

NUTECH SOLUTIONS

# CASE STUDY

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THE AIR FORCE ACADEMY



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### COMPANY BACKGROUND

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The Air Force Academy in Deblin, Poland, is one of the largest academies for pilots in Europe. Formed in 1927, the Academy currently consists of thousands of lecturers, pilots, navigators, and students. Over the last ten years, the Academy has invested over \$530 million in new hardware and equipment, such as advanced flight simulators, new aircrafts for training and military use, a new airport, as well as a state-of-the-art Information Technology infrastructure.

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### UNDERSTANDING CUSTOMERS NEEDS

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The Polish National Air Force has estimated that the total cost for each pilot trained by the Academy exceeds \$3.6 million. The optimal selection of pilot candidates is very important, because every “bad” candidate (somebody who drops out of the training program) costs the Academy millions of dollars. The Academy also collects a vast amount of data on every candidate, so that the Examination committee can make better recruiting decisions each year. This data includes:

- Results of more than 60 psychological tests.
- Results of general and special medical exams.
- Results of intelligence tests.
- Personal and environmental data

Unfortunately, better recruiting decisions were not made by committee year over year, and the dropout rate had remained steady at 22 - 29% during the last eight years. In order to decrease this percentage, the Polish National Air Force decided to develop an advanced expert system to identify poor candidates. The construction of such an expert system began with a complex data mining process on previous candidates and students, and the customization of NuTech Solutions’ Retention Optimizer.

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### CUSTOMIZATION OF RETENTION OPTIMIZER

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NuTech Solutions was responsible for the customization and integration of its Retention Optimizer with the new expert system, as well as the underlying data mining required to build the system. Several Polish scientific centers were asked to join the program, as well as George Mason University in Washington D.C. A sequence of subprojects was then identified and completed:

- Introduction of new tests testing the candidate's physical, intellectual, and psychological capabilities.
- Construction of a unified candidate and student database, which included historical data.
- Extensive data mining focusing on the relationship between the results of educational process and the analyzed data.
- Optimization of the set of parameters for the Retention Optimizer.
- Integration of the Retention Optimizer with the remaining Expert system.

During the data-mining phase of customizing the Retention Optimizer, several groups of methodologies were applied. These included:

Methods based on *machine learning* techniques:

- Decision rules induction
- Decision trees induction
- Modern *statistical* methods
- Grade Correspondence Cluster Analysis
- Decision trees
- Cluster analysis
- Block cluster analysis
- Multiple regression analysis

Methods based on *fuzzy sets* and *neural networks*:

- Kohonen self organizing maps
- FSM – Feature Space Mapping
- K-nearest neighbors methodology

Methods based on *rough sets*:

- Data preprocessing and predicting

A cost-benefit analysis proved that implementing a SAS environment would not yield the performance gains needed. The data sets were extremely complicated, with considerable missing data and a large noise factor. Consequently, NuTech Solutions applied its proprietary data mining tools to these data sets.

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## RESULTS

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More than 100 complex decision rules were extracted from the database and then incorporated into the Retention Optimizer before the product was integrated with the expert system. The Retention Optimizer was also tested against the historical data of the Academy, and there was a significant difference between the recommendation of the Retention Optimizer and decisions made by the Examination committee in previous years. In 14% of cases, the Retention Optimizer made a decision that was contrary to that of the panel, and the historical data proves the validity of the system's decision over that of the Examination committee. After these tests the

complete expert system was then tested on live candidates, and preliminary results proved that the expert system was capable of decreasing the dropout rate of air force recruits by more than 50% (from an average dropout rate of 25%, to less than 12%). Beginning in the 3rd quarter of 2001, the expert system will be used as a standard tool by the Polish Air Force Academy, and is expected to save the Academy more than \$18 million annually.