting and methodology applied in the study. Next, the data analysis section highlights the findings gathered from the case study. The paper concludes with discussions on the main contributions, limitations, and further directions derived from the research.

2 Resource Orchestration in Regional Clusters

2.1 Innovation and Regional Clusters

Innovation researchers have acknowledged that rarely is innovation ascribed to one person (van Hippel, 1988; Lundvall, 1992). Increasingly, innovation has evolved to a more network-based approach (Choi et al. 2010) involving an interactive and inherently complex process with multiple components and conditions. Hence, innovation is a contingent phenomenon, dependent on context and circumstances and thus, researchers must understand how innovation components interact in time and space (Mattsson, 2009).

Industrial clusters are one type of innovation network approach defined as a concentration of firms that prosper because of their interaction, whether through competition or cooperation, or by serving as suppliers or customers in the value-chain (Padmore and Gibson, 1998: pg. 627). According to Porter (2000, p. 253), industrial clusters are: "*geographic concentrations of interconnected companies, specialised suppliers and service providers, firms in related industries, and associated institutions (e.g. universities, standard agencies, and trade associations) in particular fields that compete but also cooperate"* (Porter, 2000, p. 253). It is generally accepted that innovation takes place to a higher degree in regional clusters than elsewhere (Maskell & Malmberg, 1999; Porter, 2000) as innovation is the goal and the cluster is the means to achieve it (Mattsson, 2009).

Going further, Malmberg and Power (2006) differentiate between three cluster types- functional, territorial and regional policy projects/cluster initiatives. Hsieh-Sheng (2011) defines regional clusters as those businesses situated in an industrially clustered region where the regional dimension is of key importance. Often industries do not have a choice but to settle in an area due to regional characteristics. Being situated near each other is essential for activities such as research and development which

demand face-to-face interaction and help facilitate effective technology exchange and lower trade costs. Previous researchers have examined the connection between regional dimensions and innovation performance. For example, regions have differed concerning their industrial specialisation pattern and their innovation performance (Mattsson, 2009). And, it has been shown that knowledge spillovers, which play a key role in the innovation process, are often spatially bounded (Bottazzi and Peri, 2003). Gertler (2003) stresses the ongoing importance of tacit knowledge for successful innovation and its exchange requires intensive personal contacts of a trust based character, which are facilitated by geographical proximity (Morgan, 2004).

Developing an innovative regional atmosphere is often part of government policies to encourage economic development. For example, Hsieh-Sheng (2011) highlighted the role played by the Taiwanese government in clustering industries and regional innovation projects to boost industrial development. In a study of multiple Taiwanese locations, the author found a significant and positive correlation between industrial technology clusters and innovation outputs. Additionally, more innovations were related to the density of cluster concentration in a networked industry, number of research institutions, and number of factories (Hsieh-Sheng, 2011).

Other research supports the role of research institutes in an innovative regional atmosphere, including local universities, research and educational institutions. For example, in Carayannis and Campbell's quadruple helix model (2009), innovation is the outcome of the interplay between academia, government, companies and society. These four actors must create a clear and comprehensive value proposition (Walrave et al., 2018). Then, through a collaborative process which encourages the creation, diffusion, and application of new knowledge, new ideas, technologies and innovations are generated (Cavallini et al., 2016).

Despite literature highlighting the success stories of industrial clusters in improving the innovation capabilities of a region, some studies have reported failures of industrial clusters. Arne (2018) studied the reasons for the failure of the Norwegian boat-building cluster and concluded that a lack of support in practice and policies by the regional innovation ecosystem led to the collapse of the cluster. Similarly, Baum and Mezias (1992) attributed the failure in the Manhattan hotel industry to a highly localised competitive intensity between hotels that compete for similar resources in densely populated geographic regions. Highlighting the issues in government policies regarding an SME cluster in Indonesia, Tambunan (2005) found that the SME cluster's struggle to access the local or international market led to its failure. Therefore, it's important to understand how successes and failures occur related to resource orchestration in regional clusters.

While there is clearly a link between regional clusters and innovation, it is not clear how these clusters are formed and managed for innovation. Researchers such as Padmore and Gibson (1998) suggest that a region assess existing and emerging clusters or cluster fragments to ask what new infrastructure could support the cluster, what industrial strengths to encourage, and what firm strategies to encourage. Then, policy makers can develop policies to fill in these gaps or address weaknesses by linking similar firms at horizontal or vertical levels with educational institutions and industry associations (Padmore and Gibson, 1998). Even though previous research has looked at the role of government policy in encouraging linkages, it is not clear how a resource orchestrator actually links these different resources to drive innovation in a regional cluster and how that role might change during innovation projects' lifespans.

2.2 Resource Orchestration

Resource orchestration theory has emerged as a fitting theory for understanding how heterogeneous actors can be connected and managed in a cluster. Resource orchestration theory is the merger of two different yet complementary theories that focus on resource management (Sirmon et al., 2011): resource-based theory (Wernerfelt, 1984; Barney, 1991) and the concept of asset orchestration derived from dynamic capabilities theory (Teece et al., 1997). The resource-based view of the firm states that firms gain a competitive advantage by having resources that are heterogeneous, valuable, rare, inimitable, and non-substitutable (Wernerfelt, 1984; Barney, 1991). However, the theory fails to explain how to deploy and configure those resources for gaining a competitive advantage. The resource orchestration theory addresses the gap by emphasising that a different combination of resources, capabilities, and managerial acumen are likely to give a firm/supply chain/network a competitive advantage (Sirmon et al., 2011; Chadwick et al., 2015; Liu et al., 2016; Gong et al., 2018).

According to the theory, a particular actor plays the leading role in orchestrating knowledge and resource use (Gong et al., 2018). Sirmon et al. (2007) developed a resource management structure based on managers' actions; here, the orchestrator links the heterogeneous actors in the cluster by *structuring*, *bundling*, and *leveraging* resources to create value for customers and competitive advantage. *Structuring* refers to the portfolio of resources (acquiring, accumulating and divesting), *bundling* refers to building capabilities (stabilising, enriching, and pioneering), and *leveraging* capabilities in the marketplace covers mobilising, coordinating, and deploying resources to create value (Sirmon et al. 2007). Subsequently, the researchers found that synchronisation of these processes was important to create value (Sirmon et al., 2008).

Few studies have considered the role of resource orchestrator or the hub-firm in operations and supply chain management. Hughes et al. (2018) considered bundling of resources at the firm level, the unit of analysis proposed by Sirmon et al. (2007). Expanding beyond the firm, Liu et al. (2018), Gong (2018) and Ketchen (2014) considered the role of orchestrator at the supply chain level while Cui et al. (2019) considered the community level for driving innovation projects. While inter-organisational networks can be nurtured through existing management structures, the resource orchestrator in the form of 'hub-firm' must manage the network structure of the regional cluster (Ye et al., 2020; Dhanaraj and Parkhe, 2006). The hub-firm takes the key leadership role by structuring, bundling, and leveraging resources and capabilities between members of the cluster to benefit the regional cluster (Ye et al., 2020). However, there is still a gap in the literature that considers how the hub-firm takes the transformational role in developing innovation capabilities of the cluster members.

Most recently, considering the ecosystem level, Bittencourt (2021) examined two industrial ecosystems and found that it is vital to have a particular actor play the role of orchestrator as it improves the use of resources (Heaton et al., 2019) as well as facilitates communication between all actors and the articulation among them. Thus, it is suggested that interacting with different actors and transforming resources into innovations is the main characteristic of the hub-firm's performance (Ye et al., 2020). From this recent work, it is also clear that depending upon the stage of collaboration (early, developing, developed), the lead role in orchestrating resources for a project changes when transitioning from structuring to bundling to leveraging resources. And by extension, when considering a regional cluster, where the orchestrator contributes to creating collaborative project groups, the role of the lead orchestrator could shift to other players as the knowledge is orchestrated from inception to the end of the project state.

