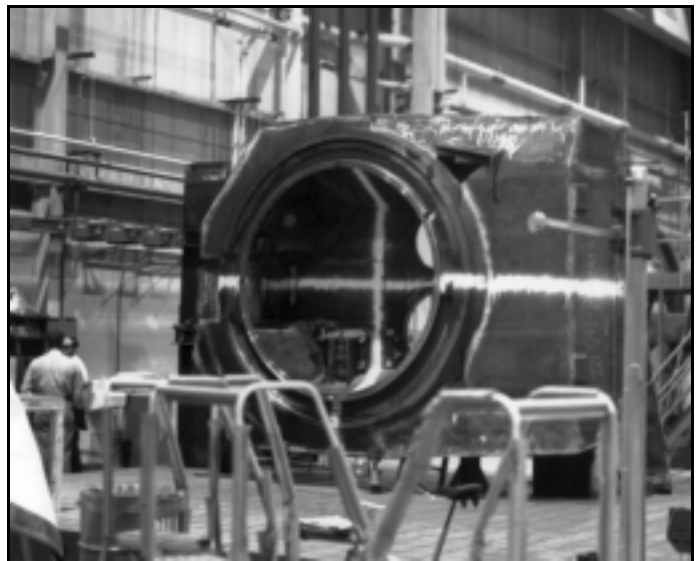


You Want to Shut Down The Tank Plant !?

by Don Loughlin



The flurry of recent articles about the Future Combat System (FCS) in trade journals is a lot of talk about a system so far away.^(1,2,3) According to what I read, some in the government wanted to shut down tank production facilities so we can concentrate limited R&D funds on completing technology development of components and subsystems needed for the FCS. The FCS is intended to defeat a threat system of unknown capabilities emerging at some unknown time in the future. These articles raise several troubling issues:

The possibility of shutting down tank production facilities until the FCS is ready for production, and using the savings to fund development of components and subsystems of the FCS.⁽¹⁾

Although this idea may not be too likely right now, depending on which article I read, it wouldn't take too many changes of leadership to make it a lot more likely in the future. In my opinion, shutting down tank plant production capability would be a disaster for the Army and the nation. The loss of continuity and the loss of critical skills found in experienced design and production teams would be a far worse problem than the loss of the facilities. Should a national crisis develop, these skills cannot be recreated rapidly enough by throwing money at the problem. While the government can print money, it takes time, patience, and skill to create resources. In peacetime, the country still builds ships and aircraft, but no one will remember how to design, test, and produce a tank **system** once we shut down tank production. With production capability shut down, who would be left in the con-

tractor base or in the government that would know how to design the system, prepare a program plan for production, prepare a system-level production test plan, prepare a production technical data package, design and build the production line, and test production prototypes? Where would we get the very important vendor base of qualified suppliers, including the second and third tier suppliers? The Army's skills at system-level testing will atrophy, with nothing to test but components and subsystems. The technologists will say, "No problem," but take it from me, don't believe 'em.

Where would we get armored vehicle transmissions, for example? These unique items have no comparable technology in the commercial market. If you wipe out the vendor base for designing and producing entire armored vehicle transmissions, the new transmission supplier, who may never have built one before, would have to start from scratch, develop his own vendor base, and train his own design and production staff, but who would be available and qualified to do the training? The lead time from cold start to transmissions coming off a line could take years. I'm not going to say how many years, because I have it on hearsay and, if I told you how many years, you wouldn't believe me anyway.

Keeping the tank plant open doesn't necessarily pay for whatever production rate is being proposed by the tank plant managers or tank program office. There is little money available for all we need, so all programs may have to produce at a lower than desirable rate, and at a higher unit cost, just so we can maintain other important capabilities.

Another experienced team that would atrophy would be the manufacturers' project management staffs, a large group of skilled people that includes technicians, draftsmen, designers, engineers, and scientists, not just in the engineering departments, but in the test, purchasing, and production and manufacturing departments. Of almost equal importance to their individual skills is the fact that many of them have worked together for decades, and know each other well – this is what makes them a team. Because they know each other well, they can rapidly contact the person with the correct, unique skill when a problem arises, speeding any proposed solution. If we shut down tank production facilities, this capability, like so many others so patiently built up over the years at great expense, will quickly just blow away. Recreating these skills won't be easy because the skills are so foreign to the contemporary common experience of most of the public. The general population now has little military experience (thanks to the All-Voluntary Military). When I started in the defense industry in 1957, virtually every man that I worked with had been in the military, many with service in WWII and/or Korea. Today, you can hire an engineer to design shoe-making machinery, or to design a bridge; and he or she can learn the job quickly with some specific training, because the engineer knows what shoes and bridges are and how they are supposed to function. But just try telling that same person that he or she is to work on a coax machine gun installation, including boresight, zero, and ammo feed system, paying particular attention to ruggedness, ease of use, and simple operator mainte-

nance. Imagine next that there is no one around who can train that person because the plant had been shut down years ago, the former design team has been scattered to the winds, and you will have some idea of the chaos that will result. The military's cutbacks, regardless of how painful and sometimes unjust (How many civilians have been laid off from the Pentagon?), result in a loss of ability to meet national commitments, but not in the total loss of institutional memory to conduct warfare. Cutbacks in the defense industry can result in a *total* loss of defense capability in some areas, and in some cases we are already well into loss of institutional memory. There's nothing new about that; after all, the cutbacks started ten years ago.

