AFRL

USSF

FINAL REPORT

SCIENCE & TECHNOLOGY (S&T) 2030 STRATEGY: LINE OF EFFORT 3.6: BUILD A PIPELINE OF TECHNOLOGY PROFICIENT MILITARY AIRMEN & GUARDIANS

"It's hard to manage something you don't understand, and development of new defense systems is the management of engineering and technical risk."

– Honorable Frank Kendall

EXECUTIVE SUMMARY

The Origin: In 2019, the S&T 2030 strategy implementation was assigned to AFMC. The strategy was divided into lines of effort (LoEs) managed by the Air Force Research Lab (AFRL). The design team for LoE 3.6: "Build a Pipeline of Technology Proficient Military Airmen and Guardians" was championed by the DAF Chief Scientist (DAF/ST). This document is a summary of the LoE efforts and accomplishments between Spring of 2020 and Summer 2021.

The Challenge: Technology is central to the battlefield of the future. China is building a Science Technology Engineering or Math (STEM)-heavy Peoples Liberation Army (PLA).[1] In 2025, China will graduate twice the STEM PhDs than the USA.[2] China's General Armaments division is headed by a 4-star general with a Physics PhD.[3] Given the rapid pace of technology, advanced education is key for any future offset that will maintain technological superiority.[4]

LoE 3.6 Data Findings: As a reference point, about 30% of the founding CEOs of transformative Fortune 500 companies had STEM Masters degrees[1] and about 13% had STEM PhDs.[5] We now compare this to the USAF. In 2021, the LAF General Officers with STEM advanced degree education stood at 15%, a near 30-year low and half that of industry. Less than 2% of Colonels and less than 1% of Generals have a STEM PhD.[6] The DAF position codings that request leaders with a STEM PhD has dropped by 20% since 2010 while LAF authorizations has remained flat during the same period.[7] There are 311 leadership positions specifically designated for developing future technology superior to our adversaries. These are called Materiel Leaders for Lt Col (O-5) positions and Senior Materiel Leaders (SML) for Col (O-6) positions. Of these 311 as of summer 2021, only 5 require an advanced STEM degree.

The Next Phase: SecAF Kendall has made organic technical expertise a priority. In coordination with SecAF-level efforts, we hope to engage the technically-focused S&E community in a series of in-person and virtual panels discussions beginning summer 2022. Goal will be to refine a collective vision for the role and paths technically-proficient uniformed S&Es need to play to succeed in strategic competition against a technology adept adversary.

[1]Anthony Tingle, "Army Generals are Not Prepared for the Future", Defense One, 22 May 2021

[2]Remco Zwetsloot, et.al. "China is Fast Outpacing US STEM PhD Growth", CSET Data Brief, Aug 2021.

[3]George Dougherty, "Accelerating Military Innovation: Lessons from China and Israel", Joint Forces Quarterly, Vol 98, 10 Sept 2020.

[4]Chad Bollman, et.al. "Education is the next off set", Proceedings, Vol 146, November 2020.

[5]Ben Werdmuller, "Examining degrees of Fortune 500 Tech CEOs", Independent Study, Dec 11, 2018.

[6]William Cooley and George Dougherty, "Every Airmen and Guardian a Technologist", Air and Space Power Journal, Fall 2021.

[7]John Crown, Shirley Ross, Samantha DiNicola, RAND Project Air Force, PAF-1P-654, March 9, 2021.

LoE 3.6 Accomplishments

- Grass Roots Involvement:
  - Built a MilSuite network of over 360 S&E members to engage the community to articulate and prioritize the uniformed S&E issues.
- Strategic Reimagining of S&E role: Published three open academic papers addressing a "strategic reset" of how to engage uniformed S&E members in strategic competition
  - Cooley, William and Dougherty, George, "Every Airman and Guardian a Technologist", Air and Space Power Journal, Vol 35, Summer 2021.
  - Fry, Brian. "Mobilizing Uniformed Scientists and Engineers", Air and Space Power Journal, Vol 35, Fall 2021.
  - Fry, Brian. "Taking the Brakes off Uniformed Scientists and Engineers", Air and Space Operations Review, Spring 2022.
- Metrics to Monitor and Drive Uniformed Technology Proficiency:
  - With RAND, gathered baseline data on the status of the uniformed S&T system.
- Expanded Opportunities for Uniformed Technical Depth
  - **Edison Grants.** The top MilSuite site recommendation to strengthen the S&E community was to "Let Engineers to Engineering". In response, AFRL launched a rapid funding source facilitating technical uniformed members anywhere in any MAJCOM to "do" short engineering experiments to build technical competence and instincts and form an AF-wide network.
  - **Project Arc: Operationally Integrated Engineering Cells.** Bridging the gap of military scientists and engineers to warfighters. Uniformed S&Es serve a key role in adapting technical possibilities in an operational setting. Project Arc supports unformed S&Es through TDYs into operational spaces to practice technical adaptation while building operational instincts.
  - **Expanded Graduate School Opportunities.** The PhD Management Office worked with AFIT to expand graduate school while awaiting pilot training.
  - **Expanded Career Timeline enabling more Technical Depth.** The PhD Management Office enabled officers to delay promotion boards while in a PhD program.
  - **AF-wide SME search engine.** A "LinkedIn" for technical expertise: https://smeprofile.usaftechconnect.com/. The SME search engine enables S&Es to find the government technical experts!
- Expanded the formal STEM demand signal at the Senior Officer Ranks
  - Grew the number of General Officer billets coded for advanced STEM degrees from 1 to 5 an increase of 500%!

Contents

REPORT BODY

Background on LoE 3.6: The design team for LoE 3.6 of the S&T 2030 Strategy was chaired by the Military Assistant from DAF/ST with the senior mentors of the Chief Scientists (Dr Joseph and Dr Coleman) and MGen Goldstein, USAFR. In the Fall of 2019, the design team formed under an IPT charter by Gen Bunch, AFMC/CC. Team members were volunteers with a self-identified passion for the mission from AFRL, SAF/AQH, SAF/AQR, HAF/A9, HAF/A9, HAF/A1, AFIT, AFMC, USAFA, ROTC, SMC, AFTAC, NRO, and NASIC. A list contributors is found in Appendix A. The volunteers met virtually every other week. To gather ideas, a private MilSuite site was created and was advertised through MyPers which attracted over 360 members.[8] The MilSuite site gathered from the S&T community perceived issues, suggested solutions, and voted the ideas up or down. Using guest speakers and discussions, the design team agreed on the desired end state, approach, and guiding principles to achieve the objective identified in the S&T 2030 strategy. They then designed or endorsed pilot efforts with the potential to move the existing pipeline system towards the desired end state. RAND was placed under contract to support data analysis and advice.

The LoE 3.6 design team gathered data to describe a desired end state. We then built small experiments to study how to incrementally move the Department of the Air Force in a meaningful direction.

Consensus End State and Principles:

End State: Uniformed airmen and guardians with the education / experience / instincts / vision to make the real-time judgements that navigate the terrain of rapidly-changing technology more effectively than near-peer competitors to ensure US national security.