There is no one-size-fits-all solution for orchestrating different resources internally (firm) or externally (supply chain) or combining internal and external resources to drive competitive advantage. The advantage or outcomes derived from the deployment of resources are determined by joint effects of connecting synergistic resources to maximise the benefits or impact on the organisation and/or its supply chain (Gong et al., 2018; Liu et al., 2019). Liu et al. (2019) highlighted the positive role of a resource orchestrator on supply chain activities amongst supplier firms which positively influenced their performance and helped create shared values among the members of a supply chain network. However, understanding the dynamic role of a hub-firm in a broader regional cluster requires attention as some examples show this orchestration can have negative outcomes. The literature clearly identifies the issue of misalignment of interests between resource orchestrator and actors in the industrial cluster or between actors in the cluster, which resulted in the destruction of shared values among cluster

members and negative impacts on members' performance (Kramer and Pfitzer, 2016; Porter and Kramer, 2011). Thus our study further examines how the cluster orchestrator's role shifts from the initial stage to get the right partners on-board that have shared values and ensures that their interests are aligned through the entire innovation process. Our research demonstrates 'how' this role facilitates creating shared value between heterogeneous players, changes over the project span, and leads to the different outcomes of the longitudinal projects that cluster members jointly undertake.

3 RESEARCH DESIGN

Our exploratory case studies investigate the role of resource orchestration in a regional innovation cluster. In the tradition of studies designed to generate theoretical insights, we chose the case study approach, following recommendations from Eisenhardt (1989) on theoretical sampling. Here, the innovation projects developed within the Bordeaux wine region cluster fit the research conceptualisation. Meredith (1998) suggested that case study methodology is appropriate for investigating phenomena in a real-life context. The research team used this methodology to fill the gaps and extend insight into how collaborative innovation is facilitated in a regional cluster, thereby allow discovery of any unanticipated findings or reconcile any contextual idiosyncrasies affecting the study's outcome. Within the context of *Inno'vin* and the regional cluster, we chose individual projects as the unit of analysis as these aligned with the research questions and conceptualisation of the study (Eisenhardt,1989).

3.1 Research Setting: The Bordeaux Wine Industrial Cluster

This study focuses on *Inno'vin*, the resource orchestrator of the French Wine Innovation Cluster. While France is the second-largest wine producer in the world, the Bordeaux region, traditionally a global leader in the wine world, has faced increasing pressure to defend this position not only against traditional old world rivals (i.e., Spain and Italy) but emerging rivals like Australia, which sell quality wines at much lower prices. Recognising the need for innovation and technology transfer, in 2009, sixteen funders, including the Interprofessional Council of Bordeaux Wines (CIVB), Institute for Vines and Wines (ISVV), and Bordeaux Metropole created *Inno'vin* for the sector. Their aims included linking research and industry, building closer relations among companies and academic research units to facilitate industrial transfer opportunities, fostering the competitiveness of companies and thus contributing to the development of the wine industry in the region and beyond.

We chose to study *Inno'vin* as it met the criteria of being the hub-firm of an innovation-driven regional cluster. *Inno'vin* is a rich source of collaborative innovative project examples as it has maintained a unique place in the wine and vine industry with more than 100 funded projects (out of more than 250 projects applications). The organisation has secured funding of € 15 Million and supported 15 new start-up businesses. Since 2010, *Inno'vin* has experienced continuous membership growth surpassing 180 cluster members today. Additionally, the authors have a longstanding relationship with *Inno'vin*, thus facilitating access to various project participants for interviews to explore the formation of project collaborations, their functioning and outcomes, and access to existing project documentation.

3.2 Research Design and Data Collection

To address our research questions, the study adopts a multiple exploratory case study approach considering individual projects under the *Inno'vin* umbrella (see Table 1). By analysing these innovation projects, we can demonstrate the role of *Inno'vin*, as a resource orchestrator at the project level and the changing role of orchestrator throughout the innovation process. The research also shows how different entities contribute to individual projects enabled by the orchestration. Generally, each project consists of a collaborative team where the innovation provider (suppliers), knowledge provider (academics) and winery or other suppliers have defined and equally important roles. After the project team formation, the role of the orchestrator changes depending on the resources and capabilities that each member brings to their respective project team (see Table 1).

Table 1: Projects, Institutions and Respondents

Project Name	Description	Start date	Year	Total Project Funding	Respondent-Role
SORTSIZE	Process development on grape sorting and impact on wine quality	July 2012	2012 - 2016	414 K€	**SS-Supplier**
					SS-Winery
					SS-Academic-A
					SS-Academic-B
COMPOST	Automation of vineyard composting and fertilisation	October 2010	2010 - 2012	189 K€	***Compost-Supplier***
					Compost-Assoc-A
					Compost-Assoc-B
					Compost-Winery
					Compost-Academic
AROMA	Molecular determinants of aroma characteristics in Chardonnay	June 2016	2016 - 2018	735 K€	**Aroma-Supplier-A**
					Aroma-Supplier-B
					Aroma-Academic
DSS		April 2014	2014 - 2017	395 K€	***DSS-Supplier***
					DSS-Academic

	Decision support system for automated pesticide spraying				DSS-Winery
BARRELO2	Oxygen transfer in barrel aging	July 2012	2013 - 2015	290 K€	***BarrelO2-Supplier***
					BarrelO2-Academic
EXTRACT	Development of plant extracts for beverage additives	April 2017	2017 - 2019	214 K€	***Extract-Supplier-A***
					Extract-Supplier-B

Wine related Associations	**Respondent Role**
INNO'VIN	Director
	Communications & Training Manager
	Project Manager
Bordeaux Wine Council (CIVB)	President
	Technical Director
	Communications Director

Italic – Project initiator; **Bold** – Project leader

Of the 100 funded projects, we first looked for projects that were larger scale in terms of budget (greater than 150K €) and considered a typical project from the perspective of *Inno'vin*. Of the resulting ten projects, for each project case, we requested interviews with all project participants. We required the project leader and at least one other participant. Six projects met that criteria. Archival data sources, such as videos, internal brochures, newsletters, websites, annual reports of *Inno'vin* activities, newspaper articles, and numerous project documents, were used to complement and triangulate the interview data. Furthermore, the primary data collection was guided by a semi-structured interview protocol (see Table 2) and adjusted to the characteristics of representatives (academic researcher, supplier, winery, or vineyard manager). The interview strategy aimed to gather a diverse range of views from team members on processes and outcomes specific to each project and the role played by *Inno'vin* from project conceptualisation to completion.

Table 2: Interview Protocol

Demographic & Company information

1. Company, years in business, Respondent role, History, Number of Employees?
2. Please provide a brief description of your company (primary markets; primary products/services; competitors).
3. How does your company fit into the wine industry? (e.g. supplier, vineyard, technology provider)
4. How important is new product development and/or innovation to the success of your company and its profits?
5. How important is environmental and social sustainability issues to your company? What in particular is the most pressing sustainability issue from your company's perspective?

Inno'vin Cluster

1. What motivated you to approach Innovin and how did you get involved?
2. What is Inno'vin's role in innovation adoption within the cluster and your company?
3. What is the role of Inno'vin from the perspective of the Bordeaux wine industry?

