

## Chapter 5

# Using Data Mining Techniques to Discover Patterns in an Airline's Flight Hours Assignments

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### ABSTRACT

*The quality of a company's information system is essential and also its physical data model. In this article, the authors apply data mining techniques in order to generate knowledge from the information system's data model, and also to discover and understand hidden patterns within data that regulate the planning of flight hours of pilots and copilots in an airline. With this objective, they use Weka free software which offers a set of algorithms and visualization tools geared to data analysis and predictive modeling of information systems. Firstly, they apply clustering to study the information system and analyze data model; secondly, they apply association rules to discover connection patterns in data; and finally, they generate a decision tree to classify and extract more specific patterns. The authors suggest conclusions according these information system's data to improve future decision making in an airline's flight hours assignments.*

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## **1. INTRODUCTION**

The aviation scenario is demanding and variable for its high costs (Gangoiti, 2008) and its competitiveness, which severely hampers the management of an airline and its resources. Many organizations use technology only as a way of communication, and don't use it as a tool to improve their offered services and to create value to the consumer (Wang, 2008) and itself. Technology and Internet created for airlines the best way to commercialize their products (Vázquez, Díaz & Suárez, 2004), and also technology helps to improve planning and optimization of resources in a company (Llisterri & Angelelli, 2002) or airline with the study of its activity and its data.

According to Molina (2002), knowledge discovery should be defined as a non-trivial extraction of potentially useful information from a set of data in order to find relationships or patterns using databases, statistics, and research. Therefore, we could define data mining as the process of extracting knowledge from databases with the objective to discover tendencies, interesting and/or anomalous situations, and particular patterns of behavior within such data (Hand, Manila & Smyth, 2001). Once the company improves the use of information with the use of technology, a good practice is to make a study of data mining to see if we are using the information in the most optimal way. Therefore, this article aims to examine the importance of applying data mining techniques, as a tool to reduce costs (Castañeda & Rodríguez, 2003) discovering optimal patterns in an airline's flight hours assignments.

*Weka*, an acronym of Waikato Environment for Knowledge Analysis, is free distribution software developed in Java and independent of architecture, because it works in any platform as long as there is a Java virtual machine available. It was developed by Waikato University, New Zealand, and it is a data mining environment that allows for the application, analysis, and evaluation of the most relevant techniques in data analysis (Ramesh, Parkavi & Yasodha, 2011). *Weka* is developed by a series of open source packages with different techniques such as pre-processing, classification, association, and visualization techniques. These packages can be integrated into any data analysis project, and can even be expanded by contributions from users who develop new algorithms. In order to facilitate its application to more users, *Weka* also includes a graphical user interface to access and configure any different and integrated tools (Witten, Frank, Trigg, Hall, Holmes & Cunningham, 1999).

In this article, we will use *Weka*, a free data mining software (University of Waikato, 1999), to create a practical case of database analysis for the planning of flight hours of pilots and copilots in an airline with the aim to generate knowledge from the airline's information system in order to improve the planning and optimization of available material and human resources, and to formulate conclusions by using a predictive method (Witten & Frank, 2005).

## **2. BACKGROUND STUDY**

In an airline there is a wide variety of timetables, flights and staff, and although there are some basic principles and rules governing the design of their planning, each situation presents slightly different problems. Many industries and companies work throughout the year, providing services at all hours and every day of the year (Lezaun, 2007), as it is the case of airlines. So it is customary to split daily work between working days and flights, and to plan all of it on a rotating basis. The manner in which work is organized may differ depending on the geography and the business philosophy of the airline. In particular, the planning may depend on many factors: on whether the workload varies with the days

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