Suppose now that war comes before the FCS is ready. Aside from the loss of experienced teams, there will be shortages of critical materials, machine tools, and time. Printing money won't change the availability of anything. If the Air Force can even now get \$1.3 billion to spend on a plane (each, not per squadron), would you like to try to compete with that horsepower in trying to get resources in a crisis?

Another difference between the military's problems and industry's problems during a critical cycle of retrenchment is that when a new armored formation is created, it has a training period for it to form and to learn to operate together, as well as to learn to operate its equipment. There is no such grace period for the operators of a new production facility in a time of national crisis. It will start to work to meet its contract commitments (surely made optimistically), which will include trying to find equipment, materials, and personnel — and this *community of strangers* will then try to design and manufacture the equipment in which *you* will go to war. If that doesn't make you feel very comfortable, consider that the contract probably will go to the low bidder.

An excellent report on the importance of continuity of design and production experience is *Armor Development in the Soviet Union and the United States*.⁽⁴⁾ It is concise and eminently readable with a minimum of jargon. Here are some excerpts:

Page v: *"Improved weapons are primarily the outcome of a process of cumulative product improvement and evolutionary growth."* In other words, the 'Great Leap Forward' is more likely to result in a stumble.

Page vi: *"...an effective R&D strategy can be abstracted: (1) product improvement of existing designs; (2) independent development of components and technology; and (3) construction and testing of experimental prototypes."*

Page 2: *"... flexible, experienced design teams that can respond to the surprises of R&D are more likely to be creative than those that have little continuity and are constrained by rigid, pre-established plans."*

Page 5: In referring to pre-WWII American tank design strategy, the report made this statement that is every bit as valid today: *"U.S. tank development was also influenced by a belief that research could meet the specifications laid out by military planners. Many of the designs that were requested were both unrealistic and inconsistent with budgets and technology."* Unfortunately, the unrealistic ideas have all too often been sold to the users by the technologists of both industry and government.

Page 135: In "IN SUMMARY": *"... Prototypes provide a better way to test hardware than any paper analysis, computer simulation, or intuitive judgment."*

Page 105: I conclude the quotes with a sly smile on my face while I add this: *"The program-management strategy (i.e., the 'new' concept of the Program Manager having authority and budget control) also spread to other systems, with the same results as those of the Sheridan — unpredictably high development and production costs, extended times to development, and considerable (often unmanageable) technical problems."*

The second troubling issue that concerns me is the drift toward a tank with an external gun and minimum turret armor.

Every illustration of a notional FCS that I have ever seen shows an external gun turret. It is clearly the preordained solution, and any contractor with his eyes open will bid an EGT because that is what the powers-that-be obviously have been sold on. Pious declarations in the proposal solicitation that 'all solutions are acceptable' if they meet the performance requirements will be seen for what they are, just so much smoke, and they will be ignored in favor of the perceived 'school solution.' Every briefing given by a military or industrial organization anxious to win a role on this big development

project will enthusiastically tell the user what a great idea the EGT is. Candor would be punished by exclusion from being part of the team.

I have already had most of my say on the subject of EGT,^(5,6) and so have my critics,⁽⁷⁾ but there are two issues on which I wish to dwell further: that the external gun turret (EGT) is not really 'low profile;' and that minimizing armor on any turret, external gun or not, is not advisable.

The External Gun Turret

In Section 2 of my article on external gun turrets,⁽⁵⁾ I referred to height problems with an EGT but didn't spend much space on it because I didn't know how to handle the difference between the paper claims and the real world. I finally realized that there is a real world comparison available. In the competition for the Assault Gun System contract, there were four real-world prototypes, one being an external gun turret and three with conventional turrets.

Let's look at the reducible height of both winner (conventional turret) and the EGT:

	Conventional Turret (M8 AGS)	EGT
Reducible Height	2.38m ⁽⁸⁾ (93.7 in)	2.45m ⁽⁹⁾ (96.5 in)

Table 1.

