

The last decades, globalization and the soaring competition in the world market have forced firms to increase their productivity and performance. Performance improvement requires a constant evaluation of the products, services and the operations of the firm. Consequently, performance measurement and benchmarking can be viewed as supplementary fundamental factors of firms' longevity.

Performance assessment can be achieved either by parametric approaches, when specific functional forms that transform particular inputs to outputs are assumed or by non-parametric approaches, when no assumptions on the production functions are made. The main advantage of the latter ones is that the efficiency assessment relies exclusively on the data and thus, distortions of evidence by imposing wrong parametric forms are avoided.

Data Envelopment Analysis (DEA) is a non-parametric technique for measuring the performance of similar entities, called Decision Making Units (DMUs) that use multiple inputs to produce multiple outputs and has been established as the leading technique in performance measurement. Standard DEA models treat the DMUs as one-stage production processes i.e., only the levels of the inputs that are utilized and the levels of the outputs that are produced are known. However, there are cases where the internal flow of the production process is known, and it plays a crucial role in the efficiency assessment. Network DEA (NDEA) is one of the most recent and major extensions of the conventional DEA, which conceives the production process that characterizes the DMUs as a network of linked sub-processes (stages, divisions).

Over the last years a considerable increase has been witnessed in the volume of NDEA literature and NDEA has been established as a flexible and multifaceted decision-making tool with a wide range of applications. Regardless of the application field, the estimated efficiency scores are the drivers for decision and policy making. However, there are still crucial theoretical issues that question the validity of the efficiency scores in several cases.

The aim of this project is to provide an extensive analysis of the existing models of the literature, to identify their weaknesses and limitations and then, relying on Linear Programming and Multi-objective Programming, to develop new models and techniques that will address various shortcomings detected in the literature. The results are expected to strengthen the theoretical foundations of NDEA and to provide practitioners and experts with enhanced NDEA models, which would allow to cover a wider set of real-world entities' types with a reliable performance measurement method.