Underlying Principles:

- Uniformed Scientist and Engineers (S&E) airmen and guardians have three distinct roles/functions compared to civilians and contractors
    - To deploy
    - To command
    - To bring a mindset of military operations and strategy
- S&E's that deploy and command will serve critical roles in conflicts against technologically-sophisticated peer adversaries that will likely provide us technological surprise us in battle:
    - The ability to make command decisions regarding how to maneuver in a changing technology landscape faster than an adversary.
    - The ability to perform technology adaptations on the edge (e.g. remote battlefield with poor reach-back capability).
    - The ability to reach-back and communicate/integrate urgent needs with the national security R&D enterprise.
- Uniformed S&Es from all career fields be "Multi-capable Airmen" that:
    - Have operational expertise and instincts,

[8]Milsuite Site address: https://www.milsuite.mil/book/groups/af-2030-st-strategy-technology-proficient-military-airmen-ipt

  - Have technical expertise built on technical judgments exploring S&T frontier,
  - Train for deployed missions integrating technical with operational expertise, and
  - Employ technical expertise in adaptations as a defense against technical surprises from peer adversaries.
- The combination of operations and technical expertise is built with many cycles of small experiments or small tests with solid feedback. The critical steps for expertise are:[9]
  - Try new things; make technical judgements on topics where unknowns exist. Without pressing the technical edge, peer adversaries will get there first.
  - Test the judgement hands-on while making failure survivable. For example, instead of a 5-year $100M contracted program, build towards an ultimate capability with a series of in-house integrated $5M prototypes every 6 months.
  - Know if you failed. Document the experiments with rigor and validation! For example, experience setting up a contract or approving a design may build time in acquisition coded positions, but it does not build technical expertise until the judgments face a rendezvous with reality.

Metrics on the Current Pipeline of Technology Proficiency Airmen and Guardians

Throughout the effort, RAND provided data to ensure the issues and pilots were quantitatively grounded. Here we discuss the metrics and data which reflect the health of the uniformed S&T workforce and the associated pipeline.

The data in Figure 1 indicate that since 1994, less than half of the Air Force officer corps are commissioned with STEM (Science Technology Engineering or Math) undergraduate degrees. In Figure 2, we see the inventory of officers with STEM master's degrees fell dramatically from about 7000 in 1989 to a low of 4500 in 2007 and is now slowly recovering to just over 5000. Over the same period, the Air Force's inventory of STEM PhD officers has been steady at around 500. However, during that same period, the number of PhD requirements fell by 20% indicating a lack of support for STEM PhDs by senior leaders.[7]

We find that this inventory is about half of what is needed. In practice, Figure 3 shows only about half of the billets coded for a STEM advanced degree (both masters and PhD) are filled with an occupant of that education level. Since 2019, the HAF/A1 PhD Mgt Office has validated the PhD positions and is revalidating the master's degree positions. Some of the officers with the degree codes should naturally serve some time in career broadening positions. The stable history of the 50% fill rate suggests the AF needs about double the number of officers with STEM advanced degrees.

[9]Model for expertise taken from Tim Hartford, "Adapt: Why Success always begins with Failure", Picador Press, 2012.

