An AI-Ready Military Workforce

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Many recent professional military articles, like the National Security Commission on Artificial Intelligence's Final Report, stress the need for an Artificial Intelligence (AI)-ready workforce.[1] AI has the distinct potential for creating a battlefield advantage to whichever warring party can best harness the technology, making an AI-ready military workforce imperative to gaining that advantage.[2] Thus, while it is generally clear that the military needs an AI-ready workforce, it is less clear what an AI-ready workforce should actually be. Most commentators in this area tend to vaguely suggest 'AI experts in uniform' as the solution to an AI-ready workforce for the military.[3] Recent work has suggested that there are distinct roles in the production of AI, as well as distinctive training needs for different roles.[4] Additionally, commentators have pointed out the need for some level of understanding of AI for senior leaders[5], acquisitions personnel,[6] and users of AI-enabled systems.[7] Despite the recent scholarship identifying different relationships to AI within the workforce, there does not exist a unifying model of an AI-ready workforce that takes into account needs like the scale of the different parts of the workforce. AI workforce proposals to date only take into account creation of an AI-enabled system (e.g. running an AI project, creating a model from scratch) or of running a full data science project, and do not take into account more realistic uses of AI in military settings, which include tasks like maintenance and adjusting models to changes in the operational environment.

In this article, I argue that an AI-ready workforce for the military should be built around an AI skills-in-depth model that

1. Creates gradations of AI-technical skills that address the actual demands AI-enabled technologies will place upon a military force.
2. Focuses on educating leadership and the acquisitions community on recognizing opportunities to use AI and evaluating AI capabilities, and
3. Prioritizes creation of lower-skilled technicians in uniform over creating higher-skilled AI-experts in uniform.

Before exploring the proposed model for what an AI-ready workforce looks like for a military service, it's important to clarify a few points about the use of AI. First, AI-enabled systems require maintenance. Machine learning algorithms, which are what make an AI-enabled system 'AI', suffer from many issues to include: model drift, changes in the data generation environment, issues with models being deployed in real life,[8] newer, better models coming out – just to name a few. These inherent issues with AI-enabled systems mean that these systems will require periodic maintenance, updating, and monitoring for changes in model performance or data input in order to continue to be useful. Second, the application of AI requires careful consideration of the problem. AI is not a catch-all that can solve any problem. AI-enabled systems typically need to be tailored to a specific problem, which requires thought about what problems are amenable to AI solutions and how to implement those solutions in a way that works for the organization.[9] Third, AI will often come as part of a larger, integrated system. The actual machine learning that makes up any AI-enabled system is typically just one, relatively small component.[10] This AI component is commonly just one component of a larger system, like the autonomous threat recognition algorithm for a mobile, autonomous platform. When using an AI-enabled system for a real-world problem, it's

important to remember that that system will require maintenance and that machine learning models will only be narrowly applicable to a given problem.

From these fundamental observations, we can deduce the rough outlines of what AI will look like in the military, even if particular details are missing. AI will be present in many, if not most battlefield systems, from vehicles to mission command suites, and built in as core components of those battlefield systems by defense contractors. All of these AI-enabled systems and their associated machine learning models, just like any other piece of battlefield equipment, will require maintenance, at least some of which will need to be conducted by uniformed personnel. There will also likely be a need for ad hoc data science and AI solutions created within military units to support a particular commander or battlefield problem. Thus, interactions with AI-enabled systems will be predominantly user-level, followed by much fewer maintenance types of interactions, and very few design-and-implement kinds of interactions.

