A View of the 1960's: FTD's Formative Years

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I arrived at the Foreign Technology Division (FTD) as an Air Force captain in August 1963. After the customary inprocessing, I reported as instructed to what was then the School of Foreign Technology (SOFT) in building 263, a wooden structure of World War II vintage. I found that this was a holding assignment for people waiting for clearances. I did meet briefly with the chief of the Aerodynamic Systems Division, where I would be assigned to the fighter branch in building 828 after being cleared. I was told that the clearance process could take as long as 5 to 7 months and that, in the interim, I should follow the guidance of SOFT.

SOFT was headed by Charles Zimmerman, an engineer who had come to FTD from industry and physically bore a strong resemblance to Alfred Hitchcock. I got to know him quite well during the next few months and was impressed by his understanding of both industrial and bureaucratic processes. A lot of what I learned from him at that time served me well as I got more responsibility, especially later in life after I retired from the Air Force.

Mr. Zimmerman, or Charlie as we referred to him in his absence, also served as a special advisor to the commander and was part of a select few who reorganized FTD after the Defense Intelligence Agency (DIA) was formed in 1961 and the Air Force retained control of FTD by making it part of Systems Command. We discussed the organization and functions of each directorate of FTD at length because one of the first tasks he assigned me was to prepare a briefing on the FTD mission, functions, and organization; and present it at a symposium for the other divisions of Systems Command.

It helps to understand at this point that SOFT had neither faculty nor course structure, and learning was to be accomplished by temporary assignment to various divisions that did not require special clearances. For a newcomer like me to be assigned a briefing function seemed a bit strange, but I had just come from 4 years in the Strategic Air Command, so doing the illogical and seemingly impossible was something that I took for granted. Besides, for the first time in 4 years, I actually got nights and weekends off from duty. Less than a year earlier, I had been an aircraft commander of a B-47 crew during the Cuban missile crisis.

Charlie explained that, based on his experience with industry, the organization of FTD was structured like that of an industrial production line, where raw material and small parts enter at one end, refinements and subassemblies occur as the material moves along; and a finished product comes out of the final step. He emphasized that each step required close attention and quality control, or too much workload would be placed on the final assembly team, which would need to make up for inefficiencies and mistakes made along the way. He also observed that it was unrealistic to expect the whole process to work without problems.

His view was that industrial organizations and bureaucracies had a lot in common. Any organization with a lot of people and resources could seem to be actively and gainfully employed; but if the proper stimuli, schedules, quality control, and product quotas were not in place, then little of value would be produced.

There was another piece of advice that I remember clearly. I was 31 years old at the time, and he recognized that I probably had more fire than wisdom. He observed that I was just getting started on a course of more responsibility, and then told me there was a good rule to follow. "No matter what kind of problem, project, or situation you are faced with," he said, "you can always assume correctly that someone has encountered something like it before. If you make use of the work others have done as a starting point, you will likely succeed. If you try to start from zero, you probably won't do much more than define the problem."

I remembered this advice every time I encountered something difficult. Later in life, when someone came to me with a serious problem, I would defuse the tension by opining that Julius Caesar probably ran into the same thing.

The briefing at the symposium was not a work of art, but we got through it. At FTD, I spent some on-the-job training time in TDB, learning about the documentation acquisition and cataloging process; in TDC, learning about electronic intelligence collection and signal analysis; and eventually in TDD, learning how performance data were prepared for TDF, where I would eventually work.

While I was in SOFT, I met an interesting fellow student named Augustus H. Paine. We called him Hans or Major Paine. He was a self-taught Russian scholar who volunteered to give us an introductory course in Russian. He had some lesson plans oriented toward technical terms, and explained the Cyrillic alphabet in a way that was easily understood. What I learned from him served me well when I later did technical translations of my own.

