A Detroit Dream of Mass-produced Fighter Aircraft: The XP-75 Fiasco

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Historians of technology have tended to write more often about successes than of failures.[1] This article investigates a significant failure—not to censure but to understand. One can never be too confident, however, that the painful past will be heeded, especially when recalling that revealing New England aphorism: "Experience is a wonderful thing; it helps us recognize our mistakes when we repeat them."

Before World War II, the aircraft industry in the United States was, in comparison to the automotive industry, a decidedly modest operation. As General "Hap" Arnold, who commanded the Army Air Forces throughout the war, once remarked, the aircraft industry on the eve of the war ranked somewhere down among the candymakers in annual dollar volume. As late as 1939, one of the largest airframe builders in the United States was turning out only three aircraft per day when foreign purchases gave him a large backlog of orders. By contrast, a typical Detroit auto manufacturer was turning out two or three cars a minute.[2]

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[1]Melvin Kranzberg, "Let's Not Get Wrought Up about It," *Technology and Culture* 25 (October 1984): 739. See also Henry Petroski, *To Engineer Is Human* (New York, 1985), which argues that engineers learn more from failure than success.

[2]I. B. Holley, Jr., *Buying Aircraft: Matériel Procurement for the Army Air Forces* (Washington, D.C., 1964), p. 26. Arnold's offhand remark actually understated the situation. As late as 1939, at a time when the Nazi buildup had reached crisis proportions, the confectioners produced goods worth $297,762,000, or $18 million more than the value of the products of the aircraft industry at $279,497,000. U.S. Department of Commerce, *Statistical Abstract of the United States: 1941* (Washington, D.C., 1941), table 867, p. 852.

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Much of the difference, of course, was attributable to the fact that the auto industry, with its high volume, could justify heavy investments in production tooling and the use of moving assembly lines with elaborate jigs and fixtures. In 1937, before war orders distorted the picture, the entire airframe industry produced no more than 3,100 airplanes, and that number included light civilian puddle jumpers as well as military and commercial units. On the other hand, in the same year, the auto industry produced 4.75 millon units. Volume sales warranted elaborate tooling, and tooling made the difference. Where Chevrolet invested $2,600 per worker in plant and equipment, Glenn L. Martin, a leader in the aircraft field, had an investment of about $800 per worker.[3]

In short, the prewar aircraft industry in the United States was still making airplanes largely by hand. The small-scale character of the industry is evident in table 1. With the approach of war, and a flood of orders from the French and British governments, the dollar volume of orders for military aircraft rose rapidly. After the long drought of the Depression years, however, most aircraft firms in the postwar years were reluctant to expand for fear of excess capacity, which threatened to impose crippling overhead costs when there were no more high-volume orders.[4] Such attitudes, coupled with the limited volume that

TABLE 1
U.S. AIRCRAFT PRODUCTION, 1919–1939

Year	Total Aircraft	Military	Civilian
1919	780	682	98
1923	743	687	56
1927	1,995	609	1,386
1931	2,800	853	1,947
1935	1,710	336	1,374
1939	5,856	921	4,935

SOURCE.—U.S. Department of Commerce, *Historical Statistics of the United States: Colonial Times to 1957* (Washington, D.C., 1960), Table Q 343–351, p. 466.

[3]Holley (n. 2 above), p. 27. In a year when one auto builder spent $10 million on tooling, one production-minded airframe firm spent $150,000. Where airframe firms estimated costs at $5 to $8 a pound, automakers' costs ran between $.15 to $.20 a pound (ibid., pp. 520–21). The best brief account of production engineering in the prewar U.S. aircraft industry is T. P. Wright, "American Methods of Aircraft Production," *Journal of the Royal Aeronautical Society*, March 1939; and in the British journal, *Aircraft Engineering*, December 1938, as well as in T. P. Wright, *Articles and Addresses* (Cornell Aeronautical Laboratory, Buffalo, N.Y., 1961), vol. 2, along with numerous other Wright articles on production engineering.

