**WP1 - Supply Chain Network design**

**D1.2 - AN INTEGRATED SET OF METHODOLOGIES AND ALGORITHMS FOR OPTIMIZING MULTI-ENTERPRISE SUPPLY CHAINS**

The problem of decision making in the process industry is becoming more complex as the scope covered by these decisions is extended. This increasing complexity is additionally complicated by the need to consider a greater degree of uncertainty in the models used to forecast the events that should be considered in this decision making. The problem of decision making associated to Supply Chain (SC) operational management (procurement of raw materials in different markets, allocation of products to different plants and distributing them to different customers), which is attracting the attention of the scientific community in the last years, is, in this sense, on the top level of complexity. And, in the case of the Chemical Processes Industry, the complexity associated to chemical operations and the market globalization should be added to the usual difficulties related to the integration of various objectives to be considered for SC planning.1

The researchers identify some significant open issues to improve the decision making in the Supply Chain Management (Figure 1). The work of the Chemical Engineering department focus on the systematic consideration of one of the elements introducing a greater degree of uncertainty in the planning problem, which is the fact that the SC of interest should face a global market.1,2,3,4,5

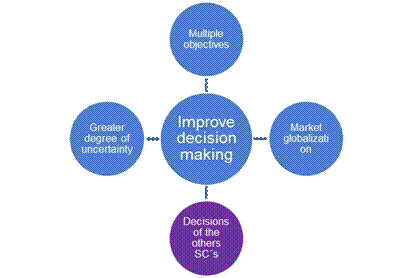


Figure 1. Open issues to improve the decision making

In this scope, it is not enough to study the problems that industry deals with and to apply fast and reliable optimization techniques to find isolated robust solutions. SCs are embedded in a competitive market, and managers have to take care of the decisions of the other SCs (known or uncertain), since these decisions will impact in the profit of their own SC.2

The different concepts describing the GT (Game Theory) and its application to solve industrial decision making problems can be easily found in the literature. It is worth to mention here that one of the first steps is to characterize the scenario where the GT is applied, starting with the identification of two opposite types of game: the cooperative game and the non-cooperative game. In fact, the industrial practice is never so simple and elements of both types of game can be specifically found in situations like the ones described in the previous paragraphs. This and many other practical problems cause that nowadays only some aspects of this theory have been successfully applied to SC Management (SCM): it is easy to find applications related to non-cooperative games and non-zero sum, while the use of cooperative games, dynamic or asymmetric games for decision making has not been exploited yet (Cachon and Netessine, 2003). In this sense, GT has not been extensively used to analyze the behavior between different SCs yet, and only some works can be found which address very specific situations: Leng and Parlar (2009) use Nash and Stackelberg Equilibriums to determine production levels, playing different scenarios to fix the price between seller and buyer; this kind of game has been also successfully used by other authors (Cachon, 2004; Granot and Yin, 2008; Leng and Zhu, 2009; Wang, 2006), each one using different techniques from the [GT. Zamarripa *et al.* (2012)1](http://dx.doi.org/10.1016/j.compchemeng.2012.03.009), introduce the use of game theory to determine the optimal production, inventory and distribution levels for several SC’s in a competitive/cooperative planning scenario.

The scope of the planning of SCs problem is typically to determine the optimal production levels, inventories and product distribution in an organized network of production sites, distribution centers, consumers, etc., taking care of the constraints associated to products and raw materials availability, storage limits, etc. in such network nodes.1 The mathematical model associated to this problem is usually leading to a mixed-integer linear program (MILP) whose solution determines the optimal values for the mentioned variables. Zamarripa et al. (2012)2 extend the consideration of several SC’s in cooperative and competitive scenarios under multiple optimization criteria. Zamarripa *et al.* (2011)4 propose a two stage stochastic programming model to optimize the production planning of several SC’s under cooperation and competition scenarios; the resulting two stage competitive model arises in a mixed integer nonlinear programming model (MINLP) where global optimality is compromised. Then in order to improve the decision making under uncertainty in competitive and cooperative scenarios Zamarripa *et al.* (2012)3 have been used a Genetic Algorithm, and the comparison between the typical mathematical programming tools and the global search methods have been done. There are many useful concepts/policies related to decision-making optimization in cooperative/competitive games which can be applied to SCM, and most of them have been applied by the works developed by the Center for Process and Environmental Engineering.

In order to improve the decision making in chemical processes under uncertainty, the Center for Process and Environmental Engineering have been presented several contributions in technical communications, conferences and scientific meetings, also sending papers to reviews in high impact journals in the last 2 years.

References:

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