Chapter 1
Flight Operations

ABSTRACT

This chapter is a brief overview of some important milestones in the history of aviation. Armed with this knowledge it is hoped that the reader can gain some appreciation of the necessity, and indeed the urgency, of providing additional decision and targeted activity support for flight crews of modern high-speed commercial and military aircraft. It is important to realize that as aviation advanced from simple single-engine aircraft capable of flying not more that about 100 MPH, to advanced, multi-engine aircraft with international capabilities, complexity, and mental workload increased exponentially. This in turn has increased our attention to understanding how to support the flight crew better. This chapter is a brief historical overview, a mission structural representation, and some discussions on flying in adverse conditions.

INTRODUCTION

This chapter is a brief overview of some important aspects in the history of aviation and provides an important historical perspective to the conceptual design work which follows. Armed with this knowledge, it is hoped that design teams, research groups, and managers can gain some appreciation of the necessity, and indeed the urgency, of providing additional decision support for flight crews of modern high-speed commercial and military aircraft.

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MILESTONES IN AVIATION

With the speed of less than 100 knots (kn), the aircraft deployed in combat during World War I were made largely of wood and fabric with an engine producing about 80 to 100 horsepower. Horsepower ratings continued to increase fairly rapidly; by the end of World War I they were producing up to 400 horsepower. World War I airplanes were mostly biplanes; however, a few monoplanes were in use.

Aerial combat was invented during World War I. This involved two machine guns mounted along the forward fuselage approximately within the center-line of the airplane. This required a gun to fire inside the arc felt of the propeller. The arc of the propeller hindered placing the machine gun closer to the fuselage where it was most accurate. For accurate airborne machine gun performance, a mechanical device called a propeller interrupter was invented.

World War I brought rapid advances to aviation. What was learned about aerodynamic performance between 1914 and 1918 was considerable. This period in aviation also experienced a very high accident rate, particularly for student pilots. During this time period the United States experienced more than five hundred training accidents and fatalities of its student pilot population. This was a higher mortality rate than during combat.

Although aviation was still in its infancy, Max Immlemman and Oswald Boelcke developed the first principles of air combat. These principles attacking from behind, attacking out of the sun, firing at close range, and turning and facing the enemy when attacked from behind. While appearing to be simple, these principles were elegant and effective. They represented what later would be known as “higher order cognitive skills.”

In the 1930s, commercial aviation grew as new aircraft such as the Electra, DC-3 and the Boeing 247 entered the scene. These airplanes were all metal construction, multi-engine equipped, and could travel long distances. The DC-3 for example, traveled nonstop across North America. Both the United States and Europe were working on improving reliability and safety of commercial air travel. Significant improvements were made in the area of instrument flying, ground-based navigation systems, and communications. However, pilot training consisted of little more than teaching pilots some technical knowledge about standard flight procedures.

During World War II the airplane became a serious air combat and air transport vehicle. Large multi-engine bombers were developed. These included the Lancaster bomber, B-17, B-24, and B-29. All of these aircraft were quite sophisticated for the day and required multiple crew members to operate as a navigator, flight engineer, and bombardier. A very large bomber fleet was fielded by the Allied forces and eventually strained the pilot training resources to breaking point. At the end of the war, pilots were being sent to combat with only about fifty hours of total flight time.
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