ABSTRACT:

Name of Responsible Researcher:	**Mauricio Andrés Varas Valdés.**
Proposal Title:	**Managing uncertain coalition costs in the collaborative wine supply chain: governance structures, modeling issues and solutions algorithms.**

The wine industry faces intense competition, particularly in global markets, where numerous wineries vie for profitability. In order to optimize their profits, wineries need to minimize their expenses. Within the wine supply chain, there are several prospects for reducing logistics costs by employing a strategy of horizontal collaboration. **Literature shows several applications of horizontal collaboration for improving wine supply chain logistics activities.** In all these works, collaboration among wineries is modeled as a cooperative game whose characteristic function is derived from mixed integer linear programming models. In some situations, however, the characteristic function of a game does not fulfill the sub-additive property. In such a context, two fundamental questions arise: Which coalitions of wineries should form? How should the wineries in a coalition split the benefits of the cooperation? Both questions are answered by tackling the so-called coalition structure and cost allocation problems.

Although several efforts have pointed out the incorporation of uncertainty as an interesting future research line in coalition structure and cost allocation problems, most works are limited to the deterministic case. **In practice, however, the optimization problem one needs to solve to compute the characteristic function of a cooperative game may naturally be affected by sources of uncertainty.** For example, in collaborative wine logistics, the transportation and inventory problems underlying the cooperation of wineries include parameters related to the demand for goods or services. Therefore, the uncertainty in logistics costs translates into a random characteristic function. **This raises the question of how wineries should be grouped to minimize the impact of logistics cost uncertainty on the coalition's performance.** Logistics costs, however, are not the only relevant cost in this context. Coordination costs, which arise from decomposing tasks and coordinating the activities to be completed jointly, are also uncertain and could severely detriment horizontal collaboration. Due to its relevance in practice, **the comparison of the different governance structures used for implementing collaboration,** including the participation of governing bodies, intermediaries, contracts, and incentive schemes, **has been pointed out as a promising research area**. Nevertheless, to the best of our knowledge, **the impact of (random) coordination costs in horizontal collaboration remains largely unexplored in the relevant literature**, for which no effort was identified in the wine supply chain.

In this project, we propose to tackle a new cooperative game, i.e., the coalition structure and cost allocation problem under random costs and governance structures elections which arises in the wine industry (and other industries) due to the uncertainty in logistics and coordination costs. **The general objective is to support the collaboration of Chilean wineries by managing the randomness of these parameters**. This, in turn, poses several challenges and encourages the development of new solution methodologies. We answer this call by devising new formulations that build on stochastic programming and robust optimization approaches, and new solution procedures that borrow ideas from cutting planes and column generation methodologies. These tools will allow us to evaluate some managerial structures that contain coalitions' cost deviations proactively. Specifically, we will use these tools to generate insights into the role of governance structures in mitigating uncertainty when wineries share their resources and coordinate their logistics activities. To accomplish these goals, **we propose to use the standard methodology in optimization projects focusing on mathematical modeling**. This methodology encompasses the following six stages: 1. characterization of the problem, 2. formulation of mathematical models, 3. generation of test instances, 4. design of efficient solution approaches, 5. evaluation of the solutions, and 6. diffusion of results. **We expect to publish at least two articles in high-impact WOS journals**, disseminate our results in two academic international conferences, and work with at least four undergraduate or MSc students.