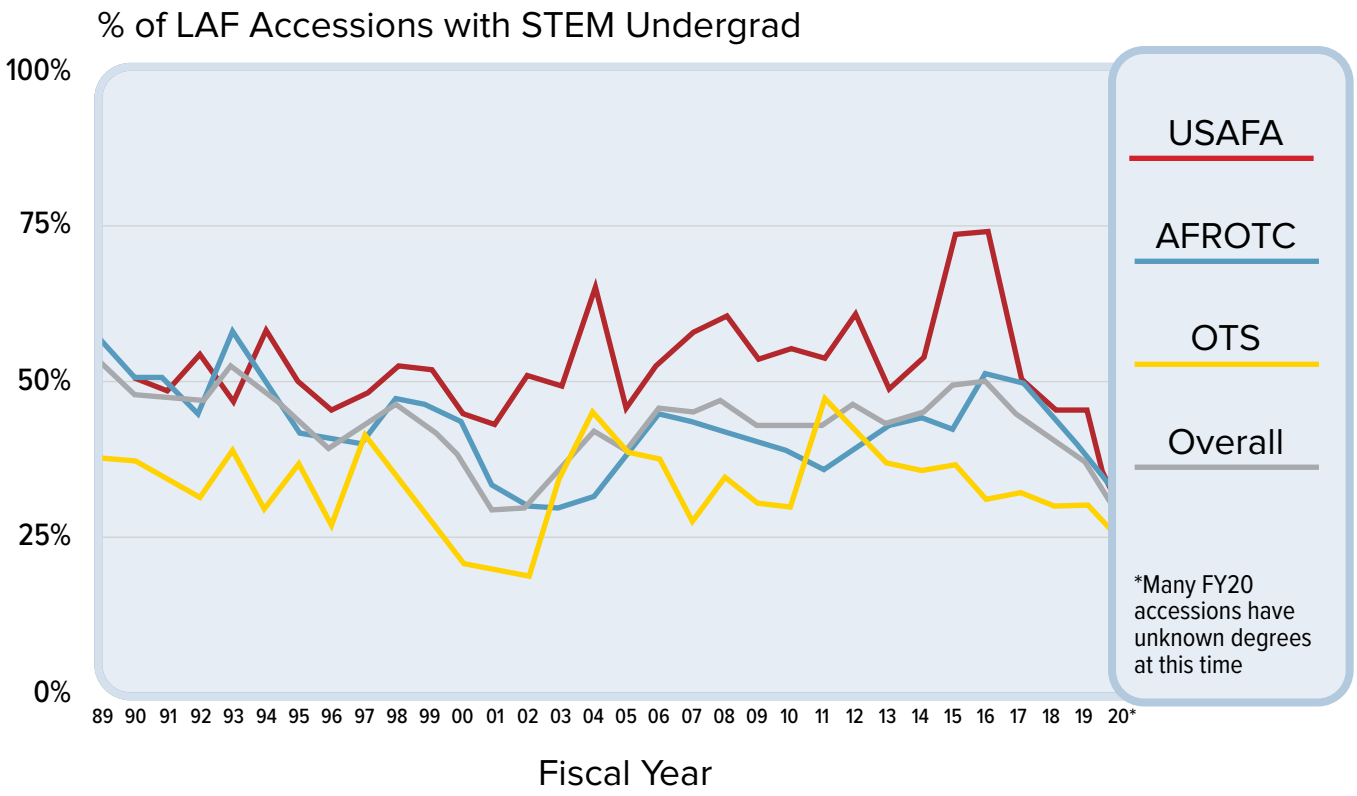

Figure 1: Less than half the officer accessions have a STEM undergraduate

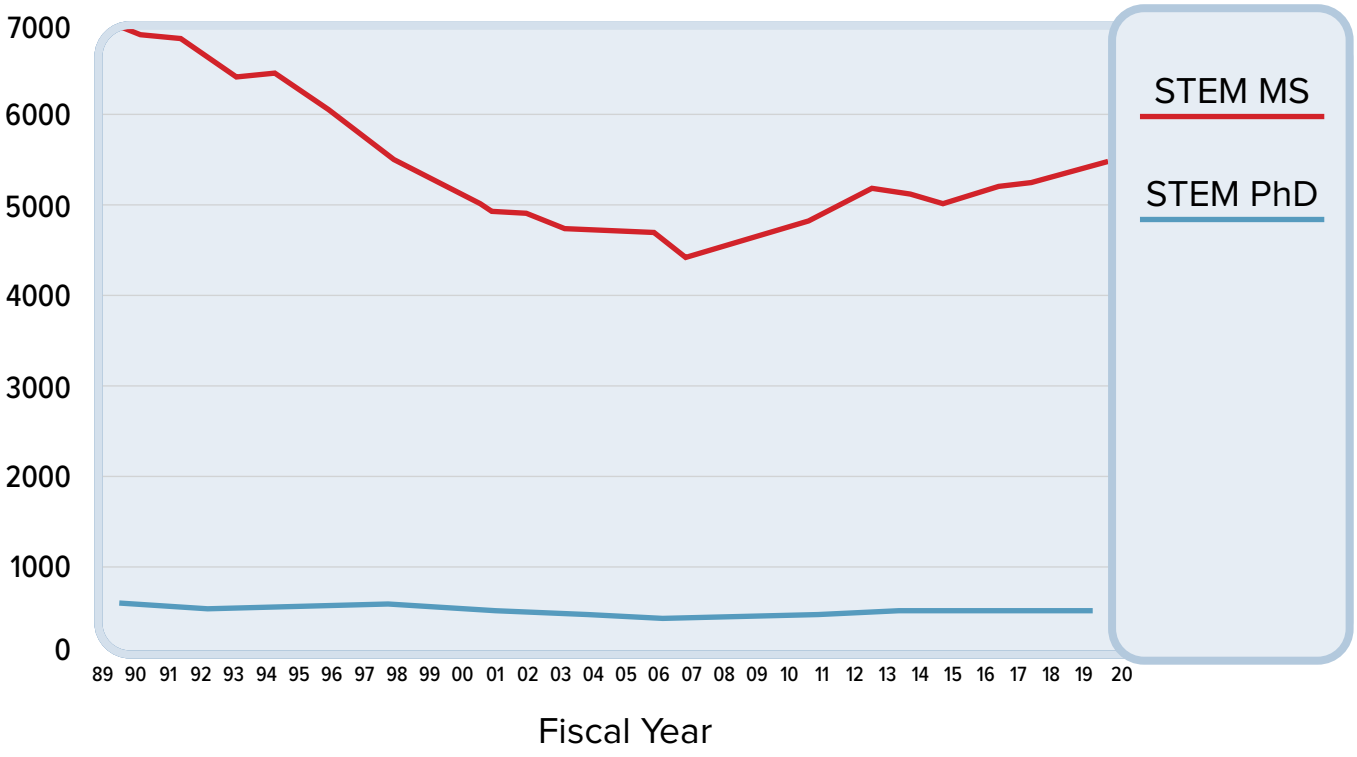

Figure 2: Inventory of STEM Advanced Degrees among the officer corp.

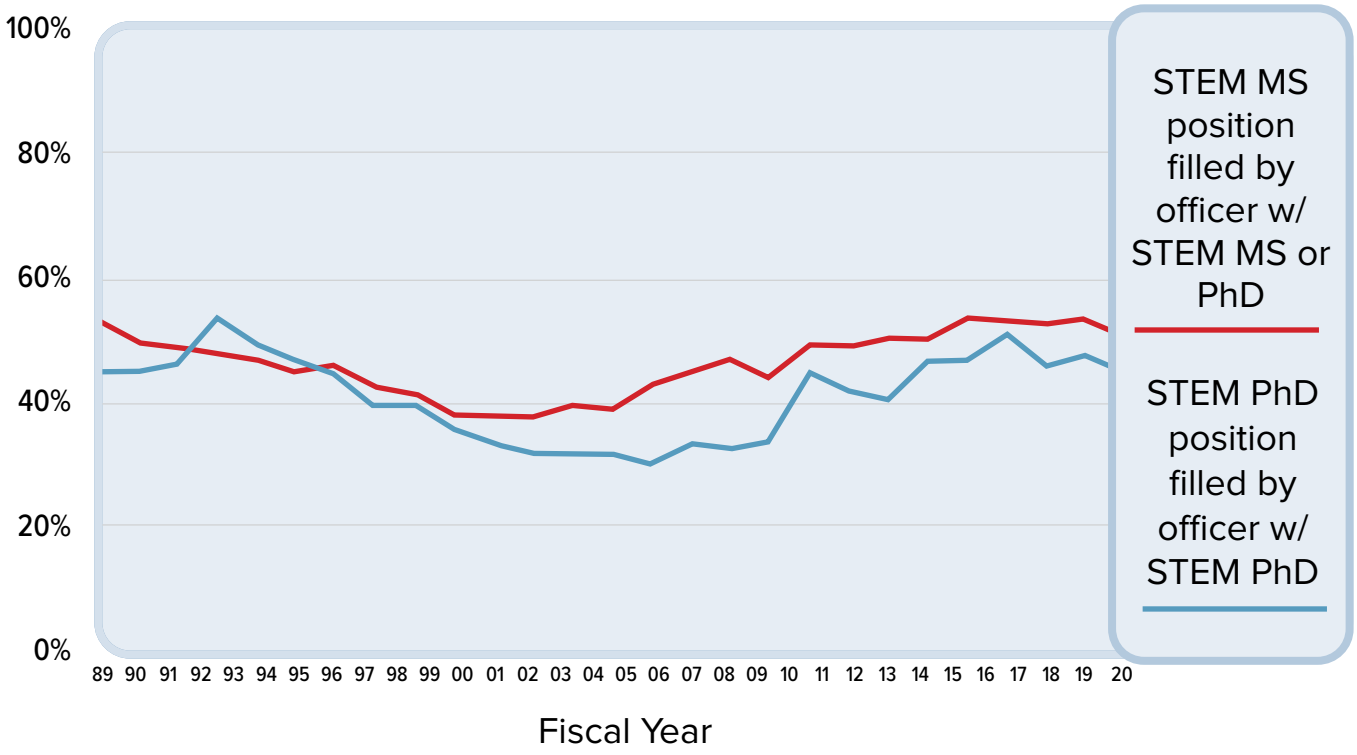

Figure 3: Fraction of positions coded for STEM advanced degress filled with officers with a STEM advanced degree of the requested level.

The data suggests the inventory of technical proficiency of senior leaders is particularly low. As seen in Figure 4, General Officers with STEM advanced degrees (either Masters or PhD) was at a high point in 1979 with almost 25%, but has not risen above 15% since 2003. Comparing to Fortune 500 technology companies where over 30% of their CEOs have STEM advanced degrees, the value of 15% seems too low by about half.

The situation with PhDs is worse. As seen in Figure 5, in 2021 the USAF and USSF line general officers have less than 1% STEM PhDs among their ranks. Table 2 in Appendix B shows that about 2% of Colonels have STEM PhDs. Compare this to the 13% STEM PhDs among founding CEOs of Fortune 500 technology companies.[10] Those were the leaders which created transformative capabilities efficiently enough to out innovate other existing companies with more resources. This comparison suggests that to out-innovate our competitors as called for in the National Defense Strategy, we are lacking the diversity of thought and technical knowledge associated with a STEM PhD in our senior uniformed leadership. Our diminishing technological overmatch compared to competitors can likely be partially attributed to the deficit in STEM expertise of our senior leaders.

[10]Ben Werdmuller, "Examining degrees of Fortune 500 Tech CEOs", Independent Study, Dec 11, 2018.