Both the above systems used the same M35 105mm tank gun; both were designed to meet the same C130 air transportability requirements since the C130 requirement puts a premium on minimum height, and the system with the conventional turret still had a lower overall height, which proves my point: the alleged low profile of the EGT is fictional. (The comments about both the EGT vehicle and the M8 being designed for C130 transport, and both using the same cannon, doesn't mean that they were both designed to meet the same overall military specs, including armor protection. Only the M8 was tested by the Army; all other comments about the EGT are based upon the bidder's unverified data sheet.)

The height of the 360° view ring of unity, direct vision periscopes on top of the turret does add a little height to the M8, but such clear vision at the top of the turret is one of the advantages of a conventional turret: One can easily go

Armor Location	Est. armor thickness (mm) & obliquity (deg)	
	T-62 Tank	T-55 Tank
Turret: Front	242 @ 0°	203 @ 0°
Turret: Sides	153 @ 5°	150 @ 0°
Hull: Front (Glacis/top)	102 @ 60°	97 @ 58°
Hull: Front lower	102 @ 54°	99 @ 55°
Hull: Side upper	79 @ 0°	79 @ 0°
Hull: Side lower	15 @ 0° *	20 @ 0° *

* Limited protection by roadwheels, but not much.

Table 2. Russian Armor Distribution, T-62 and T-55.

into turret defilade. But one cannot readily obtain unity, direct vision at the very top of a vehicle with an EGT. One could remote it, at considerable expense and complexity, but I doubt how effective something like a fiber-optic bundle would be in trying to replicate a ring of simple periscopes. Sight heads for IR or TV sights could be mounted on top of the gun mount, from where they could be remoted to both commander and gunner, but they would not provide the daylight visual acuity of direct vision obtainable with simple periscopes.

I have seen photos of a vehicle with EGT next to an M1, with the caption saying something about the photo illustrating the advantages of the EGT. That is very misleading! Similar photos of an M41 light tank next to an M48 tank show the M41 obviously smaller. Both the M41 and the M48 have conventional turrets.

What such a photo illustrates is only the difference in size between a light tank and a main battle tank — which is all the EGT vs. M1 photo shows. (Speaking of EGT, when told that xyz's EGT can, in case of autoloader failure, emergency-load the gun under armor, ask 'em to demonstrate it.)

How Much Armor on the EGT?

The sources cited are inconsistent as to how much armor is needed on the EGT. If the Future Combat System is to have "...armor capable of stopping all known tank munitions..."⁽¹⁾ then that implies that the EGT will also be heavily armored. If the rationale is that burying the crew down in the chassis means that there is no need for a heavily armored turret,^(2,3) then I emphatically disagree. How can anyone convince themselves that minimizing armor on the EGT to save weight does not also degrade survivability of the vehicle and crew? In a hull defilade position, the only part of the vehicle

exposed to hostile flat trajectory fire will be the least armored part of the vehicle. Does it really make sense to have little or no armor on the turret? Gunners are trained to shoot at the apparent center-of-mass. What else do they have to shoot at on a vehicle in hull defilade, other than the turret? During cross-country movements, the undulations of the ground will provide some protection against flat-trajectory fire for the lower part of the vehicle, but the top of the FCS (the turret with minimum armor) will be the part most likely to be exposed to fire.

An example of how the Russian experience has led them to armor their vehicles can be seen in the armor data at Table 2, which show that the turret was always armored at least as well as the hull.⁽¹⁰⁾

The Russian tank designers clearly saw the necessity for the heaviest armor on the turret, even to the point of having almost no armor on the lower sides of the hull. The same priority on armor placement must still be in place on the T-72s because 25mm Chain Gun penetrators were killing T-72s in Operation Desert Storm with side shots "...out to 1,000 meters ... if you get it between the tracks where the armor is thin."⁽¹¹⁾

Any kind of armor unclassified data that has been released to the public is hard to find, and it will usually be available on tanks that are no longer first-line systems. However, it is reasonable to believe that the frequency and location of direct-fire, KE cannon hits on tanks (in the vertical plane) are no different now than they were in the past, nor should they be any different in the future. (If they are, then let's hear the rationale from the FCS advocates.) Let's look at these older tanks and examine their armor distribution (see Table 3).⁽¹²⁾

So, we have seen that, in the past, it appeared that the turret was at least as heavily armored as the rest of the vehicle. Why wouldn't it be necessary now on the FCS? I have read the fallacious reasoning that, with the crew safely (!?) buried in the hull, if the gun is blown away, the crew will still be safe. If the gun were to be blown away, how do we know that the ammunition in it, or around it, would not detonate and cave in the hull roof just below it, under which the crew is 'safely' hidden? Even if it were true that the crew could be safe after the gun is blown away, which I dispute, how long would they be safe after they were disarmed and the system turned into a mobile target? Once disarmed, the defenseless hull would be easy pickings for most weapons on the battlefield. How safe is the crew now? They can't even call for help, because their antennas were on the gun mount and they were blown away with the gun. A strategy that's good for a turtle is not necessarily good for a tank. The turtles' enemies don't have tank guns, artillery, AT rocket launchers, bombs, guided missiles, and satchel charges.