Outline of an AI-Enabled, Military Workforce

Given the real world demands of using AI in the military, the best way to create an AI-ready workforce is to follow an AI skills-in-depth model of training and education. This model must economize resources while also producing a military workforce that can actually harness the battlefield advantages offered by AI. While no part of the model is sufficient to create an AI-enabled workforce by itself, each part addresses a necessary component, and combined they are sufficient to achieve the desired end state. The model's fundamental dynamic can be summarized as exponentially decreasing the numbers of military workforce members in work-roles as we increase the AI technical skills required for those work roles. This decrease is done for two primary

reasons. First, as the level of expertise in AI-technical skills increases, the "cost" to create proficiency with those skills increases exponentially. Second, this model will decrease the number of servicemember interactions with the AI-enabled systems that require specialist, AI technical skills. The following figure, Figure 1, summarizes the model and its different components. Each of the components (i.e. Users, AI Technicians, etc.) are described in detail in Table 1.

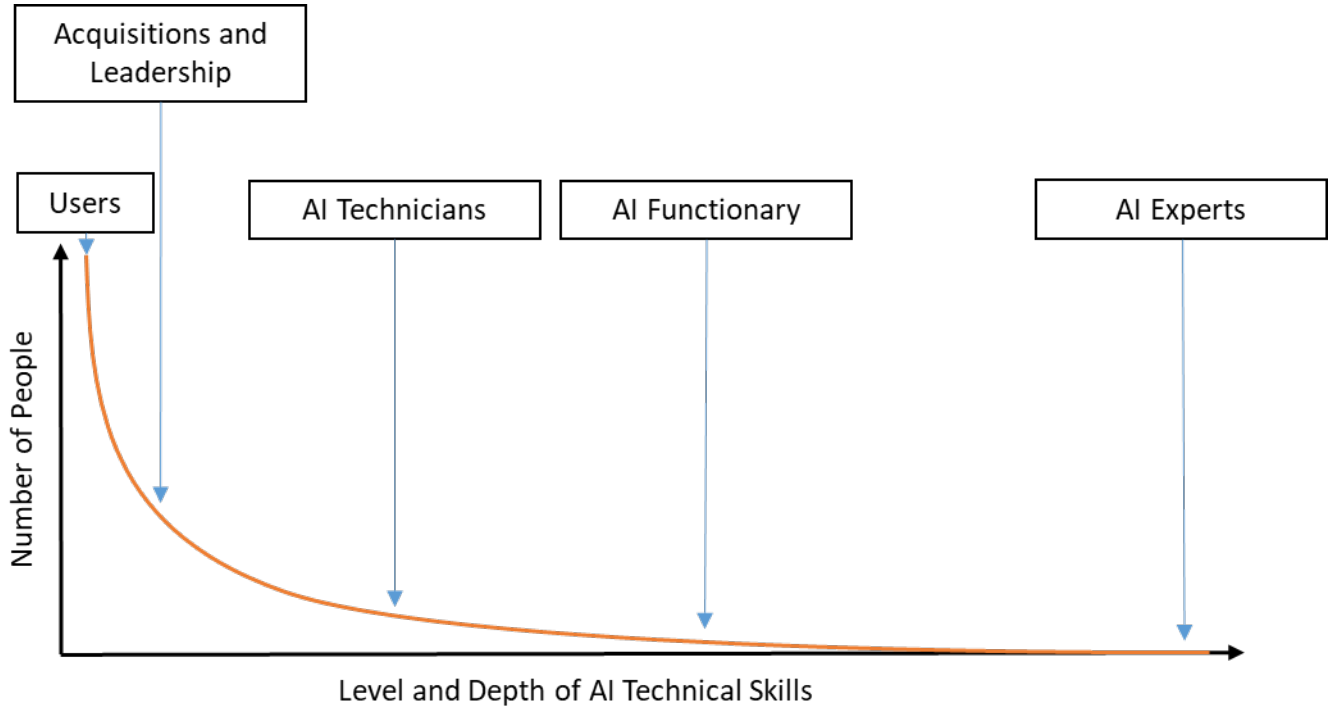

Figure 1: AI Skills-in-depth model. Exponentially decreasing the number of people in the workforce as the level of hands-on technical AI skills increases.