When I started working temporarily in TDD, I met Joseph Scaglione, whom we called Scag. He was the chief analyst for aircraft and was responsible for integrating input data, which consisted of weights, lift, drag, and propulsion, to produce final flight envelope and mission data. When he explained the process to me, I got a strong sense of deja vu. I had done something very similar when getting my aeronautical engineering degree at Penn State.

To make the material more interesting, the instructor for my university course on aircraft performance had us analyze the F-86 and the MiG-15. We used all available open-source literature to get a configuration, weights, and engine data for each airplane. Lift, drag, and installed thrust were calculated and computations were made for maximum level flight speed, service ceiling, and range. If the initial values we came up with did not match known performance from open sources, then we tweaked the computations until we got close to what was known.

People in the early 21st century should realize that this was before the age of hand-held calculators. Addition and subtraction were done by hand in rows and columns; and multiplication, division, exponents, and trig functions were done on a slide rule. When I worked at the Aircraft Laboratory at Wright Field in the mid 1950's, it was still done this way. Some people used a machine called a Marchant calculator, which was a noisy, gear-driven device that sounded like it was about to come unglued when it did a square root. A lot of the time, a human could do better than this machine.

Scag explained to me that, at FTD in 1963, they still prepared input data by hand but performance computation was done with a computer program. He explained that this was the result of an effort started in the late 1950's by I. H. Herman, whom most people credit with bringing FTD into the computer age.

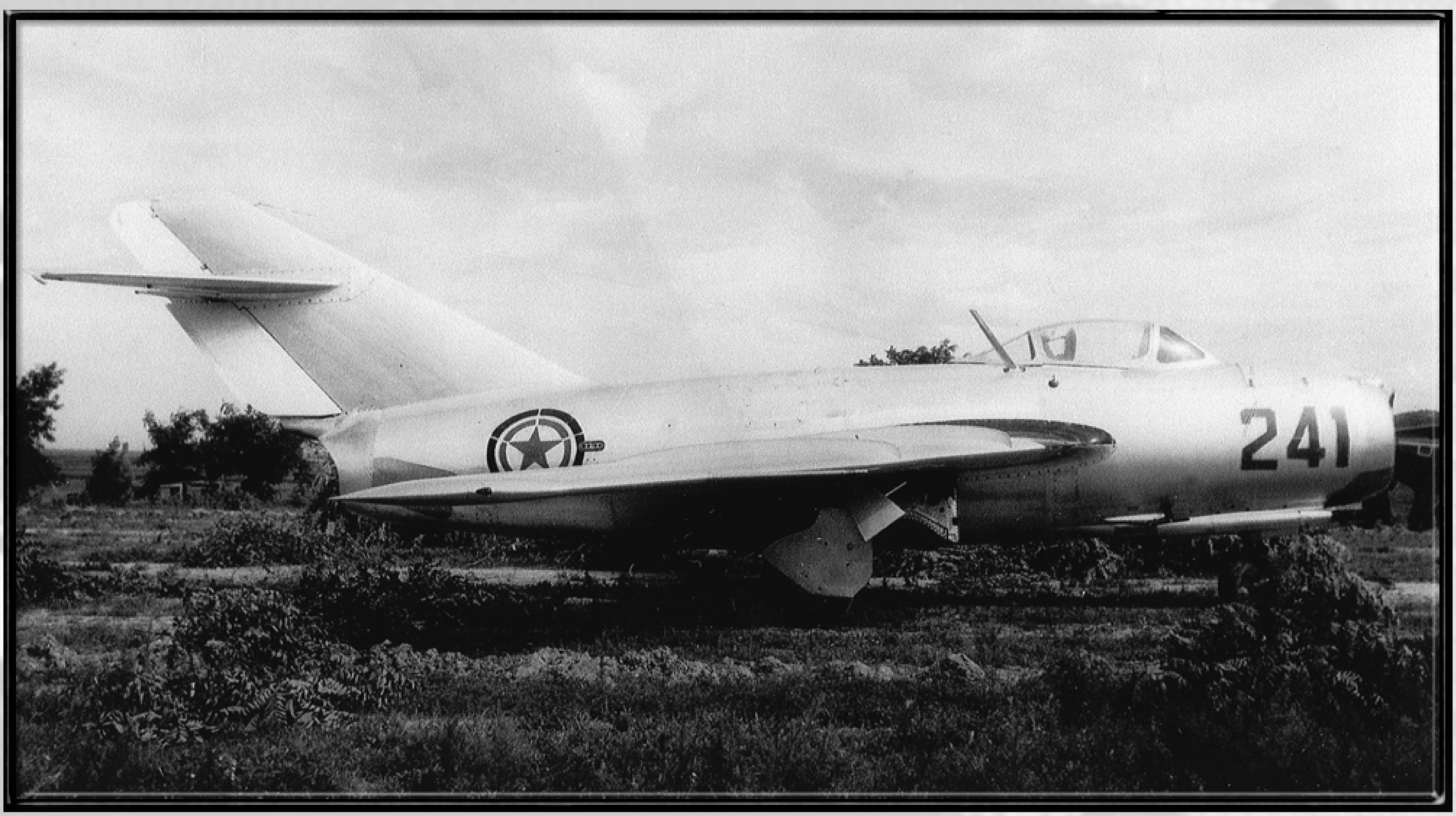
Tabulated input data were punched into cards by the computer staff, which was off limits to analytical personnel. The computer program, which was written in FORTRAN, also was on punch cards. The whole thing was run in batch mode after normal working hours with the expectation that you would get something the next day.