Could it be that the real reason for not armoring the EGT is not that it isn't needed, but because of the ex-

Armor Location	Est. armor thickness (mm)			
	French AMX-30	UK Mk13 Centurion	UK Vickers Mk1	US M48 Series
Turret: Front	80.8	152	80	110
Turret: Sides	41.5		40-60	76
Hull: Front (Glacis/top)		118	80-60	
Hull: Front lower		76	40	
Hull: Front, combination	79			101-120
Hull: Side front	57			76
Hull: Side rear	30			51

Table 3.

...Those threat briefings were usually exaggerations. When we later got our hands on the threat hardware, all too often, either the high tech wasn't there, or it didn't work very well....

treme difficulty of providing any substantial armor on it?

Another concern is timing — in other words, “What’s the rush?”

The specific capabilities of the FCS need to be tailored to at least match, and preferably overmatch, the specific capabilities of the next-generation threat system. It does not make much sense to commit the country to finishing development of the FCS so we can go into production when the threat system is so undefined. And from where will this powerful threat originate? From a country that, in the past, specialized more in the idea that ‘quantity has a quality all its own,’ rather than high tech solutions? Yes, I’ve heard future threat briefings; I heard ‘em for 40 years. Those threat briefings were usually exaggerations. When we later got our hands on the threat hardware, all too often, either the high tech wasn’t there, or it didn’t work very well.

One of the few cogent statements made by the supporters of the FCS (based upon reading the trade journals) is the need to reduce the logistic burden of the M1 tank, not the least of which is its massive weight and high fuel consumption. It would make more sense to invest in a more supportable, lighter weight version of the M1 than to invest in the FCS. We have spent a lot of money on advanced armor technology, haven’t we?

I’m also concerned about proposals for an “Advanced Gun.”

If we’re seriously considering a revolutionary cannon using advanced technology for the FCS,⁽²⁾ then this taxpayer hopes that it won’t go too far until someone has made a public, *full-scale demonstration* of the technology in actual firings at the ranges of interest. By this I mean that the performance, weight, **volume**, and cost of the new gun have been demonstrated within the constraints (i.e., *inside!*) of the tank on which it is to be integrated. The claims for performance should not be based upon analytical projections, and the data justifying the choice should be made public. If we are told that the performance is ‘so great’ that the data must be classified, and then we are told that the other limited data that is unclassified is also closely held because it is the proprietary data of the

contractor, then it will smell like another Cased Telescoped Ammunition (and Gun) fiasco.⁽¹³⁾ A ‘demonstration’ of an advanced cannon whose total volume and weight, including all subsystems and components necessary to fire at the claimed muzzle energy and rate of fire, are *x*-times the volume and weight of an entire tank ought to make you suspicious. If the advanced cannon system is that large, then it’s too early in the development cycle to be talking about putting it inside any particular tank.

Are we again pursuing “Fads and Fashions?”

A reviewer of this article, in commenting on the EGT and the everyone-buried-in-the-chassis approach, told me that he has seen a lot of fads and fashions come and go in his years as an Armor officer and in the defense business. He noted that it is interesting how the fad of where the crew is to be located has changed. In the MBT-70, everyone was located up high in the turret, even the driver. We were told then that it was a great innovation. The view was excellent, but there were cost and practicality issues. MBT-70 has gone off to that great museum in the sky, and we can only hope that, in the fullness of time, the EGT will fade away like leisure suits and Nehru jackets.

Conclusion

I wrote this article, and my previous one on the EGT,⁽⁵⁾ in order to give the user community a viewpoint different from what they’ve been told for a long time. My conclusion is that the FCS Program has so many flawed conceptual approaches that to shut down the tank plant in anticipation of using the money saved to develop the FCS would be a disaster for the Army and the nation.⁽¹⁴⁾ Would the Navy shut down its last shipyard? Would the Air Force shut down its last aircraft factory? Hardly!

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- (13) DOD Office of the Inspector General. Report No. 96-164; *DOD Cased Telescoped Ammunition and Gun Technology Program*. June 14, 1996. (I am the complainant, and you can fax to the IG a request for a copy at fax number 703-604-8932.)

- (14) It is traditional to offer thanks to the reviewers of a draft article, and to cite them by name. I must forego that courtesy, since the four reviewers still work in the defense industry, but none stand to profit by any decision regarding the FCS, nor do I.

Don Loughlin retired from the defense industry in 1992 after a 35-year career as an ordnance engineer. Prior to that, he was a Marine armor officer for five years. He holds degrees from the University of Pennsylvania and John Hopkins University and is a 1953 graduate of the Armor School.