[4]For aircraft builders' worries over expansion, see H. L. Federman, "Financial Outlook for the Aircraft Industry," *Aviation* 42 (February 1943): 116; F. B. Wolfe, "The Threat of

radial air-cooled engines under license, the firm's staff was confident that virtually all the parts could be fabricated using the machine tools already on the plant floor at River Rouge. Nonetheless, a middle manager decided that the cylinder barrels for the P&W engine would pose special problems, so he placed an order for a $100,000 special tool from the National Machinery Company of Tiffin, Ohio. On the shop floor the foreman concerned told the manager to cancel the order because he was sure he could turn out the cylinders with the tools on hand. Forty-eight hours later he came running back to the manager to beg him to buy the new machine after all; in trying to fabricate the cylinder barrel using the available Ford equipment he had broken the machine. Because the toolmakers were swamped with orders, it took six months to get delivery.[12]

Much the same story was repeated at General Motors. When GM officials tried to increase the output of liquid-cooled in-line aircraft engines from their Allison aircraft engine division, they decided to move fabrication of the crankshaft—the toughest machine job—from Allison to the Cadillac division. There they discovered that the aircraft crankshaft was much longer than any auto shafts and that none of the lathes in the Cadillac plant could handle the job. In short, while many machine tools in the Detroit auto plants could be used for aircraft work, many others had to be ordered anew.[13]

Disillusionment over the inadequacy of their machine tools was by no means the only shock suffered by the automakers when they began to enter the aeronautical field. Henry Ford might talk of a thousand planes a day, provided that the designs were frozen, but even to think of freezing designs was absurd. Changes in design are dictated not by the whim of meddling government bureaucrats, as Ford suggested, but rather by advances in the performance of enemy aircraft that must be countered. Such essential changes can wreak havoc with high-volume production. When the French purchasing commission demanded four machine guns in place of the two originally installed in a Curtiss fighter, this seemingly simple modification involved changing 150 assembly templates and the fabrication of 350 new ones. Later, when Curtiss installed a three-bladed propeller to give the fighter a better top speed, the extra blade actuated the interrupter gear controlling the fuselage-mounted guns firing through the propeller arc so often as to cut down drastically on the rate of fire. The solution was to install the guns in the wings, but this in turn required major redesign with a corresponding reworking of the jigs and fixtures on the assembly line.[14]

[12]"How Many Planes When?" *Fortune* 23 (March 1941): 188.
[13]Ibid., p. 188.
[14]Ibid., p. 184.

Still more disillusioning to the automakers was the discovery that, even when the aircraft designers and draftsmen released detail drawings to the shop, it did not mean the designs were ready for the production planners. Experienced airframe builders understood that in sheet-metal work many changes in design had to be injected after the drawings were released to the shop. This was so because many difficulties in fabrication cannot be anticipated either by the aircraft designers or by the production engineers but are discovered only by trial and error.[15]

Given the dynamic or fluid character of aircraft design—especially for fighters, where having the edge in speed, maneuverability, rate of climb, and range was essential in the struggle for air superiority—Big Bill Knudsen in his role as production chief on the National Defense Advisory Committee wisely ruled that the traditional airframe firms had best remain as prime contractors with full responsibility for design. The automakers would devote their vast resources to the production of subassemblies and components. Under this arrangement Ford undertook to fabricate components of the Consolidated B-24 four-engine bomber to be assembled in Dallas; Chrysler and Hudson contributed components of the twin-engine B-26 medium bomber for Glenn L. Martin's Omaha assembly plant, and General Motors made components for the North American B-25 twin-engine medium bomber being assembled in Kansas City—to name but a few of the major products.[16]

[15]P. N. Jansen, "Applying Machines to Quantity Production," *Aviation* 40 (June 1941): 180–81. Much the same point had been made by the same author four years earlier in "Tooling for Production," *Aviation* 36 (July 1937): 26.

