Monitor-based vs Projector-based displays

At Micro Nav, we've spent three decades supplying customers with high-definition, bespoke display solutions for Air Traffic Control (ATC) simulation.

The pace of change in technology has seen us switch from 2D to 3D views, from low-resolution to high-definition. We are now adopting the latest display technologies to enhance our solutions.

We ensure, through customer engagement, that the optimal display solution for your physical space and budget is found.

When looking to purchase a 3D tower system, you'll choose between monitor-based and projector-based display solutions in various designs.

This education guide breaks down key differences between monitor-based and projector-based displays and what considerations you should make before adopting one in your ATC simulation system.

What considerations you should make

		Monitor-based displays	Projector-based displays
Continuous Image	A visual difference between monitor-based and projector-based solutions. Refers to whether the simulation displays as a single uninterrupted image or is broken up by bezels.	Monitor-based solutions cannot provide an uninterrupted image. However, they do provide a similar view to that of a tower window.	All projector-based solutions offer a continuous, uninterrupted image.
Cooling Systems	The more substantial your simulator system, the more heat will dissipate. Cooling systems may be required for more substantial systems, ensuring hardware continues to operate as expected.	Providing you are not working with a substantial installation, monitor-based solutions don't require cooling systems.	Lamp-based projector systems dissipate significant heat. Economical lighting solutions are advised to negate the need for cooling systems.
Field of View (FoV)	With Field of View, we're discussing the minimum need to view the runway, wider airport configuration, and other airport infrastructure simultaneously.	Size and configuration can be limited, especially the Vertical Field of View.	Projector-based displays are flexible in their configuration and cover a larger field of view horizontally and vertically.
Image Calibration Tools	Image calibration and geometry correction substantially impact the realism of your simulator. Micro Nav offers tools to ensure simulator images are aligned and true-to-life.	Automatic alignment system with geometry correction, courtesy of Micro Nav's Geometry Correction for Flat Panels (GCFP) System.	Patented Automatic Display Alignment System (ADAS) maintains optimal image alignment throughout operational lifetime. Specialist engineers and equipment not required.
Image Quality	Image quality is measured with resolution, brightness, and contrast. Requirements for image quality are dictated by training needs, as well as the scope and complexity of the set-up.	Greater control over resolution and brightness, with flexibility in display choice.	Specialist software can enhance and extend capability, bringing quality in line with monitor-based solutions.
Physical Space and Simulator Dimensions	The simulator size and the chosen display solution impact the space required to house the solution, with floor space and ceiling height taken into account. A simulator's physical size will be dictated by the number of controllers, instructors, and supervisors that must be accommodated.	Generally take up less space than projectors. Tend to fit beneath a standard office ceiling height.	Front-projected solutions require higher ceilings than monitor-based and rear-projected solutions.

Field of View (FoV)

The minimum Field of View (FoV) must cover both ends of the runway — scanning the entire length of the runway is a key skill that controllers cultivate throughout their career.

A 38° Vertical Field of View (VFoV) is considered optimal for generic simulation exercises. However, certain operations, like steeper approach paths and military manoeuvres, may have requirements outside of this VFoV.

Monitor-based displays struggle to achieve a 38° VFoV due to small physical dimensions.

The flexibility of projector-based displays allows for a larger FoV both horizontally and vertically. The number of projectors needed to accomplish this is significantly less than the number of monitors required.

Both examples on the right have the same 360° Horizontal Field of View (HFoV), set in the same physical floor area.

A/ **Front projected solution**
6 projectors
38° Vertical Field of View

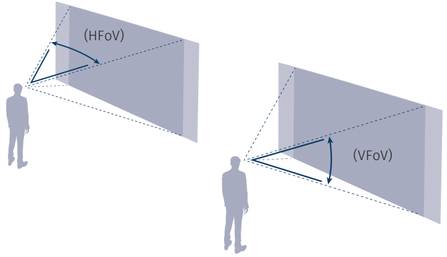
B/ **Monitor projected solution**
24 monitors
24° Vertical Field of View

Horizontal Field of View (HFoV)

The measure of the left and right view that is visible on display. A minimum HFoV will be required. However, a larger HFOV may be recommended to future-proof against future expansion plans for airport operations.

Vertical Field of View (VFoV)

The measure of the upward and downward view that is visible on display. ATC applications require a wide VFoV to replicate the view from a real control tower, including the airfield apron, stands, ground content, and a strong sky view.



