In most modern organizations, decisions at various levels are made under uncertainty. This uncertainty results from a changing environment where key data are often random. For example, in logistics, parameters such as travel times for transport routes are rarely known exactly when planning routes. Also, when planning production, one should take into account the inaccurately known demand for products in subsequent periods of time. Correct consideration of the available information on uncertain data allows us to minimize a risk associated with the possibility of high costs of decisions made. In decision support systems, mathematical programming models are commonly used, in which a cost function is minimized under given constraints. In both the cost function and the constraints, there are parameters whose values are not exactly known and they are assumed to be random. Here, there is an issue related to the representation of this randomness. In practice, decision makers have only limited knowledge about probability distributions (e.g., past data), and in the extreme case such knowledge is not available at all. Various ways of representing random data have been proposed in recent years. Often, the so-called uncertainty sets, i.e. sets of all possible parameter realizations are provided, together with a family of probability distributions in these sets. The next step is to choose a criterion by which the solution is selected. In the so-called robust approach, it is assumed that the decision maker has a certain risk aversion, where risk is understood as the probability of high costs of the decision being made. Therefore, a solution is computed that minimizes a given risk measure, which is most often a minimax criterion, minimizing, for example, the expected cost of decisions in the worst case.

The aim of the project is to explore new methods for modelling uncertainty that make use of available knowledge about the environment. When determining parameter values, decision makers often have to rely on subjective expert opinions. Here new methods are needed to take this possibility into account. The subject of research will also be new criteria for choosing a solution, taking into account the degree of optimism/pessimism of decision makers and their attitude towards a risk. The second goal of the project is to apply known and new models to practical problems. In particular, scheduling, production planning and supply chain problems, where uncertainty is an important and inherent element, will be investigated. The result will be some model proposals that can be used to obtain solutions that minimize the risk. These models will be implemented using available mathematical modelling software. A very important aspect is to examine the effectiveness of these models, i.e. whether they can be used to determine solutions to large, practical problems.