[16]For an overview on the auto industry's role in producing aircraft, aircraft assemblies, and parts, see Holley (n. 2 above), pp. 304–26, and, for the Ford Willow Run story, pp. 518–29. Ford produced 6,792 four-engine bombers; Eastern Aircraft Division of General Motors produced 5,927 fighters and 7,522 light bombers; Goodyear produced 3,940 fighters. In terms of airframe pounds, these amounted to 6.2, 2.4, and 0.7 percent respectively of the total weight of aircraft turned out by the auto industry (Holley, pp. 561–77). But the figures for complete aircraft tell only part of the story; the auto industry turned out parts and subassemblies in large volume for the conventional aircraft manufacturers. In all, the auto industry produced $11,216,487,000 worth of aircraft, subassemblies, and parts, a total that, surprisingly, outstripped the value of military vehicles and parts ($8,612,173,000) as well as tanks and parts ($3,808,626,000) produced by the automakers. See Automobile Manufacturers Association, *Freedom's Arsenal: The Story of the Automotive Council for War Production* (Detroit, 1940), p. 193. There has been no truly comprehensive treatment of the auto industry's wartime role in the aircraft field, but the following studies offer useful insights: Donald M. Nelson, *Arsenal of Democracy: The Story of American War Production* (Harcourt, N.Y., 1946), chap. 11; Robert R. Russell and Martin P. Claussen, *Expansion of Industrial Facilities under Army Air Forces Auspices, 1940–1945*, U.S. Air Force Historical Study no. 40 (Washington, D.C., 1946); Francis Walton, *Miracle of World War II: How American Industry Made Victory Possible* (New York, 1956), pp.

In June 1941 the editor of *Aviation*, the leading industry journal, surveyed the progress that had been made in the year since the fall of France and the President's call for 50,000 airplanes. He was pleased that the "soothsayers and miracle men" had departed from the scene with their uninformed "puerile prattle," doubtless a jab at Henry Ford's thousand-a-day proposal. He dismissed labor leader Walter Reuther's 500-airplanes-a-day plan with equal contempt as "totally unrealistic." He then went on to observe, "Anybody who thinks you can turn out airplanes just like automobiles hasn't seen an airplane." Where a typical Fisher-built auto body might contain 1,750 parts, an average-sized aircraft could have some 30,000 parts, not counting engines, instruments, or electronic gear. Finally, he tossed an approving bouquet to Detroit: "The auto industry has focussed the spotlight of mass production technique upon the aircraft manufacturing job and has appraised it accurately as . . . very different from its own. And it has rolled up its sleeves and gone to work to learn the new job from the bottom."[17]

In sum, the automakers were bringing a new vision of mass production to the airplane industry, but, at the same time, they were learning some sobering lessons about the difficulties encountered in sustaining "aircraft quality" and the impossibility of freezing designs. As one commentator put it, "the dominant consideration" in any effort to increase the volume of output substantially was the need to inject design changes into the production line as dictated by the performance of enemy aircraft.[18]

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While Knudsen's decision to leave responsibility for aircraft design with the traditional airframe builders undoubtedly made good sense from an engineering point of view, it did nothing to assuage the pride of the automakers. There was precious little name recognition to be derived from the fabrication of, say, a tail assembly for a B-24 bomber built by the Consolidated Aircraft Corporation. Even when Ford turned out complete Pratt & Whitney engines, they were known in the services as Pratt & Whitneys, not Fords. When a *Fortune* magazine editor described Ford, Buick, and Studebaker, all of which were building aircraft engines under license, as functioning "as a colonial dependency" of the old-line aircraft engine firms, it could scarcely help galling the leaders of an industry that spent millions of dollars annually in image building.[19]

Ford, for one, never gave up the dream of mass producing airplanes. Even while acceding to the government's demand that the firm construct components, Ford, with the enthusiastic support of vice-president Sorensen, planned the new aircraft facility at Willow Run in such a way as to accommodate the assembly of entire aircraft. Under the pretext of needing to build a whole bomber for the experience it would provide in production planning, in October 1941 Ford wangled an "educational" order for a single B-24. Well before Pearl Harbor, this was expanded into a regular production contract on which the Ford Motor Company eventually turned out a total of 6,792 bombers, hitting a peak production rate of one an hour.[20] This was far short of Henry Ford's pipe dream of a thousand planes a day, but, significantly, the one-an-hour output was attained in spite of the necessity to inject frequent modifications into the production lines.