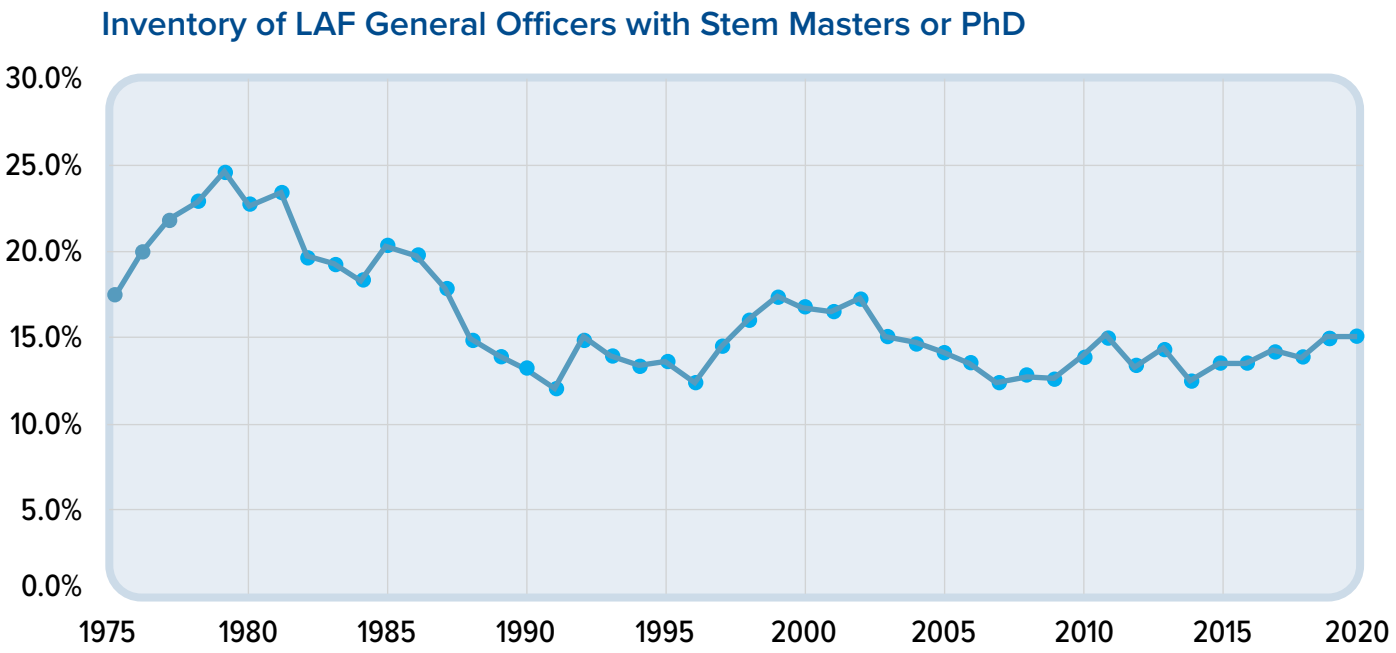

Figure 4: As a function of fiscal year, the fraction of Line of the Air Force General Officers with STEM Masters degrees or STEM PhDs. As a comparison to industry, about 30% of Fortune 500 CEOs have a STEM Masters degree.

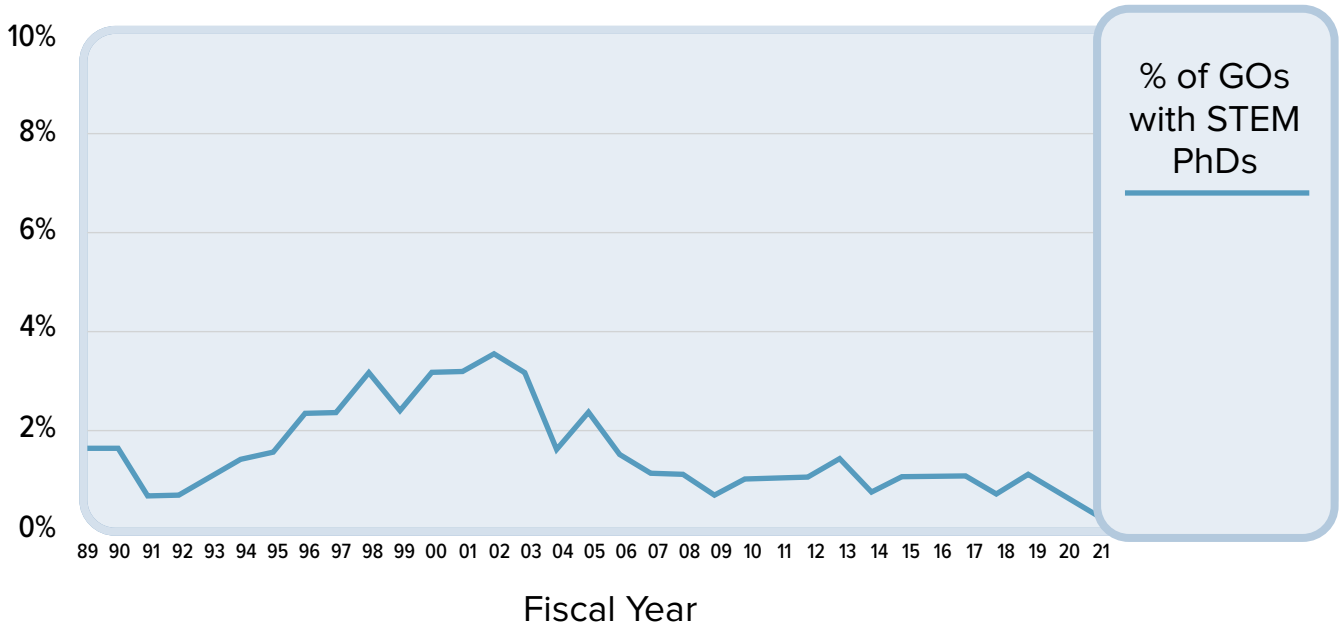

Figure 5: As a function of fiscal year, the fraction of the Line of the Air Force General Officers with a STEM PhD. To compare to industry, about 13% of founding CEOs of transformative fortune 500 companies had PhDs.

PhDs should be awarded earlier in a career. A review of recent STEM PhD General Officers shown in Figure 6 showed that all had earned their PhD by year nine of their career. In contrast Figure 7 shows that on average STEM PhDs have been earned at year 12. This suggests we should adapt the pipeline to facilitate earlier PhDs. The BS-PhD program at AFIT, opened up considerably from 2018-2020. This should be sustained and expanded.

Block Chart of General Officers with PhDs

Name	Category	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ellen Pawlikowski	Rank	01			02		03					04				05				06									07			08			09					010			
General	Education				PhD			SOS						IDE				SDE																								
	Command																	1						2					3					4	5				6			
William Cooley	Rank	01		02		03							04					05			06							07		08												
Maj Gen	Education			M					SOS		PhD						IDE				SDE													Present Day								
	Command																				1	2		3			4			5												
William McCaseland	Rank	01		02		03					04			05							06							07		08												
Maj Gen	Education		M								PhD							SDE																					Retired			
	Command														1			2					3	4					5		6		7								
Paul Nielsen	Rank	01		02		03					04					05			06							07			08												
Maj Gen	Education		M				M				PhD								SDE																				Retired			
	Command													1	2							3			4				5													
Heather Pringle	Rank	01		02		03							04				05					06				07																
Maj Gen	Education		M					SOS			PhD					IDE						SDE																				
	Command																		1							2		3		4												

Figure 6: Career milestones of recent STEM PhD General Officers. Note that all had earned their PhD by year 9. All had command experience by year 19.