Simulator dimensions & required physical space

When few Controller Working Positions are required the physical display size can be quite small – if surrounding consoles are enclosed and FoV requirements are met.

With many Controller Working Positions, the physical space required to house the simulator will have a bigger radius. Concurrently, a bigger radius means greater display height to maintain VFoV requirements.

Monitor Displays
Monitor displays need less space and normally fit within a 2.75-meter ceiling height.

Front Projected Display
Requires a higher ceiling than monitor-based or rear projector-based display solutions. Projectors are set above projection panels or use short-throw lenses to prevent the appearance of shadows.

Rear Projected Display
Requires a larger floor area than an equivalent front-projected display solution. Projectors must be placed at a specific distance behind the projection panel with these solutions.

Cooling infrastructure

Monitor-based solutions rarely require a cooling infrastructure. However, the more substantial your installation, the more heat it will dissipate.

For **projector-based displays**, economical lighting is advised to reduce the need for cooling systems.

Lamp-based projector systems consume significant amounts of energy and dissipate a considerable amount of heat, giving rise to the need for a dedicated cooling system.

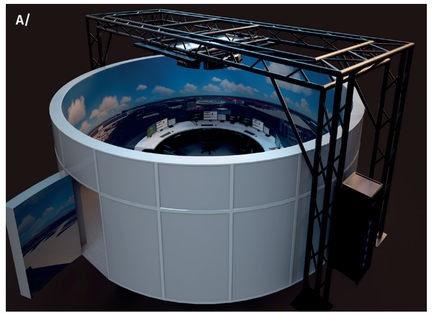
LED-based projector systems are more economical, dissipate less heat, and can function effectively alongside standard air conditioning.

Micro Nav are able to advise on the most appropriate cooling solution to your Air Traffic Control Simulation solution.

Continuous Image

The visual difference between monitor-based and projector-based systems is whether the simulator image is interrupted by bezels.

A projector-based solution is ideal if a continuous, uninterrupted image is desired within a simulator experience, providing all other requirements are met.



A/ **Projector Display**
Projector-based solutions achieve a continuous image through a bespoke rigid screen. These screens are constructed with Glass Fibre Reinforced Plastic (GRP) for a strong, durable, long- lasting, and lightweight display. Assembly tends to include multiple GRP panels.

B/ **Monitor Display**
Though an uninterrupted image isn't possible, the bezels of monitor-based solutions mimic looking out of a tower window. All monitor solutions adopt a custom-designed framework; for 360° simulators, this includes a door.

Image Quality

Image quality is measured in terms of resolution, brightness, and contrast. It is also influenced, to a degree, by training needs.

Better image quality creates a more immersive, convincing simulation experience.

System Resolution
The measure of overall image clarity expressed in Pixels Per Degree (PPD). The greater the PPD value, the better the resolution/clarity. The PPD of display systems is typically between 30 PPD and 150 PPD. 150 PPD is the upper limit of the human eye's visual sensitivity.

System Contrast
System contrast measures the ratio of white to black when the display is 50% of each. If the system contrast is too low, displays look washed out. Micro Nav recommends a contrast of at ≤ 7:1 as acceptable.

Image Calibration Tools

Projector System Alignment

Alignment systems are a critical component of our solutions. They align each projected image to the curved screen and adjacent images, providing soft-edge blending and colour-matching functions.

Over time, displays become misaligned. Specifying the requirement for an automatic alignment system avoids maintenance burdens throughout the simulator's service life.

Micro Nav's patented **Automatic Display Alignment System (ADAS)** enables users to maintain optimal alignment throughout operational lifetime. No specialist skills or equipment are required. We install ADAS as part of the display system at customer sites.

Monitor-System Geometry

Geometry Correction for Flat Panels is the monitor- based equivalent of ADAS and is included in all monitor-based solutions.

To discover more about Micro Nav's monitor-based and projector-based display solutions, contact our sales and support team who will be on hand to guide you through every step of your simulator journey to ensure you get the most from your prospective simulator solution.

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The Quadrant Group's mission is to make a meaningful positive difference to aviation safety by providing and enabling the world's best-trained air traffic controllers. We do this by engineering the industry-leading tool for training, development, and operational testing, as well as offering consultancy and support services to assist customers in establishing and running training centres of excellence.