Inno'vin Project Group formation and dynamics

1. How many projects have you done with Inno'vin?
2. Please specify the cluster project which you would like to discuss with us.
3. How was the project funded?
4. Who proposed the project and why? What was the problem that the project was supposed to solve?
5. What was your organization's role in the project?
6. Which other companies joined the project and what was their role in the innovation process?
7. Could you please give an account on how the project was facilitated by Inno'vin?
   Could you please give as a detailed account on different stages of the innovation process?
8. Were any players more influential in moving the project forward and keeping it on track?
9. Did everyone benefit equally from the project? If not, who benefited most?

Project Outcomes

1. To what extent does Inno'vin have a generic model to define and measure success during a innovation project? What was the role of Inno'vin in setting of indicators monitored during the project? With respect to selected project, how did you define and measure success during the project? What were the indicators monitored during the project?
2. What are other metrics might indicate the improved **economic sustainability** from the project? (KPI's such as revenue growth, cost reduction, etc.)
3. What types of **environmental practices** do you have (for how many years, certification year)? Have you added any new practices and related metrics as a result of involvement in this project? Generally, as a result of these practices, what kind of improvements did you see? Reduction in cost, waste, pesticides, water use, etc.

Considering Innovation Transfer and Broader Impact

1. To what extent has the innovation implemented during the project been transferred to other wine vineyards?
2. To what extent did the project make the Bordeaux wine industry more sustainable? Which specific indicators have been improved within the Bordeaux wine industry?

3.3 Data Collection

Different research team members conducted interviews, either face-to-face when possible or via video conferencing. Table 1 summarises the projects, functions, and positions of interviewees. In some cases, the project initiator and the project leader were not the same individuals. Most projects include interviews with the knowledge provider and an academic expert on wine; these participants brought specific wine research expertise relevant to the respective project. In one case, EXTRACT, two suppliers worked together due to the nature of their product innovation. Three projects included winery respondents, i.e. SORTSIZE, AROMA and DSS, because those projects needed winery participation for experimenting and prototyping. Interviews were also conducted with the leadership from *Inno'vin,* CIVB and ISVV. Overall, the research team conducted, recorded, and transcribed 26 interviews. The interview questions were created in English and translated to French by one researcher with back translation performed by a different researcher. A similar process occurred for the transcripts.

Interviews lasted for 60 minutes on average. All interviews were validated with the recordings by the interviewee to ensure data accuracy (Voss et al., 2002). Moreover, the authors triangulated data from the interviews with archival sources (for credibility and reliability) in seeking converging evidence and theorising abductively on collaboration projects. This corpus, combined with our database of archival documents, provided us with extensive information on the projects, the events organised by the *Inno'vin*, and their initiatives.

3.4 Data Analysis

We divided the data analysis into two stages, primary and secondary coding, to structure our data. During the first stage, each research team member assigned their own code to the data gathered to represent a specific meaning (i.e., a quote might be labelled: *access to information* or *connecting science and technology*). After primary coding, the research team grouped the codes into categories related to the resource orchestration process, as recommended by Miles et al. (2014). The codes are applied at the individual actor level to understand each stakeholder's perception of the *Inno'vin* and their own roles in resource orchestration. Differences were discussed and reconciled. After that step, the authors reached a consensus regarding the coding of ideas used in the analysis. Overall, the second order codes aligned with the categories related to resource orchestration but we followed the principles of theory building identified by Eisenhardt (1989) to discover new concepts.

The authors took a number of measures to increase the reliability and validity of the study, including:

- Insuring several informants from different organisations within each project case. This step ensures triangulation of views from representatives of relevant stakeholders to mitigate the presence of common method bias, as recommended by Podsakoff et al. (2003) and Conway and Lance (2010).
- Using a consistent case protocol tailored for each interviewee type – academic, supplier, winery, etc. with back-translation protocols.
- Performing data triangulation using both primary data from interviews to understand the collaboration process and secondary data from *Inno'vin* and company reports as recommended by Lewis (1998). The secondary data includes the reports and other dissemination materials generated as outputs from each of the projects. This data complemented the views gathered from interviews and, as a result, mitigated any potential interviewee bias.
- Generating codes from each interview to reflect remarks provided by participants and formally categorising the data as recommended by Miles & Huberman (1994). From this, the research

team developed a case study database, i.e. all scripts from interviews and secondary reports supported by a spreadsheet with themes and codes derived from the interviews during first order and second order coding.

- Isolating patterns, identifying commonalities among the data collected, and gradually establishing consistent generalisations across the cases, as suggested by Kaufmann and Denk (2011) and Miles and Huberman (1994).

4 INNOVATION PROJECT DEVELOPMENT

Since 2010, *Inno'vin* has worked to bring together the wine actors of the region and address challenges related to R&D for innovation. The industry members recognised the need for innovation to survive, as highlighted by *Technical Director, CIVB, "the world is constantly changing and only innovation can ensure the growth and longevity of wine companies. CIVB (via Inno'vin) seeks to facilitate innovation to preserve, and if possible, strengthen the competitiveness of Bordeaux wines".* In particular, they focused on organising a consortium of companies interested in innovation projects which would be potential collaborators with research centres in the following areas: sustainable viticulture, quality and wine characteristics, and sector competitiveness. To achieve this goal, they put in place a wide range of services for companies: calls for innovation projects, newsletters, specific sector reports for members, technological scanning and opportunity watch, innovation meetings, and a website.

Inno'vin offers a special service dedicated to project development support (Inno'vin, 2020). The process works as follows: they start by inviting companies with innovative ideas to meet. The first meeting is devoted to listening to a company's presentation of an idea. An idea could be any number of things such as a start-up creation, feasibility study, technological transfer project, etc., with funding needs of up to several million euros. If it becomes clear that the proposal does not correspond to the cluster expertise, *Inno'vin* suggests more appropriate resources to the firm. Otherwise, *Inno'vin* guides the firm and supports it at different project stages - seeking partners, formalising the idea, finding appropriate experts, tests, prototypes, etc. When the project team feels they are ready, their idea goes before the Legitimization Committee for approval. At this stage, the project idea could go through several iterations of feedback and adjustment but once accepted, the project is considered "legitimated". After which, *Inno'vin* helps the project team create a funding proposal for potential investors or specific types of government grants. Finally, when a project is completed, *Inno'vin* communicates about the project through various marketing channels and at their events. Figure 1

shows the innovative project development process under *Inno'vin*'s guidance (Inno'vin, 2016; Inno'vin, 2020).

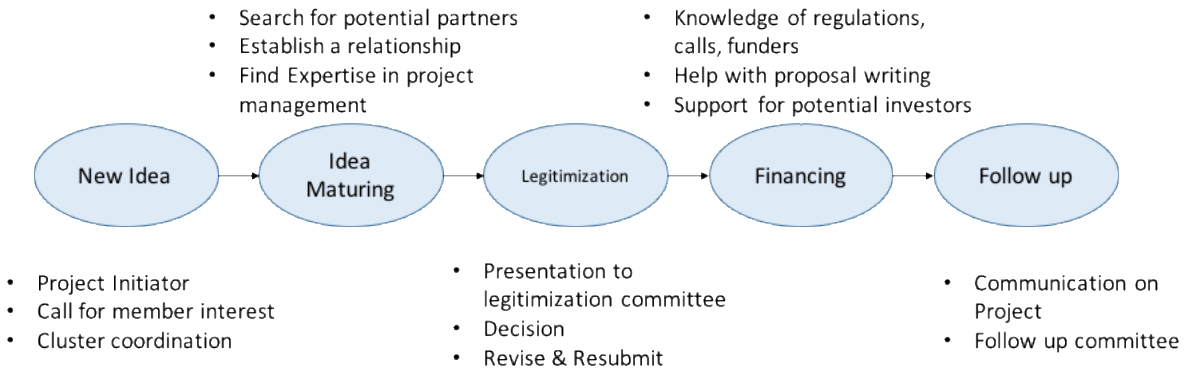

Figure 1: Inno'vin's Project Development Steps

In the case projects below, we outline the project inception, team formation, and role of *Inno'vin*. The projects represent many different activities and interests related to the Bordeaux wine industry, from vineyard production equipment to processing products (IT, machines, tools, barrels, yeast, new extracts, among others). In most cases, a winery or vineyard partner is needed for a test site and research organisations and academics are required to perform experiments or develop the technology.