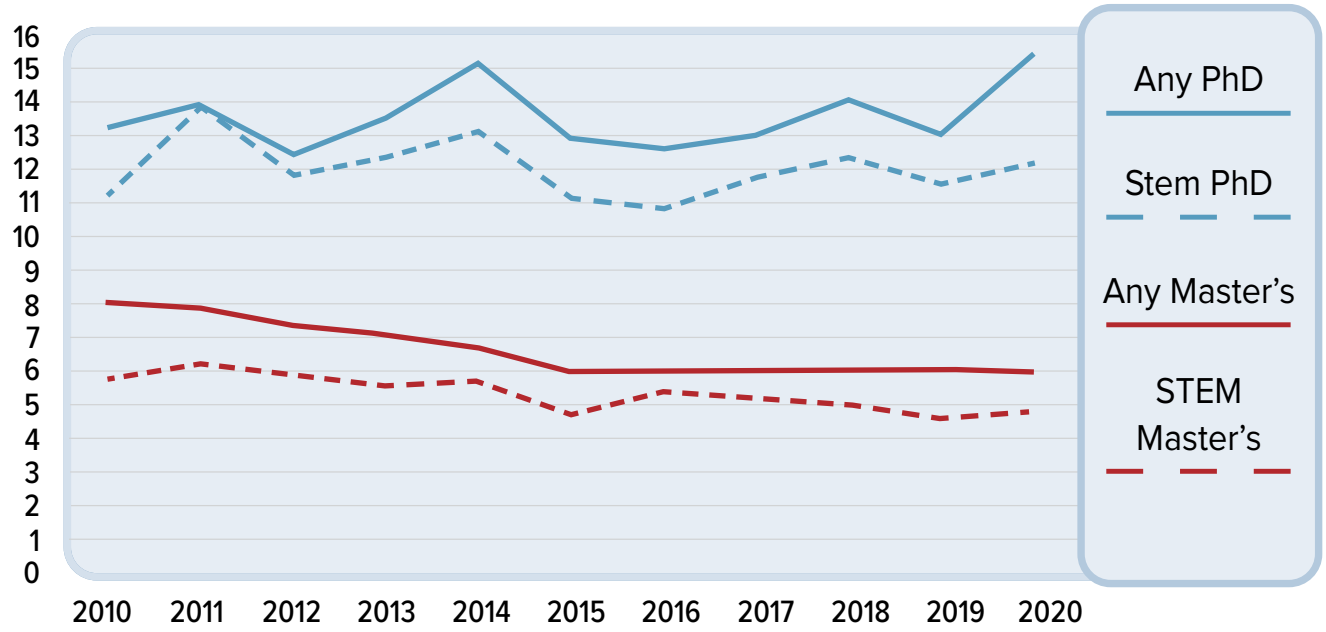

Figure 7: Calendar years of service (CYOS) at the time of earning an advanced degree. An objective for this metric would be STEM PhDs by year 9.

What does the data suggest regarding our current system's demand signal for technically proficient senior leaders? Figure 8 shows there is only one General Officer position coded for a STEM PhD: the AFRL/CC. It also shows that prior to 2021 there were no General Officer positions coded for STEM master's degrees. As a result of the 2030 S&T Strategy, there are now four General officer positions STEM coded for STEM master's degrees.

The Colonel positions also show a weak demand signal. Out of about 2500 Colonel positions, about 40 are coded for STEM advanced degrees. Figure 9 shows that this is a decrease of about 33% since the 1990s.

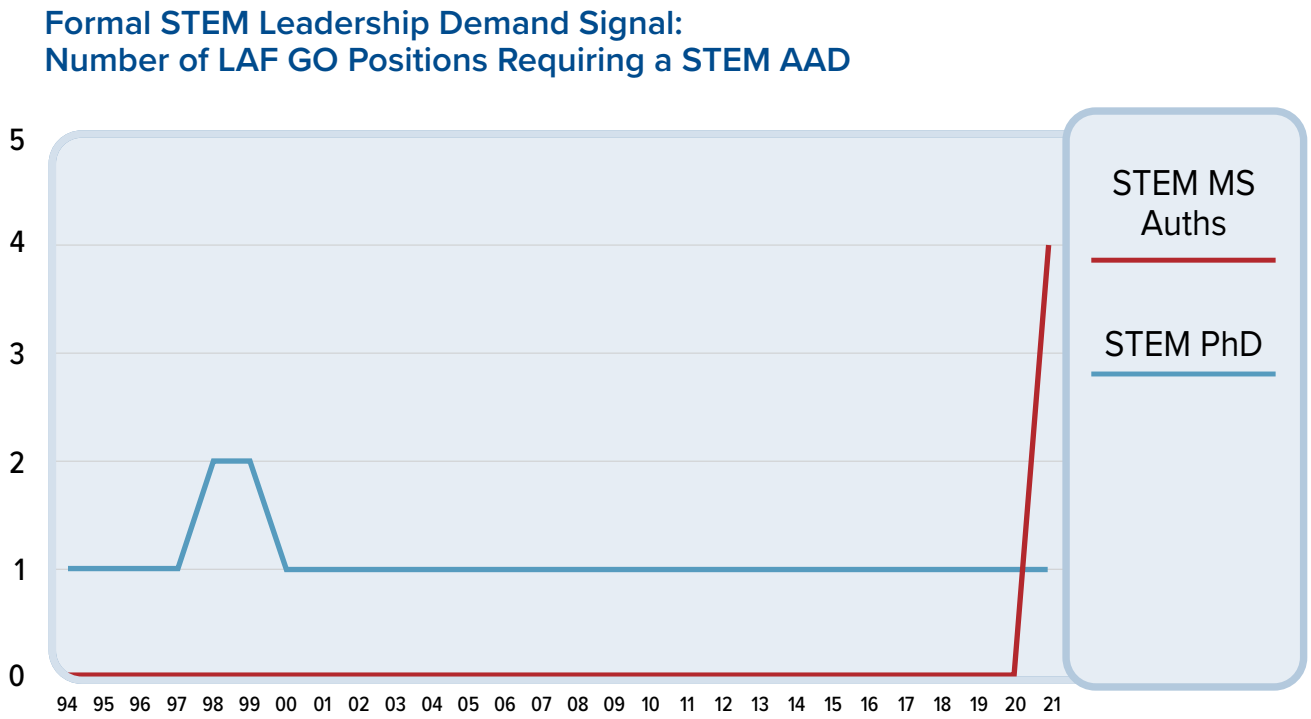

Figure 8: Number of General Officer positions coded for STEM advanced degrees.

The leadership positions specifically to developing future technology superior to our adversaries are called Materiel Leaders for Lt Col (O-5) positions and Senior Materiel Leaders (SML) for Colonel (O-6) positions. Table 1 in Appendix B shows that in 2021, there were 311 positions designated as Material Leaders (ML) or Senior Material Leaders (SML). Of these 311 positions, only 5 require a STEM advanced degree of any sort. Despite this low formal demand signal, about half of the occupants do have STEM master's degrees because the non-technical program manager career field is partially filled at the senior officer level with engineers. However, the lack of formal coding contributes underfunding AFIT Advanced Academic Degree (AAD) education programs and to the overall STEM inventory deficit identified earlier. This problem extends beyond just the leadership. As Figure 10 shows, even the overall PhD STEM requirements among all LAF officers continued to drop even after the overall authorized force size stabilized post 2008.