In view of the rivalry between Ford and General Motors, it is hardly surprising that GM also began to push for a contract to build a whole airplane and not just components. The firm had already established a toehold in the aircraft field by purchasing the Allison Engineering Company of Indianapolis, a small firm experimenting with liquid-cooled, in-line engines, and Engineering Products, Inc., a propeller firm in Dayton, Ohio, as well as major stock interests in North American Aviation and Bendix Aviation Corporation. Then, in January 1942, GM announced that it had hired Don Berlin, the director of engineering for the Curtiss-Wright Airplane Division.[21]

Recruiting Don Berlin was something of a coup for GM, one which seemed to signal the direction of the firm's intentions. Berlin was the famed designer of the Curtiss P-40 fighter, the leading pursuit plane of the day. More P-40s than any other fighter, some 17,000 in all, were turned out during the war. Moreover, by any standard, Berlin was a

279–88 and 349–73. For a brief look at aircraft production by the auto industry in World War I, see John B. Rae, *American Automobile Manufacturers: The First Forty Years* (Philadelphia, 1959), chap. 8.

[17] Neville, "What Next in Aircraft Expansion?" (n. 4 above), p. 42.

[18] H. N. Gilbert, "The Emergency in Aircraft Manufacturing," *Harvard Business Review* 19 (July 1941): 512–13. See also, A. Klemin, "Air Fighters: Characteristics Desirable in the Military Type that Keeps Bombers Away," *Scientific American* 165 (August 1941): 93, and C. B. F. Macauley, "Where the Auto-makers Stand," *Aviation* 40 (November 1941): 148–52.

[19] "United Aircraft" (n. 11 above), p. 88.

[20] Holley (n. 2 above), pp. 518–20, 577.

[21] *New York Times*, February 14, 1942, 23:2. In 1929, General Motors purchased the Allison Engineering Co. and a 40 percent interest in the Fokker Aircraft Co. of America, changing the name to General Aviation in 1930, subsequently moving most of its operations to North American Aviation, Inc., in exchange for stock in NAA. *Moody's Manual of Investments: Industrial Securities* (New York, 1940), p. 2012.

thoroughly experienced aeronautical engineer. For five years, he had served his apprenticeship in the Air Service Aerodynamics Lab at McCook Field, Dayton, Ohio, in the 1920s and had worked successively for Douglas and Northrop before joining Curtiss in 1934.[22]

What made Berlin uniquely attractive to GM was his attitude toward production. While well aware of the substantial differences between mass production as defined by the automakers and the more modest conceptions of the airframe builders, he nonetheless urged the aircraft industry to look to the auto industry for ideas and guidance. To this end, he published an article expounding his ideas in *Aviation* magazine, entitled "Applying Automotive Methods to Aircraft Production."[23] Rumors of a forthcoming curtailment of automobile production to make way for armaments gave GM a strong incentive to enhance its resources in the aeronautical field. And, when Henry Ford revealed that his firm was developing a light two-place private plane for the future mass market, GM had every reason to take thought for its postwar market, since there were numerous voices predicting that small private airplanes would be competing with the family auto in the postwar era.[24]

Immediately after Pearl Harbor the long-anticipated order to curtail auto production arrived from the Office of Production Management (OPM) in Washington, and the automobile manufacturers scrambled to pick up defense orders to fill the void. General Motors, whose Fisher Body Division had begun working on Boeing B-29 bomber components as early as March 1941, now created a whole new unit, the Eastern Aircraft Division, to manufacture airplanes in its Linden, N.J., assembly plant while drawing on its satellite units in Trenton, Baltimore, Tarrytown, and elsewhere for parts and tooling. The planes selected were the navy's F4F "Wildcat" fighter and the TBF "Avenger" torpedo bomber, both designed by the Grumman Aircraft Engineering Corp.[25] Although the production achieved by this division made a major contribution to the war effort, the planes turned out were

[22]Holley, p. 577; *Who's Who*, 1944–45, "Don R. Berlin."

[23]*Aviation* 40 (January 1941): 42–43. See also Don R. Berlin and Peter F. Rossmann, Curtiss-Wright Corp., "Engineering Considerations in the Application of Automobile Methods to Aircraft Production," an address before the National Aircraft Production Meeting of the Society of Automotive Engineers at Los Angeles, Calif., October 31–November 2, 1940. I am indebted to James R. Hansen for the text of this address from the NASA files (C1113: US/29), Langley Research Center.

[24]*New York Times*, March 10, 1941, 19:7.

[25]General Motors Corporation, Eastern Aircraft Division, *A History of Eastern Aircraft Division, General Motors Corporation* (Linden, N.J., 1944), pp. 17–21, and *New York Times*, March 15, 1942, 5:5.

identified as Grummans, so there was little or no name recognition for General Motors in the enterprise.