SORTSIZE - Project *SORTSIZE* (*SS*) originated from the observation from *SS-Winery* and *SS-Academic1* who thought that smaller grapes (berries) had a more complex taste than larger ones. They believed that different sized grapes offered an opportunity for expanded wine brands. To test this idea, *SS-Academic1*'s PhD student needed special equipment for sorting the grapes so she could do experiments on the wine produced from the different sized grapes. Through *Inno'vin*, they found an equipment maker, *SS-Supplier,* who already had a sorting machine that culled malformed and diseased berries. The equipment maker could do the machine design work, manufacture new machines, and market these new purpose machines to wineries: "*The idea is to have two different channels, be able to separate and then have two different processes and two different qualities you're targeting (SS-Supplier)*". While *SS-Academic1* and their PhD student developed a research agenda to work with the winery to create a range of wines, undertake taste measurements and analysis, and determine the viability of wines, *SS-Supplier* acted as the project leader and funder, explaining:

> "*Everything started because we were talking about all sorting systems and Inno'vin can say, well you should help them on this technology or this new product, you should have a look at it, it's going to be interesting for you … Inno'vin was just pulling everyone in a loop and saying,*

let's do it together and we are covering, synchronising, finding some funding on that project development altogether (SS-supplier)."

COMPOST - The idea behind *COMPOST* emerged when an equipment supplier met an inventor at an *Inno'vin* meeting. The inventor had developed the machine that shredded and collected vine shoots in the field, which could then be used for compost. Together they developed a sustainable soil fertilisation process and associated products. *Compost-Supplier*'s technical expertise was developing machines that work and maintain the soil sustainably. "*We give a lot of thought to this aspect, what alternatives there are to the herbicides and pesticides that are used in viticulture or other types of farming* (*Compost-Supplier).*" *Inno'vin* then connected the supplier with a technical partner and helped them write a proposal and present it to the Aquitaine regional funders. The funders provided a grant for further R&D with the University of Oenology as well as funding for a test site at a winery. *Compost-Academic* developed a research program to evaluate the sustainability of the proposed technology and worked with the test site partner, *Compost-Winery*. *Compost-Supplier* was the project leader and through the *Inno'vin* project process, found additional financial support through *Compost-Assoc-A* and *Compost-Assoc-B*.

AROMA – The project, *AROMA*, emerged from *Aroma-Academic,* who wondered about the effects of climate change on Chardonnay grapes such as increased sugar levels and alcohol as well as the effect of barrel ageing. Through *Inno'vin*, the *Aroma-Academic* found two industrial partners, *Aroma-Supplier-A,* a barrel producer interested in the impact of wood barrel ageing on Chardonnay wine taste and *Aroma-Supplier-B,* an industry microbiologist concerned with applied molecular biology aspects. *Aroma-Supplier-A* and *Aroma-Supplier-B* shared the role of project leader. *Inno'vin* supported the proposal through legitimation and funding from the regional government. *Aroma-Supplier-A* recognised the broad implications: "*Why it was funded? Because government considered it of a general interest... the results will be used by all professions, by our suppliers, by other winemakers."*

DSS - The project idea for *DSS* came from a *DSS-Supplier,* a developer of Enterprise Resource Planning (ERP) systems for the wine industry. The wine industry and its consumers were concerned with excessive spraying of toxic chemicals on grapes, over-spraying the neighbouring communities, and related health concerns. *DSS-Supplier*, as project leader, came up with the idea of a better IT system for controlling spraying and needed several partners. *Inno'vin* connected *DSS-Supplier* with an academic partner, *DSS-Academic,* who could develop software to assure the spray application precision, thereby reducing the carbon footprint and significantly dropping toxicity levels. As they

needed a vineyard for testing equipment, *DSS-Winery* got involved as they also wanted to pursue sustainable strategies in wine growing.

BARRELO2 – The *BARRELO2* project idea originated from the R&D department of a barrel producer, *BarrelO2-Supplier,* who wanted a better understanding of oxygen transfer in barrels during the ageing process. The supplier brought the idea to the *Inno'vin* cluster who linked them with a *BarreloO2-Academic* who specialised in wine aroma experimentation. *BarrelO2-Academic* found winery partners who would provide wine and ageing environments. *Inno'vin* then helped them create a project proposal and obtain funding from external financial sources. *BarrelO2-Academic* performed the oxygen measuring experiments and analysis. After completing the project and creating a tool, *BarrelO2-Supplier* gained reputational benefits as a cutting edge supplier of quality products for the wine industry. "*The benefit of the project to the company is a way to bring answers to this very important question of the wine ageing. It is a big step in the wine industry (BARRELO2-Supplier).*" *BarrelO2-Suppier* served as project leader.

EXTRACT – For this project, *Inno'vin* issued a call for projects and *Extract-Supplier-A* responded with his idea. The idea was based on a circular economy scheme using by-products of organic produce processing to extract enzymes which would capture aromatic freshness and could be used as an additive to improve the wine and other beverages. "*The idea is to use the by-products from the production of wine to produce products that could be used in wine. (EXTRACT-Supplier A)".* Another beverage additive supplier, *Extract-Supplier-B*, got involved as they were interested in using these by-products as protein stabilisers during the wine transfer process. Thus a partnership was formed with *Inno'vin* supporting and legitimising the project. Thus far, the team received two patents and two projects were still in progress, expecting product commercialisation by 2022. In this case, *Extract-Supplier-A* was the project leader.

4.1 Inno'vin's Role as Hub-firm for Project Development

From the previous description, we can see that *Inno'vin* acts as the hub-firm through multiple activities from a very early stage in project brainstorming through to team creation and project funding. Here *Inno'vin* is proactive in sending calls for proposals and creating meetings for sharing ideas. These meetings cover diverse topics that attract industry people, from manufacturers and seed suppliers to wine makers and vineyard managers. *Inno'vin* also reaches out to specific people and encourages attendance to ensure multiple viewpoints on an issue. And, *Inno'vin* stays in constant communications with its members through multiple channels. Here, *Inno'vin* decides what ideas are most promising in

terms of market opportunity and funding and then finds the appropriate team members, provides support for proposal writing, legitimates the proposal, and then secures project sponsors. This sets them apart from others as indicated by *SS-Supplier*:

> "*Inno'vin, if I can compare it with another cluster in Burgundy that's not working in a similar way… Inno'vin implements the funding. So it helps any size of company that can sometimes spend too much time working on that side because it's a lot of admin and they just keep struggling on a daily basis. So [Inno'vin] also helps on this, putting pieces together to help to make it faster, make it efficient, make sure that everyone can access it*."