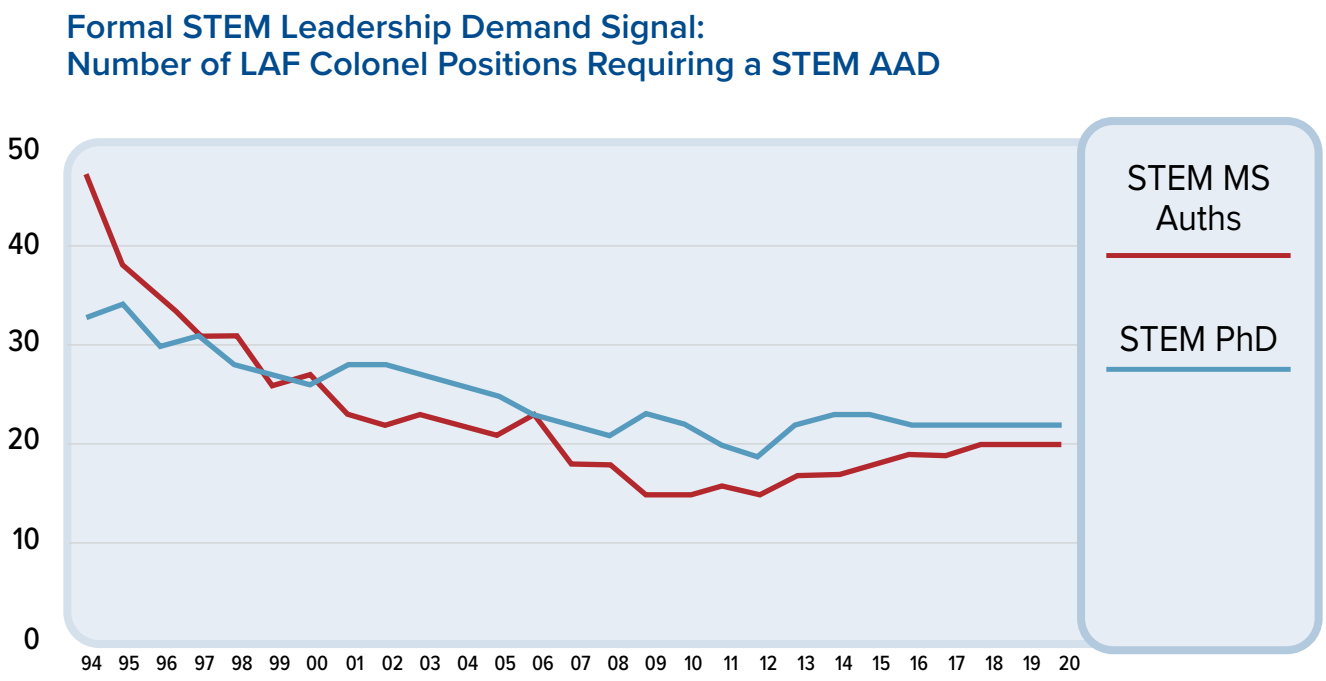

Figure 9: Number of Colonel positions codes for a STEM advanced degree has been in decline.

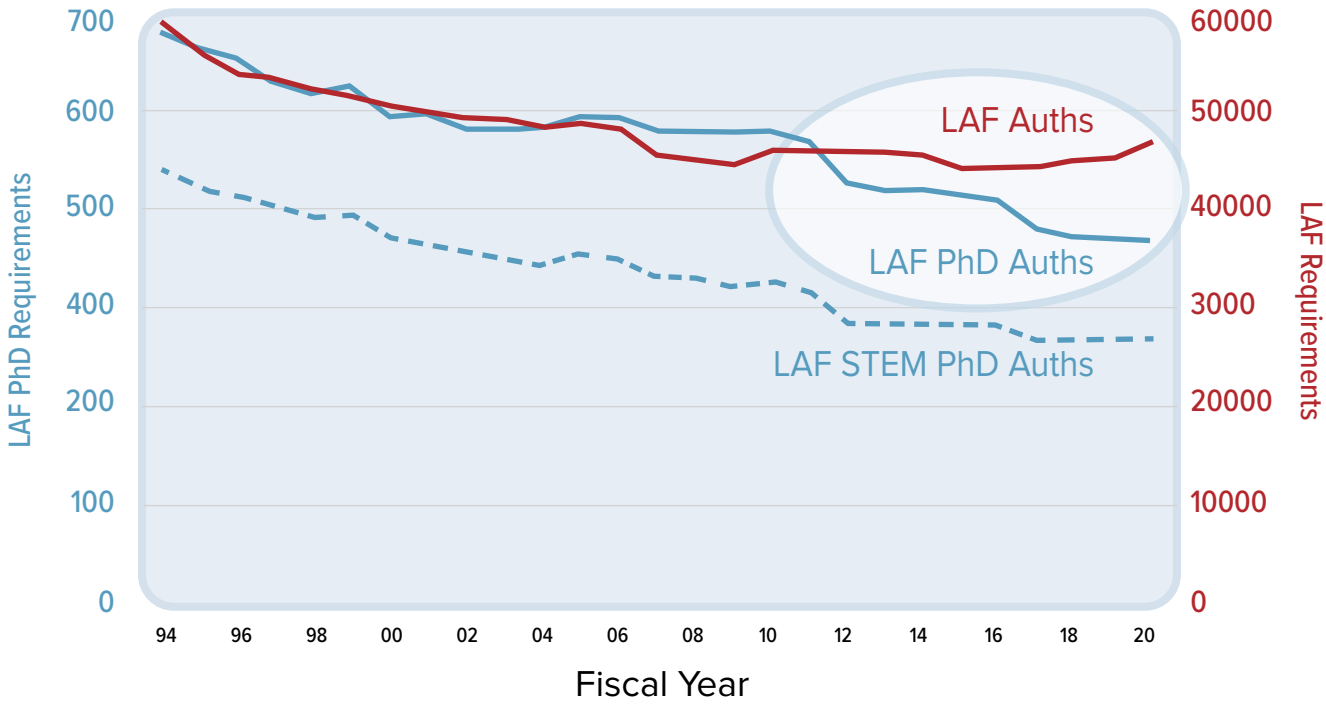

Figure 10: Number of LAF STEM PhD authorizations drop even while LAF authorizations stabilized.

Details on the LoE 3.6 Accomplishments

After reviewing the data and the MilSuite suggestions, several pilot efforts were launched. We actively attempted to build first on the most strongly voted ideas from the MilSuite site. Care was also taken to address the full life cycle of human capital management.