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Against this backdrop of events, Don Berlin came forward with a scheme to develop a fighter airplane that would meet the needs of the air force, that could be mass produced in a relatively short time, and that would bear the General Motors hallmark. In September 1941 the corporation approached Maj. Gen. O. P. Echols, the commanding general of the Matériel Command, with a proposal to develop a fighter aircraft in a remarkably short time by using, as far as possible, structures, controls, and accessories already in full production for other aircraft in order to obviate the need for long delays in tooling up for production.[26]

The ingenious scheme called for the use of the wings from the Curtiss P-40E, tail surfaces from the Douglas A-24, and so on. Only the main fuselage itself would have to be developed anew. By such shortcuts, the plane was expected to be ready for flight testing in six months. As visualized, the new fighter would attain a high speed of 440 MPH at 20,000 feet, and a rate of climb estimated at 7½ minutes to reach 30,000 feet.[27]

Air force officials, in their desperation to obtain a fighter that would outperform the planes being turned out by the enemy, were inclined to look favorably on the General Motors proposal. The mainstay air force fighter, the P-40, for all its merits, could not stand up adequately against the latest enemy models, and the fighters already being developed, such as the P-38 and the P-47, were still hampered by the inevitable teething problems of new designs, so they held but uncertain promise at best. In this context, the Matériel Command signed a cost-plus-fixed-fee contract for two experimental fighters, XP-75, at the relatively modest estimated cost of $428,271, for delivery in six months. General Motors assigned the XP-75 project to the Fisher Body Division in Cleveland even though this involved moving the B-29 component work already being done there to another facility.[28]

[26]Fisher Body Division, General Motors Corp. to CG, Matériel Center, Wright Field, Dayton, Ohio, September 24, 1942, document no. 1 in "Case History of the XP-75 and P-75 Airplane Project," compiled by Amy Fenwick, Historical Office, Air Technical Service Command, Wright Field, November 1944, Air Force Historical Research Center, Maxwell AFB, Alabama. Hereinafter all numbered documents refer to this case history.

[27]Maj. Gen. M. S. Fairchild, Director of Military Requirements, Hq. AAF, to Director of Air Defense, Hq. AAF, October 21, 1942, document no. 5.

[28]Telegram, Col. F. O. Carroll, Chief Experimental Engineering Section, Wright Field, to Asst. Chief of Staff (E) Hq. AAF, October 12, 1942, document no. 4.

While the Fisher Body staff busied itself tooling up to produce the XP-75 fuselage and began to secure the components from their several makers, the military situation in Europe took a decided turn for the worse. Bomber raids over Germany beyond escort range had encountered devastating losses, so the Matériel Command was under heavy pressure to come up with a long-range escort fighter which could accompany U.S. bombers deep into Germany and back, fending off Luftwaffe interceptors.

An intelligence report from Great Britain in July 1943 noted that the German authorities were making major modifications in their Messerschmitt and Focke-Wulf fighters to upgrade their capabilities and predicted that they would outperform the leading AAF fighter, then the P-47, in the theater. In response to this the chief of the air staff remarked, "We are all thinking about the P-75 and are in hopes that it will be the airplane that we should put into production," a comment that certainly suggests that expectations for the novel airplane were running high at air force headquarters.[29]

The XP-75, which had not even reached the flying stage yet, was still an uncertain quantity. But the need for a long-range escort fighter was pressing and threatened to become even more so in the months ahead, so the promise of a superior fighter that could be put into production quickly seems to have stimulated a good deal of wishful thinking at air force headquarters. On the other hand, if the air force planners were to wait until the XP-75 proved itself in flight tests before undertaking preparations for eventual mass production, actual delivery of the fighter to combat would be delayed for several months. So the air force took steps to shorten the delays—first, by increasing the number of experimental models to be procured from two to eight to be sure there would be a sufficient number to carry out exhaustive flight tests, and, second, by issuing a letter of intent to contract for a mass-production order for 2,500 P-75s. This latter move was to give GM an opportunity to begin placing orders for materials and to design the jigs and fixtures needed to insure precision fits on the assembly line. Deliveries were expected to begin by May 1944, approximately nine months hence, a phenomenally short time for such a complex undertaking.[30]

Total cost of the production contract was estimated at $325 million with a unit cost of approximately $100,000, exclusive of the Allison engine to be provided by the government. After considerable negotia-

[29] Maj. Gen. G. E. Stratemeyer, Chief of Air Staff, to Asst. Chief of Air Staff, Operations, Commitments, and Requirements, July 7, 1943, document no. 22.