Output data from the computer were in the form of large quantities of printout. Scag was working on automated plotting, but when I came on the scene, we hand-plotted presentations like speed-altitude and graphically solved for range and radius values using gross weight on the "y" axis and nautical miles on the "x" axis.

Automated plotting developed rapidly. About a year later, when I needed energy-maneuverability data for my work with John Boyd, Scag was in a position to immediately provide it in a form that was published in system reports. In fact, he did it long before it was done in other parts of the Department of Defense.

After I got my security clearance (which took about 8 months), I became chief analyst for the MiG-21. I then found that there was a problem getting the analytical methods to generate known information for this airplane. I remembered Charlie Zimmerman's advice and analyzed everything that had been done up to the time I took over.

What I found was that we had too much good information on the aircraft, and people were getting bogged down in the minutia. Some of the best academic minds in the country had addressed the problem and, in typical theoretical fashion, had concluded that there were more unknowns than there were simultaneous equations available to solve them. As an engineer who was also a pilot, I found



FTD analysts compared US Air Force F-86 (above) and Soviet MiG-15 (below) for practice in the 1960's.

this approach to be ridiculous because airplanes never operate exactly according to theory.

One of the engineering principles I learned along the way was that you got a better understanding of a complex problem and visibility of a solution if you simplified it as much as you could. In this case, it was possible to ignore the minutia, draw a circle around the problem, and identify inputs and outputs, much in the manner that processes and software are now flowcharted. What went in was weights, drag, and installed thrust. What came out was major performance data, such as ceiling, rate of climb at various conditions, and range with different payloads.

For determining maximum speed, the method used with subsonic fighters like the MiG-15—getting a thrust-drag match—no longer applied. Supersonic airplanes like the MiG-21, the F-104, and the F-4 were not limited by thrust but by a Mach number limit imposed by engine operating factors, or structural and stability considerations.

For this particular analysis, there was no quarrel about structural and fuel weight, but the problem became one of how much was thrust and how much was drag. How each of these was determined in FTD was looked at.

Drag was determined by using configuration dimensions and analytical techniques generally accepted by both government and industry. There were a few assumptions required, like wing thickness, but the process was well established and would yield the same results if done by different people.

