Air Traffic Controllers' working positions
NLR report synopsis

A recent study commissioned by Esterline and carried out by the independent National Aerospace Laboratory, researched the optimal set-up of air traffic controller working positions. The operator's working experience was compared for two set-ups: a multiple screen and a single screen display one. This report presents the results of that study.

Introduction

Air traffic controllers are in charge of guiding air traffic safely and efficiently, both on the ground as well as in their designated airspace sector. In order to ensure ample separation between their assigned airplanes, they often have to make split-second decisions and maintain a continuous, high level of concentration. For all those reasons it is absolutely paramount that air traffic controllers have the best working conditions in place for optimal concentration and efficiency.

The study took place in the National Aerospace Laboratory's air traffic control simulator. This Dutch laboratory is an independent organization that develops knowledge on the aerospace industry, with the overall mission of making air transport and space exploration safer, more sustainable and more efficient. Their radar tower allows of training and experimental set-ups, in which various airport operations and procedures as well as controller working positions can be simulated.

Currently the standard working position for air traffic controllers is comprised of one high-resolution primary display, with a 4 megapixel resolution (2K x 2K pixels) and a 1:1 (square) screen ratio, complemented by one or more auxiliary displays. These screens feature all relevant information, such as location, identity and altitude of the airplanes. Recently, more commercial display types have become available for use in air traffic control rooms, such as the 4K x 2K (3,840 pixels x 2,160 pixels) widescreen displays. Due to their larger size, such screens can incorporate primary and auxiliary displays in a single-screen set-up.

This study focuses on the difference in working experience perceived by air traffic controllers when working with a multiple-display set-up on the one hand, and with a single, larger display on the other.

Experimental set-up

Six air traffic controllers participated in the experiment. They were asked to monitor virtual but realistic air traffic situations, both using a standard, multiple-screen

working position and with a single, large-screen set-up. During the simulations, three secondary tasks had to be performed. These tasks were selected from the standardized training suite of the Federal Aviation Administration (FAA).

The standard working position consisted of a primary control radar screen, supported by one auxiliary display. The alternative working position consisted of one large screen, displaying both radar and auxiliary information. All other factors, including the human machine interface, were kept constant or as similar as possible. An experienced air traffic controller validated the experimental set-up, including scenarios, up front.

The study's aim was to assess the influence of screen size and screen orientation on the operator's performance. The factors and variables taken into account consisted of eye fatigue, situation awareness, workload and comfort of use.

Results

Situation awareness

Situation awareness consists of three fundamental aspects: perception of the environment, understanding of the current situation and prediction of future events. A lack of situation awareness can cause the controller to miss important events, make erroneous decisions and be unable to correctly anticipate on events. This was measured in the experiment using a questionnaire.

When evaluating the results, **the situation awareness proved to be significantly higher when using the multiple-display arrangement than the single-display one**. In a multi-monitor set-up, tasks are being presented in the center of the screen, enabling a better overview of primary, secondary, and other visual spaces.

Workload

The participants were asked to indicate how they perceived their workload on a touch screen side panel every two minutes, during execution of the tasks.

The results indicated a trend towards a lower perceived workload in the multiple display arrangement. Even though in a high stress situation, **ATCO's experience a lower workload when using a 2K x 2K display** in a multi-screen set-up, the result of a more efficient way to manage secondary tasks.

Comfort of use

To measure comfort of use, usefulness and satisfaction, the participants were asked to fill out a questionnaire including several open-ended questions after finishing with each display arrangement.

Their answers revealed that the **multiple display arrangement was perceived to increase user comfort** by offering multiple benefits, including:

  - better variation in the angle of view,

  - easier to identify the active screen,

  - fewer physical movements,

  - a feeling of peace and quiet because the tasks were visually separated.

Conclusion

Compared to a single-display arrangement, the **test results show that a multiple-display arrangement fosters better situation awareness, lower perceived workload and a higher comfort of use for air traffic controllers**. Based on the experiments one can conclude that air traffic controllers experience more benefits from the multiple-display arrangement and hence prefer the current standard set-up over an alternative set-up featuring a single, larger display.