The F-18 (and F-16) is the result of a Lightweight Fighter (LWF) Program that was initiated at the urging of a small group of U.S. Air Force officers and civilian defense analysts/engineers nicknamed the "Fighter Mafia". In a broad sense, the Fighter Mafia included a small group of Langley researchers (led by Roy Harris and Warner Robbins) who conducted a number of LFAX (Langley Fighter Aircraft Experimental) design studies prior to the F-X and LWF programs. The F-X and LWF programs would eventually lead to the future Air Force High/Low fighter mix of F-15's and F-16's. The core of the Fighter Mafia consisted of Col. John Boyd, Col. Everest Riccioni, Tom Christie and Pierre Sprey and their design philosophy was based on Col. Boyd's Energy Maneuverability Theory that had specific excess power, $P_s$, as its basic performance parameter. This theory favors a fighter that is superior in its ability to gain or lose energy while out-turning an opponent and a fast transient capability to stay inside a hard-turning opponent. Today, these characteristics are collectively termed "agility". Based on Boyd's theory, the Air Force F-X (F-15) proposal was rewritten to drop a heavy variable sweep wing requirement. While Boyd's theory led to significant improvements in the F-15, he still felt that the design was a compromise. The core of the Fighter Mafia insisted that it was gold plated; e.g. they advocated for a smaller ranging only radar and no bomb racks (ironic considering the current F-16/F-18 missions and the fact that the current F/A-18E/F has been resized to about the same size as the F-15). Their uncompromising positions and Boyd's unkempt appearance, rough mannerisms, idiosyncrasies (I often sat in meetings and watched him chew the skin off of his hands), and his de-emphasis of speed as the primary fighter performance parameter made many enemies within the Air Force.

In 1969, under the guise that the Navy was developing a small, high-performance aircraft, Col Riccioni obtained $149,000 to fund General Dynamics and Northrop (the eventual LWF winners – nothing like getting a head start) for a "Study to Validate Expanded Energy-Maneuverability Through Trade-Off Analysis" to evaluate Boyd's theory. The study showed that it was possible to design a fighter that
was twice as maneuverable and have twice the mission radius as the F-4D Phantom while only weighing about 17,000 lbs. This study impressed Defense Secretary Melvin Laird and Deputy Defense Secretary David Packard who threw their support behind the concept. In May of 1971, Congress issued a critical report of the F-14 and F-15 and advocated spending $50 million on developing a lightweight fighter. This was followed by the approval of $12 million in the FY72 budget and an RFP was issued to industry on Jan. 6, 1971 for the development of a 20,000 lb fighter to complement the F-15 (thus the high-low fighter mix of today). Pierre Sprey insisted on a fly-off between two prototypes that would be pitted against MiG-17s and Mig-21s secretly maintained in Nevada. Furthermore, the evaluating pilots would be operational pilots, not test pilots, and each pilot would fly both prototypes.

Five manufacturers submitted proposals in response to the RFP: Boeing (model 908-909; see Figures 1 and 2), Northrop (model P-600), General Dynamics (model 401-16B), Ling-Temco-Vought (model V-1100), and Lockheed (model CL-1200). It is not widely known, but Northrop actually submitted two proposals – the familiar twin-engine configuration and a single-engine version of the same configuration. Initial Air Force Air Staff evaluations eliminated the Vought and Lockheed configurations and ranked the Boeing proposal #1 with the General Dynamics and Northrop proposals a close second. The Source Evaluation Board (on which I and other Langley personnel served) eventually rated the General Dynamics and Northrop proposals ahead of the Boeing configuration. In 1972, contracts for two YF-16s and two YF-17s were awarded. The “Y” (developmental) prefix rather than the “X” (experimental) prefix was used to indicate that a mixture of off-the-shelf and experimental technologies were being used in the prototypes. Initially, the Air Force visualized the LWF program as a technology demonstration program rather than a serious effort for a production aircraft. After completion of the fly-off, the USAF declared the F-16 the winner and production of F-16s was initiated. It should be noted that one of the “Fighter Mafia” lightweight design tenets was that only one engine was needed.
So if the F-16 won, how did the F-18 survive? Congress would not provide the money for a new Navy fighter and dictated that the Navy utilize the YF-16/YF-17 program to meet their needs. The twin-engine F-18 design met the engine-out performance requirements for carrier take-off and landing that the F-16 could not meet and thus the Navy selected the YF-17 for development.