- **Establishing a set of metrics.** The first accomplishment of the IPT was to gather a set of metrics described in the earlier section which quantify in some manner the health of the technical proficiency of the S&T enterprise. These data sets should be updated annually and shared widely to inform senior leaders about the S&T expertise deficits and to track service's progress against the goals. We hope the metrics themselves will encourage efforts to improve.
- **Identifying GO positions for STEM AADs.** The S&T 2030 Strategy explicitly called for identifying general officer positions which should have STEM AADs and creating the associated pipeline. Using RAND's data analysis, we reviewed which GO positions had a history of occupants with STEM AADs shown in Appendix B Table 3. Because AFMC was the lead command for the S&T 2030 implementation, LoE 3.6 began by focusing on those positions under the control of AFMC. Between Oct 2020 and Feb 2021, senior AFMC leaders were briefed on the LoE efforts to code GO STEM AAD. The team acknowledged waivers would be appropriate to ensure the best GO ultimately fills each position but coding the positions would set a baseline to build the pipeline of Colonels and would signal the value of STEM advanced degrees to the officer corp. AFMC/CC decided to code 4 new positions for STEM Masters degrees: AFTC/CC, 412TW/CC, 96TW/CC, AFMC/A3. This is a 500% growth in GO STEM AAD positions!
- **Edison Grants.** The top voted "idea" on the MilSuite site was to "Let Engineers Do Engineering". Priorities are reflected in investments. If we value technical proficiency among our uniformed members, then resources needed to be allocated to supporting it. Normal funding processes do not operate on the time scales compatible with the demands of frequent PCSs. The Air Force Studies Board 2016 report[11] chaired by Gen (ret) Lyles recommended that the Air Force should build capability and expertise through campaigns of small experiments just as Thomas Edison had done. This was to be contrasted with the Ford Corporation's Edsel approach where one gambles a lot on a large, expensive, long experiment. Therefore, the Edison grant program was designed to grow uniformed technical expertise through many small experiments which must result in a rendezvous with reality to provide feedback. The program is run out of AFRL/CT and provides up to $75k for experiments no longer than one year to be conducted by uniformed Airmen or Guardians. The funded experiments need to result in at least one cycle of building technical expertise. Local supervisors authorize time commitments for the experiments to provide in-kind buy-in from the unit. In May 2021, over 50 applications were received requesting about $2.5M in funds. The program selected 17 projects worth about $750K. The Edison Grant program will also use the tool to build an elite network through conferences and targeted mentoring. The program is run out of the office of the AFRL Chief Technology Officer, Dr. Tim Bunning. Details can be found on MyPers.

[11]Air Force Studies Board, "The Role of Experimental Campaigns in the Air Force Innovation Life Cycle", Washington DC: The National Academies Press, 2016.

- **Project Arc: Operationally Integrated Engineering Cells.** Another top voted "idea" contributed by members of the MilSuite site was to operationalize the uniformed S&E community. The need for S&T in the operational environment can be seen by the innovations of the 99th Reconnaissance squadron.[12] Between 2017 and 2019, the squadron created its own chief innovation and technology officer. They started a new Federal Lab within a flying squadron (the first in 20 years). They contracted for in-house technical expertise including PhDs to work side by side with the squadron's operators. They integrated S&Es into their operations to accelerate their ability to adapt and be combat ready on the adversary's time scale. This is configuration of S&Es doing engineering side-by-side with operators is the vision many uniformed S&Es had when they joined the service. It is not new. Jimmy Doolittle, as commander of the 8th Air Force in Europe, incorporated an Operational Engineering Section to help the Army Air Corp faster innovate and adopt new capabilities in theater. The S&T 2030 team engaged the authors of the proposed "idea" providing feedback on a very expansive vision they were drafting. The concept and passion of the officers was contagious, but the path to their end state was not clear. The S&T 2030 team encouraged them to better understand the existing operational S&E innovation units to see if there is one that should be expanded or to better define the gap they perceive. They were also introduced to "Project Everest": an informal military network outside any official sponsor that works to advance a strategic understanding of our potential adversaries. The team then interviewed 11 innovation organizations including the Air Battle Damage Repair Depot Liaison Engineer (ABDR/DLE) program, Software factories like Kessel Run and Tron, Big Safari, the SOCOM Ghost program, the Spectrum Warfare Wing, the AFRL Center for Rapid Innovation, Sparc Cells at various MAJCOM locations. Along the way, they refined a plan, found funding from AFWRX, and collected specific actionable projects endorsed by local commanders which given S&E expertise could be achieved with an a few extended TDYs. They used these project definitions to find additional funds. The LoE chose to support and mentor, but not own this grassroots effort. The original concept on the MilSuite site was proposed by Maj Castle (AFTAC) who transitioned the project to Maj Opie (SMC) and a broader team during the summer of 2020.
    - **Project Arc:** "Bridging the gap of military scientists and engineers to warfighters."
    - **Vision:** "Embed uniformed S&Es in operational units to deliver asymmetric technological advantages through exploitation of technology and rapid adaptation to adversarial technological deployment."
    - **Project Arc Beta Mission:** "TDY about 10 uniformed S&Es for 4-6 months at six locations to evaluate the ability of S&Es to execute small adaptations quickly, by solving operational problems."
    - **Status:** They have completed the first round. The program has been encouraged to continue after a review of the first round of results by Lt Gen Richardson and Dr Coleman. Details can be found on MyPers.
- **Strategic Communications.** A third highly voted "idea" suggested in the MilSuite site was

[11]Gino, Francesca, "The United States Air Force: Chaos in the 99th Reconnaissance Squadron", Harvard Business Review, May 2019.

a "Strategic Reset" of the S&E career field. To better articulate options for this strategic reset, several members engaged in writing thought pieces about what this might look like. Three of the resulting publications influenced by the LoE's discussion are being published during the summer and fall of 2021 in the Air and Space Power Journal.

- Cooley, William and Dougherty, George, "Every Airman and Guardian A Technologist", Air and Space Power Journal, Summer 2021.
- Fry, Brian. "Mobilizing Uniformed Scientists and Engineers", Air and Space Power Journal, Fall 2021.
- Fry, Brian. "Taking the Brakes off Uniformed Scientists and Engineers", Air and Space Operations Review, Spring 2022.

- **Enhanced Coordination.** Although not LoE efforts explicitly, the bi-weekly interactions between AFIT, HAF/A1, ROTC, USAFA, AFRL, and AF/ST enabled a lot of additional coordination and sharing to occur. AFIT engaged HAF/A1 on the potential of better coordinating individuals awaiting pilot training (APT) such that they could complete an AFIT master's degree. ACSC shared a community they were creating of the uniformed PhDs called Synaptic Forge championed by Maj Hila Levy. The HAF/A1 PhD management office shared the concept and progress in a new policy that allows more flexibility in promotion timelines that may enable people to complete a PhD without missing key milestones in their traditional career progressions. Last, a new badge for the scientist AFSC was coordinated.
- **Wargame Testing Technical Proficiency.** Historically, uniformed STEM technical proficiency was used to accelerate adaptation to technical surprise in war. For example, Jimmy Doolittle earned his PhD in Aeronautical Engineering from MIT. He spent his time as a CGO experimenting with extending the range of aircraft. During World War II, it was his combination of operational and technical understanding that enabled the Army Air Corps to push the limits of long-range flight needed to inflict technical surprise and perform the Doolittle raid on Tokyo.[13] Peace time commanders are not challenged or tested in a manner where the value of technical expertise can have feedback on who is promoted. Commanders assume they will have the time, the quality of intelligence, and the communications needed to delegate to a civilian expert any decision relating that may involve the interplay of technical expertise on combat operations. If there is technical risk they don't understand and don't wish to take, that territory is ceded to the adversary's maneuver space. There is no feedback loop to represent the role and value of senior leader technical judgments. After discussions with HAF/A5, Lt Gen Hinote agreed to allow the Foxes agile wargaming team to run a few small test wargames to see if the value of technology proficient leaders could be tested in this simulated environment. Four games were performed with volunteers from the MilSuite site. The information directorate in AFRL/RI helped create unclassified cards that created a constrained set of options demonstrating the cyber situation commanders will likely face. The games tended to be valuable for the players appreciation of the cyber domain, but failed to test the added maneuver space a deep understanding may enable in combat. Maj Tim Carbino from the NRO was the POC for these experiments.