From the project participant's perspective, they discuss different aspects of *Inno'vin*'s ability to find different types of resources, evaluate the capabilities of different players, refine the innovation idea, put together the project teams, and create a fundable proposal (legitimation). Table 3 illustrates the themes of access to resources, legitimation of project ideas, and *Inno'vin* serving as bricolage.

Table 3: Inno'vin's Role as Hub Firm for Project Development

Access to resources
The companies wanted financial help from the region (Aquitaine region) and Inno'Vin, you have to pass through Inno'Vin to ask for such funding at Région Aquitaine. (BarrelO2-Academic)
I expect from being a member of Inno'vin is to be helped in identifying calls for projects, to be given the chance to expand our network, to participate in events, and confidentiality. (Extract-Supplier-A)
Our interest to be in Inno'Vin was facilitation of cooperation with another industries and also with the French Government because we had some programs which were co-founded by them. Inno'Vin played the role to arrange data, to write papers and to connect with good people to make this program possible. (Aroma-Supplier-B)
Bricolage
The goal of Inno'vin is to help innovation to merge and to be adapted to the need of the producers to help them to face the changes. (Product Manager Inno'Vin)
If I can share experience with Inno'Vin what I like, it's this glue system that they put us in contact altogether (SS-Supplier).
They know the people who can develop products in an experimentation way (R&D). They also need financial partners to present it to the region and get grants for R&D (Compost-Supplier)
Inno'vin is really the cross link between the industrial and the university… they can call me and tell me: we have a project, it could be interesting for you because they work in say, bacteria for another industry. And so it's very important for the link between the industry and the university. (Aroma-Supplier-A)
Inno'vin helps bring ideas from the field to the scientist. It is the interface that allows communication between the two worlds, because a scientist has a hard time relating to a farmer, and a farmer has a hard time relating to a scientist. To me, this space for communication is the most important role for Inno'vin." (SS-Winery)
Legitimation
Inno'Vin is a legitimator and puts a stamp on the project and this helps get funding. (SS-Academic-B)
Inno'vin for me is, quote, "second-nature". I know that if I have an idea I would automatically go to them, because they are highly professional. (Compost-Supplier)
There is a validation by Inno'Vin that the project could be interesting for the overall wine industry. (Aroma-Academic)
And above all, that things are kept confidential. (Extract-Supplier-A)
We pay a lot of attention to everything linked with confidentiality. (Project manager, Inno'Vin)

Considering access to resources, *Inno'vin* acts as the gatekeeper to the regional (Aquitaine) funding for projects, information and knowledge transfer, and access to a customer base and project partners. All of the project participants mention calls for projects, the meeting network, support with proposal writing and idea refinement, particularly funding from the regional government. According to *Aroma-Supplier-B:*

> *"Our interest to be in Inno'vin was facilitation of cooperation with other industries and also with the French Government because we had some programs which were co-funded by them. Inno'vin played the role to arrange data, to write papers and to connect with good people to make this program possible."*

Inno'vin acts as bricolage (a bundler), by connecting diverse entities. It has a large social network and facilitates innovation in science and technology among wineries and their suppliers. *DSS-Supplier* mentions: "*Inno'vin has been able to put around the table: the government, the region, the scientists that we were supposed to work with in this project, the mathematicians and the professionals. It's kind of a union thing which is managing the interest of the wineries in Bordeaux."* Regardless of the member's role, each sees the advantages of working together. From a winery's perspective: *"Inno'vin helps bring ideas from the field to the scientist. It is the interface that allows communication between the two worlds, because a scientist has a hard time relating to a farmer, and a farmer has a hard time relating to a scientist. To me, this space for communication is the most important role for Inno'vin* (*SS-Winery*)." The academics give a similar spin on their experience: *"Inno'vin was born to break this wall between research and end users and industry* (*SS-Academic B*)." And from a supplier perspective, "*Inno'vin pulled everyone in a loop saying, let's do it together and we are covering, synchronising, finding some funding on that project development all together* (*SS-Supplier*)."

Finally, through *Inno'vin*'s market scanning, research, and diverse knowledge, the organisation can assess the feasibility of the project and, by their approval, add legitimacy to the project. All the members trust them in their actions and decisions. And their stamp of approval bears weight: "*There is a validation by Inno'vin that the project could be interesting for the overall wine industry (Aroma-Academic).***"** Clearly, *Inno'vin* improves existing resources by sourcing and assembling the right type of resources required to launch an innovation project.

4.2 Inno'vin's Role in Developing Capabilities

Through their process of creating events and pro-actively building a network of collaborative activities, *Inno'vin* helps develop the capabilities of the members that participate in the projects and network as

well as the overall level of innovation capabilities of the region. At the individual level, potential project members learn functional skills such as brainstorming for ideas with other industry members, finding appropriate partners, and writing a successful proposal for funding from government agencies and other sources. As seen in the cases, a supplier typically becomes the project team leader. The suppliers are in the best position to create a marketable product or process even though not all innovation ideas emanate from them. In the case of *SS*, the project idea started with a winery and academic, but they needed a machine supplier to realise their idea. While in the case of *AROMA*, an academic initiated the idea, but ingredient suppliers were required to implement the innovation. Project leaders- suppliers, see opportunities for developing their own innovation capabilities through the process as well as creating benefits for their industry and region. These capabilities relate to a new product or process development and quality improvement. As a team, the project leader and team members experience capability improvements such as research capability enhancement and gaining distal knowledge enabled through collaboration with other heterogeneous players in the innovation project (Table 4).

Table 4: Improving Capabilities

SUPPLIERS

Innovation to Product or Process

I would say, well, there isn't a specific budget set aside for innovation, it's determined more by the projects that present themselves. We listen to what the winemakers tell us, that's very important to us. We try to stay in close contact with them and according to what they tell us we develop new products. (Compost-Supplier)

We have a lot of competitors and to attract customer, we need to offer all time something new, something which suits better to the demand and that's why we release almost every year something new. (Aroma-Supplier-B)

The aim of the project - to create a tool for the top-level vineyards in the world. (BarrelO2-Supplier)

Quality Improvement

At the moment our business is focused on how to work the soil, how to maintain the soil without chemical products. Not just that, it can also be mowing, and looking for alternatives. We give a lot of thought to this aspect, what alternatives there are to the herbicides and pesticides that are used in viticulture or other types of farming. We have always manufactured products that – maybe through foresight? –that are in the vein of sustainable development. I think it's in the spirit of our business. (Compost-Supplier)

Wine is very high image, so it's very important to improve all of the input that you use for wine. (Aroma-Supplier-A)

People like to see company involved in environmental issues and social responsibility. So due to the fact that we work with wood, we have been involved in different certification program for sustainability of the forest...We have got two: ISO certification program and another one, PEFC which is a specific certification for wood sustainability(Aroma-Supplier-B)

The results we got, they can serve for anyone because it was published and people are access to that, but the driving force of project was our need to understand… in Chardonnay, we wanted to know better what kind of barrels would kind of ageing Chardonnay need for better quality. (Aroma-Supplier-B)

More recently, the market asks us to go further. So now we are looking at how to save the water, how to save the energy, how to use less plastic and so on …
It's more or less like if feeling we have a research community in the company. For example, we can integrate some new knowledge in quality control. (Aroma-Supplier-B)

PROJECT TEAM & REGION

Enhanced knowledge creation and sharing

The school wanted a cluster to connect wine makers, businesses, researchers to transfer knowledge to end users but also have users work with researchers to create new ideas or approaches (SS-Academic B).

