Tutorial 7: Human Factors

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Summary

[Mackay, 1999] conducted two field studies to learn about air traffic control in general and paper flight strips in particular in order to answer the research question -- How can we help air traffic controllers make the transition from today's paper flight strips to "more modern" computer-based systems? Summary results of the field studies, along with the usability and safety issues on the use of paper strips were discussed. Finally, a new strategy for updating air traffic control systems using augmented flight strips was proposed.

The first field study was a four-month ethnographic study on a team of 10 controllers and 5 students at the Athis Mons (Paris) en-route control center to gain an in-depth understanding of the use of paper strips. A total of 100 hours of work were recorded in the form of video and detailed, timed notes comprising counting of activities, communication patterns and use of tools such as paper flight strips and radar. The data collected were then processed to present an observer's interpretation of how controllers use strips and other technologies to support their work. Observations were divided into three broad categories. The first observation was that controllers maintain two complementary views of the air traffic. The radar screen view provides current aircraft position. Paper flight strips allow controllers to organize the traffic, plan their strategies, and record key decisions. The second observation was that paper strips are flexible, take advantage of both visual and tactile memory, and form an essential component of today's air traffic control system. They also offer many other subtle and intangible benefits such as a systematic routine of checking each aircraft, and reducing the controller's mental load. The third observation was that peripheral awareness is extremely important for air traffic controllers. This comes in the form of a variety of auditory, visual and tactile input. Controllers use general noise to get a sense of the overall traffic situation. Specific noises such as the sound of the strip printer prompts the controller to prepare for the arrival of a new aircraft. Visual cues include various displays around the control room such as the Digitatron that give controllers instant pictures of current conditions. Tactile cues such as running one's hands along the strips helps to mentally count them, even when looking elsewhere. Small physical workspace keeps controllers in close proximity which allows monitoring of each others' activities such as looking at each other's strip annotations and also ensuring neither falls asleep during night shifts.

The second field study was a comparison study of seven other air traffic control centers in France and Netherlands against the first study at the Athis Mons control center to gain a broader understanding of the diversity of the use of paper strips. Differences among control centers include variation of paper strips in terms of color, size and certain details, arrangement of information being customized to meet local needs, whether or not an aircraft is represented by a single strip, and the omission of strips in certain control centers.