[13]Benjamin Bishop, "Jimmy Doolittle: Cincinnatus of the Air", School of Advanced Aerospace Studies, PhD Thesis, 2016

- **Quantifying and Utilizing Technical Proficiency.** It is hard to quantify technical proficiency. Two approaches were explored. First, a module to be added to the "My Vector" competencies feature. The 15A community is pioneering this approach, and we worked to follow their progress. Second, a resume tool for DoD technical SMEs was championed by other parts of the S&T 2030 implementation team.[14] The recording papers and patents is the closest measure of the number of cycles an individual has performed towards expertise in technical domains. The SME Search engine is a strong product that allows one to look up the resume for individuals. The new tool is a major step that now enables those with technical needs to do a search on FOUO resumes and find potential government SMEs that can be engaged! Before this, the best available tool to find government experts was LinkedIn or Google Scholar. The next step will be to extract measures from the use of talent marketplace, the SME search engine, and the "My Vector" competencies module which will serve as a proxy for proficiency or skill set combinations in high demand. This team was led by Maj Bevins (AFIT).
- **New Badge for 61X Officers.** Although this was proposed before the S&T 2030 design team stood up, the bi-weekly meetings helped facilitate the process for the adoptions of the "Scientific Applications Specialty Badge" by the 61X career field. The badge was approved in the fall of 2021.

[14]The CAC-enabled web site enables S&Es to find each other by searching the posted resumes. See: https://smeprofile.usaftechconnect.com/

The Next Phase

During the summer of 2021, the implementation team for the S&T 2030 strategy stood down. The Chief Scientist Office shared the results of this study with senior Department of the Air Force leaders. Since then, SecAF Kendall has made organic technical expertise a priority. He has commissioned the DAF Chief Scientist Office (AF/ST) to perform a study to assess the organic technical expertise beyond the scope of LoE 3.6 to include both the military and civilian S&E populations. In coordination with SecAF-level efforts, we hope to engage the technically-focused S&E community in a series of in-person and virtual panels discussions beginning summer 2022. Our goal will be to refine a collective vision for the role and paths technically-proficient uniformed scientists, engineers, and technologists will need to fulfill to succeed in strategic competition against a technology adept adversary. What more can be done to achieve this vision? The articles published under the strategic communications section provide one perspective. The panels aim to discuss these approaches and potential alternatives.

APPENDIX A: Contributors to LoE 3.6

S&T 2030 Strategy: LOE 3.6
Create a Pipeline of Technically Proficient Military Airmen

Summary: The LoE 3.6 team self-assembled from passionate members from the USAF and USSF community. Together the team and sub-teams built a MilSuite network of over 360 members to articulate and prioritize the issues, worked with RAND to gather critical data on the health of the uniformed S&T workforce, prepared several papers for publication, orchestrated 5 war games, expanded the number of General Officer billets coded for advanced STEM degrees by 500%, launched several programs to support uniformed technical depth development and connectivity to the operational community, supported key Air Staff efforts to expand STEM education, and supported the SME search engine that enables S&Es to network and do research at the speed of need.

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AFRL HQ	Ms. April Jarman,
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2019, Executive Officer	Lt. Col. Ethan Holt
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SAF/AQH	Mr. Tedrow, Col. Ferguson,
SAF/AQH	Capt. Sadhwani,
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CGO Engagement	Capt. Hubbard, Capt Chris Beto
Enlisted-Tech Development	Lt. Barret, MSgt. Coker
AFOSR (Uniformed Post Doc)	Col. Michelle Ewy, Lt Col Alan Lin Lt. Col. Ahlers
Tech Deployments	Capt. Lagrange, Lt. Justus
A9 (15A CFM)	Col. Artelli, Mr Smith
Guest Speaker	MGen (ret) McCasland
Guest Speaker	Col George Dougherty
Guest Speaker (Synaptic Forge)	Maj Hila Levy, Maj Shawn Hackett

APPENDIX B: Data Tables

CY20 61/62/63 ML & SML: Authorizations

Data from the Sep 2020 Manpower File:			
Authorized AFSC	Total Auths	STEM MS	STEM PhD
60C0 (Col)	20	0	1
ML 62S0 (LtCol)	14	1	2
ML 63S0 (LtCol)	181	0	0
SML 63G0 (Col)	96	0	1
TOTAL	311	1	4
And for AFRL only:			
Authorized AFSC	Total Auths	STEM MS	STEM PhD
60C0 (Col)	1	0	1
ML 62S0 (LtCol)	7	0	2
ML 63S0 (LtCol)	3	0	0
SML 63G0 (Col)	5	0	1
TOTAL	16	0	3

60C0:
Senior Material Leader – Upper Echelon

63G0:
Senior Material Leader – Lower Echelon

62S0:
Senior Material

63S0:
Senior Material

Table 1: Data on Material Leader and Senior Materiel Leader positions that request a STEM advanced degree.

FY	# of LAF GOs with PhDs	# of LAF GOs with STEM PhDs	# of LAF GOs	# of LAF Cols with PhDs	# of LAF Cols with STEM PhDs	# of LAF Cols
1989	11	5	310	148	82	4175
1990	10	5	309	144	85	3923
1991	6	2	298	142	85	3765
1992	6	2	289	135	89	3455
1993	5	3	279	127	84	3193
1994	6	4	283	128	86	3240
1995	7	4	256	126	88	3062
1996	9	6	256	118	76	2959
1997	8	6	254	111	73	2776
1998	9	8	255	101	63	2770
1999	7	6	253	109	69	2906
2000	10	8	254	98	61	2737
2001	10	8	253	87	47	2677
2002	10	9	254	89	45	2749
2003	10	8	254	100	48	2789
2004	6	4	251	104	50	2681
2005	9	6	252	94	44	2569
2006	8	4	265	103	53	2625
2007	7	3	265	91	52	2495
2008	7	3	271	86	48	2619
2009	5	2	294	90	49	2741
2010	5	3	295	98	52	2715
2011	5	3	296	96	45	2575
2012	5	3	283	102	48	2631
2013	6	4	286	114	55	2629
2014	3	2	272	120	58	2404
2015	3	3	281	129	68	2316
2016	5	3	282	135	68	2412
2017	7	3	282	129	57	2401
2018	8	2	280	138	55	2372
2019	7	3	271	145	58	2442
2020	7	2	276	144	64	2421

Table 2: History of the inventory of Air Force leadership, General Officers and Colonels, with STEM PhDs.

General Officer Position	Timeframe	Frequency w/ STEM AAD (years0	Percentage
SAF/AQ Mil Dep	2010-2020	10	100%
ASAF Dean of Faculty	1993-2020	22	79%
Missile Defense Agency*	2003-2020	4	67%
Space/Missile Sys Center (CV)	2002-2020	10	63%
AFLCMC/DSH - Tanker and Bomber Modernization 2009 – 2020 7 58.33%	2009-2020	7	58%
The Civil Engineer	1993-2020	16	57%
SMC/CC	2002-2020	10	53%
SAF Cyber Strategy ISR and CEO (OL A650, Room 5C1050 Pentagon)	2010-2020	5	50%
AFLCMC (OL KE) C31 & Networks	2010-2020	5	50%
AFLCMC/DSH (OL WA01) Fighters and Bombers, Advanced	2014-2020	4	50%
502 ABW/CC (AETC)	2009-2020	6	50%

Table 3: List of General Officer Positions, not considered in the 2020 review, which have had the majority of occupants earn a STEM Advanced Degree.