

Engineer a Jetliner Background Reading

Before a commercial airliner carries its first passenger to his or her destination, every part of the airliner has been thoughtfully designed and carefully tested to ensure it meets its mission objectives. The design process used to engineer the airplane is more or less always the same: design, build, test, redesign, retest. This process has gone on for as long as airplanes have been manufactured. Need proof? The Wright brothers—the pioneers of powered flight—built one of the first simple wind tunnels in order to test different wing sections and decide what types of changes to make to their designs. This was back in 1901! Wind tunnels are still used today to test designs for all the conditions an airplane will experience in service. The computational power now available also allows aerospace engineers to design and test virtual airplanes to predict whether they will meet the criteria for success.

You take on the role of an aerospace engineer in the *Engineer a Jetliner* interactive. Your task is to design solutions to meet several sets of mission criteria and constraints. Typically, mission criteria are what your customer or a regulatory agency wants, and constraints are any restrictions or limits that may challenge your ability to give it to them.

You will test your solutions and evaluate them. You can then optimize your solutions by modifying certain aspects and retesting the design. For this interactive, some characteristics of the airplane have already been decided for you. Namely, the airplane model is a single-aisle, twin-engine jet, with turbofan engines suspended in pods from the wings. (Other less common airplane designs feature engines mounted to the rear of the fuselage.) The airplane also features swept-back wings. This planform (the shape of the wing when viewed from above) is most commonly used for commercial jets today. A moderate wing sweep results in less drag while maintaining stability at lower speeds. High-speed fighter jets have greater sweep. These military airplanes are not very stable at low speeds, so they must take off and approach for landing at a high rate of speed.

Your design decisions will be focused on selecting an appropriate wing size, with certain modifications to the basic form and materials, as well as the size of the engine and the variety of turbofan (high or low bypass). There are seven different wing and four different engine configurations. Each of these design options is assigned a build cost, weight, and fuel burn score. In most cases, the lower the score, the better. However, while an inexpensively built airplane is typically desirable, sometimes it makes sense to spend a little more up front to build a plane that will operate with greater fuel efficiency and save the airline money over the long run. This reinforces the idea that airplane design is an exercise in tradeoffs: fuel efficiency comes at a cost.

As you begin selecting wing and design options, you'll see a bulleted list of pros and cons associated with each one. Be sure to consult the Technical Notes feature. These tips detail the factors that you should keep in mind when making your selections. After you leave the introduction screen, you will navigate through the interactive in a straightforward way, using the following tools:

- At the top left of the screen, you'll see which mission you have selected.
- Click on the down arrow, and a pull-down menu displays buttons for all four missions.

- Additional menu buttons to the right of the pull-down menu enable you to navigate to the screens for Wing Design, Engine Design, and Test Results (which is disabled until both wing and engine selections have been made).
- Click on the *Engineer a Jetliner* title at the far right to return to the introduction screen.

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