[30] Report of Conference July 6, 1943, in Office of Asst. Chief of Air Staff, Matériel Maintenance and Development, with Mr. E. F. Fisher and Mr. Don Berlin, by Col. J. W. Sessums, document no. 21.

tion the air force agreed to $4,450,702 as the estimated cost of the eight experimental airplanes, but allowed GM a fixed fee of no more than $75,163 or 2.65 percent of the original estimated total, a figure well below the usual 4 or 5 percent fee.[31]

But, even as these contracts were being prepared, General Arnold, in his capacity as commanding general of the Army Air Forces, made it clear that everything depended on the performance of the initial experimental aircraft. "If it does not meet our requirements," he wrote, "all orders may be cancelled; everyone must understand this."[32]

While the air force was busy hedging its bets by planning for the eventual substitution of the P-75 for the P-47 if the latter were to be outclassed by the latest Luftwaffe airplanes, designer Don Berlin and his engineering staff at Fisher Body had begun to encounter some troubling delays. When the XP-75 passed from the visionary stage of paper plans to the point where they began to rivet metal out on the shop floor, the whole scheme of using ready-made assemblies from airplanes already in production began to fall apart. Where the original plan had been to use the wings of the Curtiss P-40E, Fisher soon switched to using wings from North American Aviation's P-51. When the P-47 landing gear turned out to be too heavy, Fisher looked to the Douglas A-24 gear in its stead. These and other similar substitutions involved a great deal of redesign on the fuselage to accommodate the new assemblies. And each such change involved a redesign of the jigs and fixtures used to produce uniformity on the aircraft assembly line.[33]

Not surprisingly, as delays began to pile up in the Fisher Body plant, the estimated delivery date of the first XP-75 for flight testing slipped from the originally promised day in May to sometime in November 1943. When an AAF test pilot from Wright Field finally flew the plane, he was decidedly disappointed. Every new model aircraft has bugs which have to be ironed out; this was to be expected. But the faults encountered in the XP-75 were more than minor. The test pilot reported that the plane lacked stability and displayed a distressing tendency to stall and spin when making tight turns, the maneuver most essential to fighter aircraft.[34]

[31] Letter of Contract Intent July 5, 1943, document no. 26.

[32] Marginal note by Gen. Arnold on conference report cited in document no. 21.

[33] Engineering Memo Report Eng-M-50-825, March 8, 1943, Wright Field, document no. 13; Maj. Gen. B. M. Giles, Asst. Chief of Staff, OC&R to Asst. Chief of Staff, MM&D, March 29, 1943, document no. 14; Engineering Memo Report Eng-M-50-825, Addendum 1, May 31, 1943, document no. 19.

[34] Engineering Memo Report Eng-47-1704-A, January 20, 1944, document no. 58. For comments of one who tested the XP-75, see Mark Bradley, "The P-51 over Berlin," *Aerospace Historian* 21 (Fall 1974): 126.

By enlarging the tail surface, most of the apparent instability could be overcome, but this meant it would no longer be possible to use the ready-built, off-the-shelf stock design already in production for the A-24. Moreover, enlarging the tail shifted the airplane's center of gravity rearward, adversely affecting its flying qualities. To correct this, Fisher engineers had to extend the nose section several inches forward, and this involved redesigning a number of production tools. To make matters worse, the Allison engine, which had been rushed into production before it was thoroughly debugged, was not performing up to expectations, so the plane failed to develop the top speed needed to engage German fighters on its own terms.[35]

Worse news was to follow. Because of the inherent instability of the experimental plane, a Fisher pilot in a subsequent test flight had crashed to his death.[36] The remedy, eventually devised, was to extend the ailerons out to the wing tips to insure greater stability and control. But this, too, required reworking the standard ready-built wings that had been counted on to speed production. Moreover, longer ailerons necessitated the installation of hydraulic boosters to hold control stick forces down to a manageable level for the pilot. Each such modification added weight that, in conjunction with the limited performance of the Allison engine, reduced the P-75's rate of climb from the specified 5,600 feet a minute to a mere 3,000 feet.[37]