The main research was done at Bordeaux University. So the majority of operation of research were done by people, or our detached researchers, or by Bordeaux research or by people specifically recruited for project. And at the second time, we did some trials in wineries, so directly with our customers. We had some customers interested in that so we did some specific barrels and the barrels were trialled in the cellars of our customers. (Aroma-Supplier-B)

So in fact we recruit an engineer and this engineer will be recruited afterwards by the software company. But in fact we train that engineer about what the scientific results are. This engineer works with our research and then at certain step of the project this engineer is recruited by the company. So in fact we transfer his competency to the software company which is a guarantee for us and for the company to understand and also to have the possibility to get all the knowledge, all the experience, all the engineering experience to make it happen and to maintain the solution in the long-run. (DSS-Academic)

The project was not about developing the machine, but more about providing to the company who developed the machine, more knowledge about small and big berries which they could use to sell the machine. So in fact, the university provided a lot of knowledge on berry size and impact of berry size on wine quality which the company could use to market the machine. (SS-Academic-B)

I think we have a topic that we find interesting and then we try to find some companies that could be interested to fund this project. It's not kind of work that a company comes and say, 'Ah, we would like you to work on this topic.' And we say, 'Yes, it will cost…' It's not like that. I think we begin by our idea from an observation on some things that we consider interesting and then we try to fund it with the help of industrial partners. (Aroma-Academic)

The winegrower was very important because most of the experiments were carried out in his vineyards and his winery. So the fact that it was a wine grower involved in the project was absolutely key to the success of the project (SS-Academic-B). The winemaker is naturally very innovative and keeps exploring innovative solutions. That is the reason they have multiple projects over two decades (SS-Academic-A).

Back in the day, scientists made the decisions for everyone. They decided what was important and conducted studies. Sometimes these studies were guided by industrialists who wanted to sell their products or solutions. Nowadays, and in the future, the farmer is the one leading the reflection. (SS-Winery)

4.3 Suppliers Capability Building

Through leading and managing innovation projects, the suppliers learn how to develop new products through research partnerships and experimentation. Additionally, as project leaders, they take on orchestration activities (bundling and leveraging) as *Inno'vin* steps away after funding is secured until the project has been completed. For example, the supplier, *BARRELO2*, focuses specifically on new product innovations that meet the needs of the leading wineries of the world. Given the complexity of the barrel aging process, they need research capabilities from academics to enhance their understanding. From *BARRELO2*'s perspective, "*[our] company must be the driver of the project…it's very important to be proactive in terms of the project because it is the way to bring answers to this very important question of the wine ageing. It is big, big progress, it is a big step in the wine industry. And we now start to understand the role that barrels play with the oxygen transfer for the wine ageing* (*BarrelO2-Supplier*)." Partnerships with wine makers and growers also help develop new knowledge and subsequently products. As *Compost-Supplier* indicates, "*we listen to what the winemakers tell us. We try to stay in close contact with them and according to what they tell us, we develop new products*".

Another capability enhancement is learning to improve quality and sustainability. Projects that improve these capabilities contribute positively to the reputation of all winemakers in the region. Suppliers of vineyard machinery and IT are concerned with reducing pesticide and water use; those supplying the wine-making processes need to understand better these processes and the implications for their existing and future products. One of the key reasons for constantly improving sustainability is that "*Bordeaux wine is a premium product, so it's paramount to minimise all of the inputs that you use for wine", (Aroma-Supplier-A).*" According to *Compost-Supplier*: "*The project was recognised, it received an award at Vinitec in Bordeaux in 2012 or 2014. Aside from the economic return of a project, professionally there was a lot of talk about this project so we were known, and it was then known what our business is capable of producing."* And from *BarrelO2-Supplier*, "*Thanks to this project, the company is perceived as the leader, the real leader, in quality in the wine industry."*

4.4 Team and Region Capability Building

Project team leaders indicate that knowledge sharing is a vital aspect of the innovation process. Indeed, sharing knowledge not only with customers but with the whole cluster is important, as suggested by *Aroma-Supplier-B*, "*we share the research with whole of the profession and with customers. So we bring the knowledge to our customers. We explain it to them, for example, that ageing in such a condition can bring such quality to their wines. Our benefit is to communicate around the brand. So,*

make the brand bigger by bringing new knowledge to customers". Through their publications and presentations, academics share their findings with the entire industry. And clearly, many projects are mutually beneficial, "*For many projects, they do it to bring knowledge to whole industry… they are for the whole industry's benefit",* according to *Aroma-Supplier-B*. As pointed out in a recent report on the *Inno'vin* activities (Ausone, 2020), *"a large majority of accredited projects have addressed the regional (60.9%) and national (68.2%) challenges of the wine industry".*

Team members mention that creating and transferring knowledge during the projects can enhance the capabilities of project members. The *acquisition of distal knowledge* is a different kind of knowledge from what they would typically acquire in their own spheres. The project cases illustrate that different project team members recognise that expert knowledge can come from outside their own organisation and that together these project teams need each other to gain this knowledge. Wineries acknowledge their contribution to the generation of new research questions. As *SS-Winery* stated*: "back in the day, scientists made the decisions for everyone. They decided what was important and conducted studies. Sometimes these studies were guided by industrialists who wanted to sell their products or solutions. Nowadays, and in the future, the farmer is the one leading R&D projects in the Bordeaux wine industry".* Another example of *distal knowledge* at play is when academics train an engineer who the company then hires to implement solutions. In the example of *DSS*, the academic team recruited an engineer and trained this person on how to use their new software and interpret the results. At a certain point in the project, the supplier company took over the employment of the engineer. This illustrates a way to shift the knowledge back to the company, as stated by *DSS-Academic:*

> "*So in fact we transfer his competency to the software company which is a guarantee for us and for the company to understand and also to have the possibility to get all the knowledge, all the engineering experience to make it happen, and to maintain the solution in the long-run… guaranteed effective knowledge transfer, exploiting the solution in the long-run".*

Project members benefit from enhanced capabilities in different ways. While the academics present research at conferences and publish articles in academic journals based on the work undertaken in the projects and this enhances their reputation, other players gain reputational benefits just by participating in R&D partnerships. This diversity of views related to the reputational building was observed in the interviews. *SS-Supplier* indicates that "*they can say, with our machine, we hired a PhD. So they can advertise a lot the fact that they did research and development".* Similarly, *Aroma-Academic* mentioned that "*suppliers were also interested in participating in R&D projects because they can say to the customer, 'Oh, sir, we are very at the top of the research concerning… and we can try to give you new insights on Chardonnay*". Also, as mentioned previously, these reputation effects tie into the

perceptions of quality for the suppliers: "*Thanks to this project, the company is perceived by the wine-makers and vineyards as the real leader in quality in the wine industry (BarrelO2-Supplier)".*

4.5 Inno'vin's Role at Completion

After completing a project, *Inno'vin* gets directly involved again, assessing project outcomes and providing exposure about project results (meeting presentations, award ceremonies, and communications). They gather outcome measures such as patents, ROI and sales (suppliers); or publications and presentations (academics). *Inno'vin* finds that companies that experienced sales growth from the innovation projects attribute to *Inno'vin*'s project development process. But project leaders mention challenges: "*From the beginning of a project we are all enthusiastic, oh, it's fantastic, we're going to do great things together, we're a good team. And then in fact, it' a bit disappointing and I think Inno'vin at the moment is just thinking about reducing the number of companies that they put on one project (DSS-Supplier)."* Thus, there is a feedback loop on how to improve the project process, but we did not observe any changes to the innovation project process during this research.