Thrust estimation was a much more difficult problem. Engine inlet and outlet geometry were usually known, but what went on between the two had a lot of variables. No two analysts could agree on fundamentals like inlet performance, compressor characteristics, engine temperatures, amount of afterburning, and nozzle behavior, especially over a broad range of altitudes and Mach numbers.

The solution to the performance computation problem became obvious. Because drag was consistently predictable, it would be accepted as true and installed thrust would then be backed out of known performance. The primary matching items were service ceiling and climb rates. Scaglione and I went through many iterations and finally came up with a set of installed engine data that met the conditions for all Mach numbers and altitudes.

After the new data were used with previously determined drag and weight, the calculated performance data matched known capability of the airplane for all conditions. The soundness of the approach was verified when the new engine data were used to calculate performance of another fighter using the same power plant. The match with known performance was well within acceptable engineering accuracy.

Later on, when good information became available on the MiG-21 engine, it was found to be significantly different from Western designs, and the assumptions used by engine analysts alone would never have given credible results. The long-term lesson here is that good analysis is truly all source, and the best and most credible available inputs should be used. At times, it is necessary to ignore or overrule some analytical information.

Another thing worthy of note for 21st century analysts is that organizational output in the mid-1960's was limited by a primitive ability to produce written material. Each branch usually had a clerk-typist assigned, and the analytical product of about seven analysts was typed by one person making copies with carbon paper. Output consisted of messages, letters, and system reports. When you added the reviews at various levels of command and the retyping required, the system was ridiculously primitive and slow. I believe that this was one of the reasons analysts traveled a lot. It was more timely and effective to fly to the Washington area and discuss something than to exchange correspondence.

As I look back on this time from my perspective of being 74 years old in 2006, I marvel on how far we have come. I have more computer capability at my fingertips than existed in all of FTD in 1963. My scanning, copying, and communication systems are significantly more capable than the organization then had, and they cover a desk area that can be spanned by stretching out my arms. However, even with all the technological advances, an important thing to keep in mind is that the same fallible humans are doing analysis.

What were we like as analysts in the mid 1960's? First, we were young, cocky, and motivated. This was the height of the Cold War and the Vietnam war was getting really serious. We had a lot of self-motivation to produce material that had an influence on weapon acquisition and effectiveness of combat forces. Frequent exposure to higher levels of command, especially in the Washington area, kept us operating at a lively pace.

However, we were just as fallible as people are today. Looking back, passion does not substitute for wisdom and frequently gets in its way. Later in life, I would joke about there being two kinds of engineers, those who had made a significant mistake and those who were going to make one. I made at least two at FTD. Fortunately, they did not lead to useless loss of life, but resulted in analyses that were nothing to be proud of.

I got led astray by placing too much faith in the credibility of two subsystem analysts who assured me that there was absolutely no doubt about the accuracy of their work. I didn't fully understand the details of what they were doing, didn't have the time to learn the subject, and accepted it because it sounded credible. The lesson here is to never rely on a single source, especially if it is one you don't understand. Getting a second or third opinion, or taking the time to learn the subject, will serve you well.

Although we were fallible, I dealt with a lot of good people during this time period and later when I was in the Pentagon. Everett Henderson took over as Mig-21 analyst after I became branch chief. Fred Wood did some good original analytical work and briefing. Al Gangl provided long-term expertise that dated back to the Aircraft Laboratory at Wright Field. Al Jokela brought us useful insight into real world weapons acquisition and flight test. Jack Cunningham and Joe Petrusky were always there when we needed data from a special source. Tom Davis and John Summerfield served us well with photo analysis. Dave Richey and Ray Schneider were nationally recognized bomber analysts. Tony Dobler, Lee Morgan, and Al Cordova provided good information on foreign industrial capability. In addition to Joe Scaglione's aircraft data, we relied on aerodynamic missile analytical expertise from Joe Schmalhofer. There are many more people I have not mentioned, and I apologize for the fading of memory over the years.