As the prospect for producing a successful P-75 grew dimmer, the officer who had approved the project in the first place, Maj. Gen. O. P. Echols, began to look around for explanations as to why the undertaking had turned sour. At first he was inclined to place the blame on the engineering staff at Wright Field. He believed that their frequently voiced criticisms of the plane were either "unsound" or "inapplicable" and directed that every effort be made to remedy the plane's shortcomings.[38]

While it is easy to interpret General Echols's actions as an effort to

[35]Brig. Gen. B. W. Chidlaw, Chief, Matériel Division, AAF Hq. to Maj. Gen. O. P. Echols, Asst. Chief of Staff, Matériel Maintenance and Development, February 16, 1944, and February 24, 1944, documents no. 63 and no. 67; Brig. Gen. F. O. Carroll, Chief, Engineering Division, Wright Field, to Commanding General, AAF, July 17, 1944 thru MM&D, document no. 113.

[36]Brig. Gen. B. W. Chidlaw, Chief, Matériel Division, AAF Hq. to Maj. Gen. O. P. Echols, Asst. Chief of Staff, MM&D, April 17, 1944, document no. 77.

[37]Interoffice Memo, Fighter Branch, Production Division, Wright Field, to Chief, Production Division, July 26, 1944, document no. 114.

[38]Col. J. F. Philips, Chief, Matériel Division, AAF Hq. to Development Engineering Branch, Matériel Division, June 5, 1944, document no. 99. For those unfamiliar with air force aircraft terminology, the X designation in XP-75 refers to experimental aircraft; Y (not mentioned in this account), as in YP-75, refers to service test aircraft; and P-75

shift the burden of failure to other shoulders, in fairness one must remember that, as an officer with many years of experience in procuring military aircraft, he was well aware that the path to high performance is rocky and strewn with many frustrations. Even the most successful fighters have often had a multitude of shortcomings in their early stages of development. Almost invariably a novel aircraft design requires extensive testing, the identification of flaws, and corrective modification, a process often extending over months and years before the plane is fit to be deployed against the enemy. Without substantial faith in one's ability to overcome shortcomings, few if any high-performance aircraft would ever be built.

Nonetheless, the reported performance of the XP-75 in test flights put the whole project at risk. An inferior rate of climb would leave the plane at a serious disadvantage in combat. Even more detrimental was the plane's inability to attain the specified high speed. The chief of the air staff was told that the XP-75 had attained a top speed of 427 MPH at 25,000 feet. Yet, even if confirmed, this was scarcely impressive since the P-47N was already making 463 MPH despite the added internal fuel tanks that helped give it a combat radius of 1,300 miles. It was daily becoming clear that the P-75 was not going to be the plane of the future and would not replace the P-47.[39]

As the XP-75 flight-testing program gathered momentum in the fall of 1944, more and more evidence emerged to indict the whole scheme to use off-the-shelf stock components to build a superior high-performance aircraft. Two more of the experimental planes crashed during testing, indicating probable defects requiring still more modifications.[40] When air force officers estimated that it would take at least six months to eliminate these problems, pushing the projected date for reaching peak production past the middle of 1945, it was clear that the time had come to kill the whole project.[41]

On October 4, 1944, the chief of air staff, Lt. Gen. B. M. Giles, signed the order terminating the contract.[42] It was subsequently arranged to

standing alone refers to production models. If major modifications are introduced in the production model, these are indicated by letters after the number designation, such as P-75A, etc.

[39]Col. W. F. McKee, acting Asst. Chief of Staff, OC&R, to Maj. Gen. B. M. Giles, Chief of Air Staff, August 30, 1944, document no. 122.

[40]Brig. Gen. F. O. Carroll, Chief, Engineering Division, Wright Field, to Asst. Chief of Staff, M&S, AAF Hq., August 26, 1944, and October 11, 1944, documents no. 121 and no. 138.

[41]Brig. Gen. M. E. Gross, Chief, Requirements Division, OC&R, AAF Hq., to Chief of Air Staff, October 3, 1944, document no. 129.