DISCUSSION

This section aims to elaborate on the research questions and how the work improves our understanding of the hub-firm's role in developing the innovation capabilities of their cluster members. Building on resource orchestration theory (Sirmon et al., 2011; Gong et al., 2018), we considered the hub-firm's role in structuring and bundling resources in a regional cluster and how the role shifts to the project team leader, who subsequently leverages resources for developing innovation capabilities and resulting outcomes. Table 5 illustrates the role of different actors and the activities undertaken during the stages a typical project goes through - structuring, bundling, and leveraging.

Table 5: Phase of Resource Orchestration, Roles and Activities

	New Idea Generation	Idea Maturation	Legitimization & Financing	R&D Project Execution	Market ready, outcomes, & followup
Resource Orchestration	**Structuring**: Resource acquisition, accumulation & divestment		**Bundling**: Stabilizing or expanding current capabilities, creating new capabilities		**Leveraging**: mobilizing and deployment (implementation of capabilities)
Activities	- organize events - market research - develop cluster membership - call for projects	- search for capabilities in potential partners - establish relationships - find expertise for project management - assess viability of idea	- support presentation & proposal - knowledge of regulations, calls, funders - Feedback for idea improvement	- prototype development - experimentation - training experts for knowledge transfer - communicating developments	- product introduction - followup, assess & monitor - learning & reconceptualising - communication & marketing
Inno'vin	Hub Role	Hub Role	Hub Role	Indirect Hub Role	Hub Role
Academics	Cluster Member, Project initiator for research needs	Initial R&D, feasibility and needs assessment	Support project preparation	Perform experiments Presentations & publications	Publication, knowledge dissemination, new questions
Suppliers	Project initiator for viable product	Project manager	Project manager	Hub Role Project manager	Hub Role Knowledge dissemination, patents, product sales.
Wineries	Project initiator for desired products or process	Participant test site, raw materials or wine	Participant test site, raw materials or wine	Participant test site, raw materials or wine	Tester and Buyer of new products
Regional Government	Market information, funding resources, goal setting	Target funding for specific economic/sustainability goals	Enable projects through funding	Monitor funding	Assess projects and impact on region.

The results indicate that while the hub-firm plays a key role in structuring, bundling, and leveraging resources up to a certain point, the project leader and team members do additional leveraging of their resources to take advantage of market opportunities, further build the team member's capabilities and build value in the market and region through participation in the innovation process. The results also demonstrate how the regional characteristics such as clustering of suppliers, technology service providers, academic experts, wineries, vineyards, associations like *Inno'vin* and CIVB in the Bordeaux region jointly develop innovation capabilities (as demonstrated in the six projects) and result in enhanced image or reputation of the Bordeaux wine industry. This aligns with Carayannis and Campbell's quadruple helix model (2009) that showed how innovation in the regional cluster resulted from the interplay between academia, government, companies, and society. This agglomeration of economic activities leads to innovation, triggered through shared resources in technologies, infrastructure, inputs, and access to specialised knowledge and skills-set. And further, it gives members the ability to respond to customer requirements in local, national and international markets.

Our results show that an expected outcome of the innovation projects was improvements to the quality and/or reputation of the firms and region. This result is particularly relevant as the region and its wine had received bad press due to a diminished value proposition and poor sustainability practices which damaged their longstanding reputation as premium wine producers. Members of the *DSS*, *AROMA*, and *COMPOST* all shared environmental concerns about Bordeaux's climate change, water use, and pesticide spraying, similar to those reported by Robert (2019) and emphasised developing process and product for mitigating the environmental externalities of vine agriculture. This concern around heterogeneous actors meeting sustainability goals aligns with Porter's (2000) definition of a regional cluster where regional firms combine their individual offerings into a coherent customer-facing solution.

Hub-Firm Role in Structuring and Bundling Resources

Previous research highlighted how crucial the hub-firm's role is in driving innovation within networks of heterogenous players (Geels, 2002; Wuyts et al., 2004; Liu et al., 2019; Bittencourt et al., 2021), similar to what was observed with *Inno'vin*. Chen et al. (2018) and Ye et al. (2020) highlighted the importance of cluster leadership in influencing other firms in the cluster, establishing the cluster's identity, and promoting innovation within cluster members. Barrie et al. (2019) also found that regional industry clusters can increase knowledge and resource flows amongst their members, accelerating collaboration and cooperation activities, facilitated by the hub-firm or cluster manager. *Inno'vin,*

taking the leadership role during the project initiation stage, starts the resource orchestration process of *structuring and bundling* by connecting a wide range of organisations that shares a common goal but have diverse ideas, capabilities, and knowledge of the Bordeaux wine industry. In the first phase, we see *Inno'vin* support the *generation* of new ideas. The activities needed for these initial phases include hosting events where industry practitioners can network with others to find a common interest and *Inno'vin* offers market research that subsequently leads to calls for projects. Next, *Inno'vin* takes the bricolage role in the *bundling* stage by organising members into collaborative groups to work on a specific project and assess the viability of the idea, hence an *idea maturation* phase. This finding is aligned with Yang and Wang's study (2008) that concluded industrial clusters should cultivate high-quality inter-disciplinary talents for technical and process innovation purposes. Further *bundling* occurs when *Inno'vin* adds feedback for concept improvement, legitimation, and financing.

In addition, during the *structuring and bundling* stage, *Inno'vin* has visibility of who is doing what, where, and when related to R&D activities. This is very important for exploiting knowledge creation opportunities, enhancing knowledge flow within regional networks, and synchronising the inputs from all members to achieve innovation project outcomes (Barrie et al., 2019; Liu et al., 2019; Rampersad et al., 2010). Here we see that *Inno'vin* recognises the need for academic experts and technical knowledge specialists to be part of the project team. Researchers' specific expert knowledge on *Inno'vin* projects is vital in identifying new knowledge needs, providing expertise on the project focal area, and creating new connections with industry members. *Inno'vin* adds value by connecting members doing chemical experimentation on yeast or barrel ageing to government funders. This role of hub-firm in connecting members with government bodies is in accord with previous literature (Smith and Raven, 2012).

As indicated in literature (e.g. Gertler, 2003; Morgan, 2004) and evidenced in the *Inno'vin* approach to cluster formation, trust and sharing common goals complemented geographical proximity and intensive personal interaction during the *structuring* process. This creates a foundation for innovation and the successful completion of projects. In our study, the process of building trust among members was facilitated in the *structuring* and *bundling* activities led by *Inno'vin*. All project participants, identified and brought together by *Inno'vin* had the objective of working towards a common goal: to gain knowledge and benefits from resource and knowledge orchestration provided by *Inno'vin* and access government funding to build their innovation capabilities and also the reputation of the Bordeaux Wine Industry. The finding confirms what researchers (Shao et al., 2008; Rampersad et al., 2010; and Liu et al., 2019) suggested regarding a common goal and shared values among cluster members as essential criteria for an industrial cluster success. Addressing limitations of previous

studies that focused on more individual firm-oriented motivations such as patents, cost, risk reduction, and reducing time to market (Giusti et al., 2020; West et al., 2014; Shao et al., 2008), our findings demonstrate that increased knowledge and quality improvements are perceived as crucial shared benefits that would improve the global market share of Bordeaux wine. Shared trust among members also influences the successful initiation and completion of projects. For example, suppliers in the *BARRELO2* or *AROMA* projects align with the recognised need for maintaining the prestige of Bordeaux wine and consider collaboration as a way to enhance their image. Clearly, the way Inno'vin structures and bundles the project team and manages the dynamics of project teams is essential to creating these innovation capabilities.