How did the YF-17 become the F-18? General Dynamics took a big gamble. From the beginning of the program, General Dynamics designed the YF-16 as if it was a production airplane (probably at their own expense). On the other hand, Northrop literally used many off-the-shelf parts (from F-5 for ex) and designed the prototype as cheaply as possible (in the spirit of the program). For example, all the fuel was carried in the fuselage and the wing was dry. Many believe that this was the real reason General Dynamics won the USAF competition. Thus, when the Navy selected the Northrop design, the YF-17 had to be completely redesigned for production; the F-18, shared not a single essential dimension or primary structure with the YF-17. The redesign was extensive enough that a new airplane designation, F-18, was assigned.

How did the F-18 become a Boeing airplane rather than a Northrop airplane? Because of a lack of experience building Navy airplanes, the Navy required the LWF contenders to team with an experienced naval aircraft manufacturer: Northrop teamed with McDonnell Douglas (General Dynamics teamed with LTV Aerospace). Northrop and McDonnell Douglas agreed to evenly split the parts manufacture but McDonnell Douglas was assigned to be prime contractor for the naval version and Northrop would be the prime contractor for the land version (F-18L) that they hoped to export (bad choice!). Boeing eventually bought McDonnell Douglas and thus we have the Boeing F/A-18E/F!
Jan 1973  A Boeing close air support aircraft model based on the Boeing LWF configuration. Note the forward ventral control fins under the inlet that would allow side translations during bomb runs. (See Figure 3)

Feb 1978
July 1978
Oct 1978
Oct 1984  The Northrop YF-17 model was used for nonaxisymmetric (2-D) nozzle and thrust vectoring nozzle technology development using high-pressure air (see figures 4 and 5). Note bifurcated support system.

June 1991
Sept 1991  NASA utilized the F/A-18 aircraft for high angle of attack aerodynamic research and to demonstrate deployable nose strakes for control. To obtain controlled, trimmed high angles of attack, a poor man’s (cheap and effective but high thrust loss) external paddle thrust vectoring system was added to the F/A-18 aircraft. The resulting airplane was called the F-18 HARV (High Alpha Research Vehicle) (See figures 6, 7 and 8). The F-18 HARV model was tested in the 16’TT on a newly developed bifurcated support system to determine the control ability of the thrust vectoring system. The bifurcated support system allowed the model to pitch at the wing tips (relative to the support booms) and combined with the tunnel support system allowed extremely high angles of attack (see figure 7). Figure 8 shows the F-18 HARV with the exhaust flow vectored up (produces nose up control).

Sept 1999
July 2000
April 2002  During the F/A-18E development, the aircraft experienced severe wing drop incidents during high angle of attack flight tests (severe enough that the
pilot's head would bang against the side of the canopy (not good for tracking). This was a huge surprise since (other than a snag wing leading edge), the F/A-18E was basically a scaled up version of previous configurations and no wind tunnel tests were conducted. Under threat of program cancellation, a crash NASA/Navy wind tunnel test program was initiated. The problem was traced to a wing outboard wing panel separation that in turn triggered massive separation on the wing inboard panel. A porous cavity at the wing snag was proposed as a fix by the NASA Component Aerodynamics Branch team (primarily Steve Bauer). The porous cavity created a narrow separated region between the inboard and outboard wing panels and acted as an aerodynamic fence preventing outboard panel separation from triggering inboard panel separation. Wind tunnel and flight test results confirmed the success of this fix and the production aircraft are still flying with the porous cavity fix. This problem led to the initiation of a joint NASA/Navy Abrupt Wing Stall Program (led by Bob Hall) and the development of a free-to-roll support system to study the problem. AV-8B, F-18C (see figure 9), and F-18E configurations were tested during this program. After the 16”TT was closed, the free-to-roll support system was transferred to NTF.
Figure 1: General Arrangement Drawing of Lightweight Fighter Study Configuration