[42]Ibid.

finish the six planes that were then in various stages of completion on the assembly line for use in further testing.[43] The cost of the P-75 caper came high. Final settlement on the experimental XP-75 contract came to just over $9 million. For the production contract, the tab was somewhat over $40.75 million.[44]

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What went wrong? How can we account for this fiasco? It is clear that the whole conception of a high-performance fighter to be cobbled together with ready-made parts was fatally flawed from the beginning. The wonder is that a designer with as many years of experience as Don Berlin had in developing airplanes should ever have assumed that such an approach would be feasible. One can only speculate that it was the urgent necessity of getting a superior fighter into production as rapidly as possible that led to the experiment. The available evidence in the archival record does not reveal whether the designer was under heavy pressure from GM officials to come up with a distinctly GM fighter or if he himself led the way from a desire to justify his position in the firm. But the burden of responsibility does not rest solely with the designer or with the General Motors Corporation—which, after all, in good faith hired an individual regarded as one of the best men available in the aircraft design business on the basis of his earlier success in developing the Curtiss P-40.

The proposal submitted by Don Berlin would have gone nowhere without air force approval. So the question becomes, Why did General Echols, who headed the Matériel Command, not only approve the project but urge that it be pushed "vigorously"? He was an officer of many years of experience in developing military aircraft, so he could not possibly have been unaware of the multitude of modifications that almost invariably mark the early stages of high-performance aircraft. Echols's espousal of the XP-75 is all the more curious in view of the massive size of the plane. With its 49-foot wingspan, it was substantially heavier than virtually any other successful World War II fighter. Even in the design stage a much heavier plane should have suggested a

[43] Interoffice memo, Col. M. F. Cooper, Chief, Fighter Branch, Engineering Division, Wright Field, for Chief, Aircraft Project Section, Engineering Division, October 19, 1944, document no. 141, and Col. E. W. Rawlings, Chief, Readjustment Division, Wright Field, to Fisher Body Division, General Motors Corp., October 27, 1944, document no. 147.

[44] "Supplement to Case History of XP-75, P-75 Airplane," undated, pp. 12, 14, Air Technical Service Command, Wright Field, in Air Force Historical Research Center, Maxwell AFB, Alabama.

probable disadvantage when pitted, fighter vs. fighter, in the high-G, high-energy maneuvering of aerial combat.

The answer again seems to be that, in the latter half of 1942, the air force was desperate to get a superior fighter. Beset by a series of defeats and setbacks and painfully conscious of the shortcomings of the P-40, the principal air force fighter at the time, the situation seemed to warrant a gamble. The XP-75 was a long shot. If it could be made to pay off, the rewards in terms of getting into mass production promptly by using ready-made components were decidedly alluring. But, in order to make the gamble pay, it was necessary to prepare for mass production, with all that this implied in tooling and setting up the costly jigs and fixtures for the assembly line, concurrently with the experimental work on the XP-75. When the experimental plane failed to achieve its promised performance, the gamble failed, and the investment in production tooling simply compounded the loss.

One should not draw the conclusion from the failure of the P-75 that the auto industry could not or cannot produce airplanes of high quality. Indeed, the production record achieved by GM's Eastern Aircraft Division was remarkable. From a standing start in January 1942, when the company cleared away its auto assembly lines in Linden, N.J., GM put its first Wildcat fighter in the air for testing in September. Two months later it tested the first Avenger torpedo bomber. After that, production went into high gear, and by December 1943 the plant had turned out its thousandth Avenger. By April 1944, 2,500 Wildcats had rolled off the lines.[45] The difference between these impressive results and the sorry story of the P-75 lay in the fact that the Avenger and the Wildcat were well-developed high-performance airplanes thoroughly engineered by Grumman before they were turned over to GM.[46]

The failure of the P-75 underscores the significant differences between auto and aircraft manufacturing, the difficulties of combining development and production at one and the same time, and the importance of managerial mindsets in any attempt of innovative technology. The case of the P-75 affords us an exceedingly expensive lesson; one can only hope that a rising generation of decision makers will be moved to heed this lesson.

[45] *New York Times*, September 2, 1942, 24:2; November 18, 1942, 12:8; December 23, 1942, 14:1; December 15, 1943, 18:3; April 12, 1944, 13:8.

[46] Grumman provided GM with the designs for proven high performance airplanes. The contribution of GM engineers was to rework those designs to suit the requirement for mass production and to accommodate modifications found necessary subsequent to the beginning of production.