Project Management for Bundling and Leveraging resources and Resulting Team Innovation Capabilities and Outcomes

In the *R&D Project Execution* phase, the role of the hub-firm shifted from *Inno'vin* to suppliers. In the case of *COMPOST & DSS*, the technology providers led the project and leveraged the bundled resources to facilitate knowledge spillover. Alberti and Pizzurno (2017) and Giusti et al. (2020) have found that technological knowledge acts as a platform that drives market or managerial knowledge spillover. The winemakers and vineyards are the ones that ultimately pilot the innovation being led, developed, and tested by academics and suppliers. *COMPOST* and *DSS* projects involved vineyards in testing equipment used for monitoring vine growing; *SS* used a winery's production facility to test equipment and create wines. Owning a full R&D laboratory was beyond the scope of any individual business involved in these projects but working with the cluster members helped build the innovation capabilities of all involved. In the six projects, the project leader facilitated knowledge spillover during the project execution stage, leading to knowledge enhancement through collaboration in unexpected ways as members learn about experimentation, research challenges, and opportunities.

In the *market ready, outcomes, and follow-up phase* (Table 5), project members gained new innovation capabilities that led to improved outcomes, both anticipated (i.e., quality and reputational benefits) and unexpected outcomes (i.e., learning about research and the experimentation process), confirming what other researchers reported (e.g. Sydow and Windeler,1998; Jiaqiang et al., 2013; Soosay and Fearne, 2011). Evidence gathered from this study shows that several outcomes derived from co-innovation are found in previous studies. Similar to the findings obtained by Shao et al. (2008), market growth is generated from the diffusion of technology developed through collaboration. Another outcome is that some projects improve productivity from a process co-innovation perspective, namely *SS* and *AROMA*.

The study by Anttila (2004) also found that improved productivity is an outcome of collaborative innovation. *EXTRACT* and *COMPOST* created and diffused implicit knowledge on applying circular economy principles in the viniculture and wine production processes, respectively. Similarly, the work published by Yang and Wang (2008) found that knowledge created from sustainability practices can be diffused within an industrial cluster, whereas Giusti et al. (2020) found that the creation of implicit knowledge can leak in open innovation networks. Previous research has failed to explain how the above mentioned benefits are realised in a regional industrial cluster; our study has addressed that gap.

Although it takes time for project members to fulfil their expected benefits from embarking on co-innovation initiatives, many of the project members from this study subsequently participated in other projects as they recognised how the innovation process worked and how acquired knowledge and capabilities help drive the future innovations. And as mentioned previously, the activities that *Inno'vin* facilitates improve the overall competitiveness and reputation of the Bordeaux wine and vine industry while benefiting their individual members.

CONCLUSIONS

The study presented in this paper makes a threefold contribution to the literature. First, it demonstrates *how* the hub-firm structure, bundle, and leverage resources to develop individual and regional innovation capabilities, and thereby the competitiveness of the region. Second, the paper provides insight into how the pre-project phase involving structuring and bundling of resources through the hub-firm's bricolage activities adds to the legitimation of the collaborative projects. Third, it examines the process of transferring the hub-firm leadership role to one of the project team members, leaving that person to guide the innovation process through to the project completion stage. Also, the study sheds light on how the resource orchestration theory is used to examine the interplay of the firms and academic institutions to advance knowledge through co-innovation.

Theoretically, this paper contributes to the limited research stream on resource orchestration in regional clusters, particularly the role of hub-firm in fostering co-innovation. Here resource orchestration theory helps to go beyond 'what' drives competitiveness to answer 'how' the hub-firm develops individual and regional innovation capabilities to improve competitiveness. Through the selected projects run within *Inno'vin*, the study demonstrates how the hub-firm structures, bundles, and leverages resources to develop and fund innovation projects. In our cases, the role of resource orchestrator then shifts to a team member (usually a supplier) who further bundles and leverages the team resources and finally back to the original hub-firm for further leveraging through marketing and

communications of the finished project. Previous research has not addressed where the hub-firm might leave gaps in the process from project creation to implementation. Future research should explore how having a more consistent presence of the hub-firm in the project process, might make a difference in achieving better market objectives.

As a second theoretical contribution, this work extends the research on the hub-firm's role in encouraging innovation capabilities of cluster members via collaborative projects. Previous research on resource orchestration in operations and production management has been limited to within the micro-level (firm) and meso-level (supply network) with very limited work on the macro-level (capabilities of the ecosystem). Here, we extend the previous work by Heaton, Siegel & Teece (2019) and Bittencourt (2021) on the role of a hub-firm in industrial ecosystems. While Bittencourt (2021) found that the hub-firm was necessary to improve resource use when comparing two ecosystems, we go beyond that finding by considering how the hub-firm operationalises project creation and inception of collaborative project teams (i.e., suppliers, academics, and wineries). Here, suppliers play a significant role in managing projects and are the main market participants, measuring success by ROI, current and future sales. Academics, wineries and vineyards play a supporting role; for them, a successful project is measured by knowledge gain and intellectual contributions. Future research should take a more longitudinal approach to consider longer-term gains for market participants such as suppliers and wineries. With a long product cycle, innovations for vineyard applications such as machines and IT take many years to realise returns. Changes to barrel aging and ingredients similarly can take multiple years for consumers to recognise and pay for quality improvements in the wine. Reputational effects are extremely significant to this industry and those can be slow to realise.

Finally, the paper sheds light on the resource orchestration theory used to examine the interplay of the firms and academic institutions to advance knowledge through co-innovation. There is an opportunity for future research to apply this theory in other collaborative supply chain networks as well as areas such as the circular economy which often involve multiple participants from different industries.

Practically, this study has implications for existing and future hub-firms and project participants in regional industrial clusters. Our paper has identified the key activities future hub-firms should be doing to enhance the competitiveness of the region. For the hub-firm, this research illustrates what works in finding appropriate members and resources as well as creating project teams. The research also exposes where more attention should be given to the evolution of the hub-role in the later stages of a project. Additionally, we reveal the capabilities that each participant gains by project participation and how it leads to the regional competitive advantage.

From the policy perspective, the paper provides strong evidence of the role the government bodies (such as CIVB, ISVV, and Bordeaux Metropole, in our paper) in creating infrastructure and support mechanisms (e.g. Inno'vin and over 100 funded projects) to improve the reputation and competitiveness of a region and industry (i.e . French wine industry). The regional cluster and innovation eco-system researchers have highlighted the need for such policies and government bodies to link research and industry, building closer relations among stakeholders in the cluster or eco-system such as companies and academic research units to facilitate industrial transfer opportunities, fostering the competitiveness of companies and thus contributing to the development of the industry, region and beyond.

There are several limitations to this research. First, we focus on a specific regional cluster managed by *Inno'vin*. There are other groups managing regional clusters not only in wine but in other unexplored regional industries such as ocean technology for sustainable fishing with a project-based focus. Future research could consider how those hub-firms manage projects and how they might differ in structuring, bundling, and leveraging resources from project initiation to completion as well as the outcomes perceived by different project members. Second, our research explored projects retrospectively and we observed that project members suggested changes to the process approach. Future research may consider how smaller and more focused teams might have greater success in achieving their goals more efficiently and effectively by observing the project team creation and functioning. Third, we observed a gap in the role of the hub-firm emerged from the time the project team was formed until the project was completed, which was unexpected. Future research should examine how the project leaders are trained to lead a collaborative project team. Additionally, in some regional innovation clusters, mentors are employed to support the project team (i.e., Ocean Start-up Project, 2021), future research could examine the role of mentors in helping achieving better outcomes.

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