Another way of thinking about the AI skills-in-depth model is by the relative amount of time members of each of the components spend on hands-on work using AI skills. For example, at the user-level, the hands-on AI-technical work will largely consist of being aware of when the AI-enabled system is not working properly. This means that very little of their working time will be spent on hands-on AI-technical work. Whereas, an

AI technician or functionary, who will have to perform hands-on AI technical tasks like fine-tuning models, checking a model's performance against new data, checking data integrity, etc. will need significantly more time to perform those tasks (perhaps to the level of it being a second job or additional duty). The following figure, Figure 2, displays the dynamic of the amount of working time needed to perform AI-technical skills as part of the job.

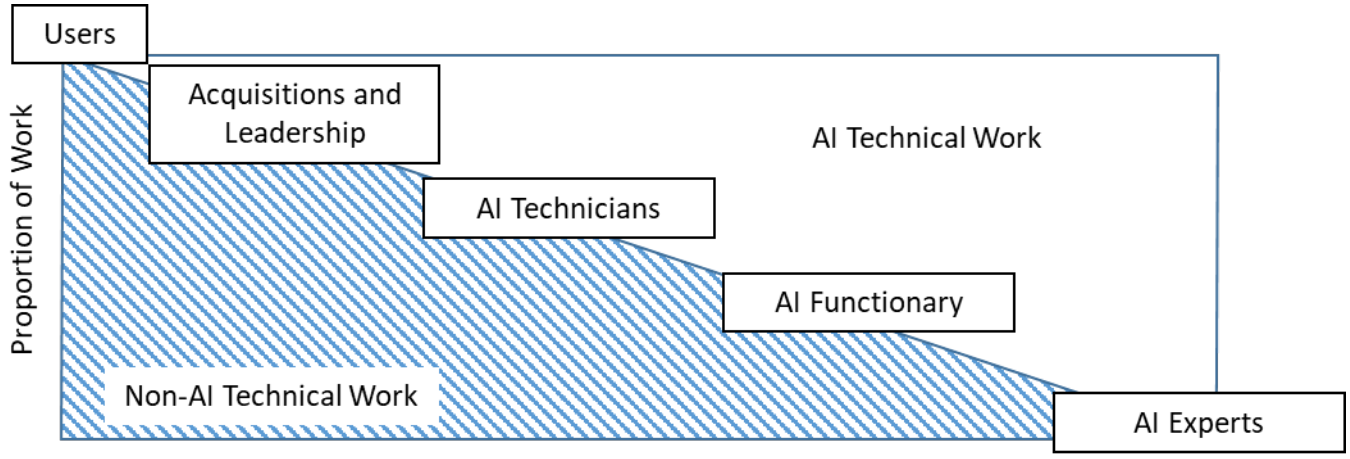

Figure 2: Relative amount of time spent performing AI-technical tasks for the different components of the AI skills-in-depth model.

This model closely resembles what is already in place in various military communities. One example is the military medical community. the U.S. Army trains all of its personnel on emergency medical procedures. This type of training is roughly analogous to what is need within the AI users' component. On the battlefield, the U.S. Army has medics at the unit level providing limited emergency (tactical casualty care) medical care. The next level is the Aid Station where you might have a Physician Assistant and possibly a Registered Nurse, both of which poses greater medical expertise and require more medical education and training. They are capable of the next level of medical care and getting the patient stabilized. These individuals and their

respective levels of skills are roughly analogous to the AI technicians and functionaries when it comes to working on an AI-enabled system. Eventually, the casualty may get transported to a full trauma center where they can receive lifesaving surgery, which is performed by surgeons, who require more difficult to acquire skills and require more medical education and training than the previous layers. These individuals are roughly analogous to those individuals in the AI experts component. Possessing a layered approach to functional expertise is already extant in some military functions, like military medicine.

More concretely, the model consists of five different components of AI training and education that differ in their hands-on, AI technical skills and scope of interaction with military, AI-enabled systems. These components, when combined, allow for a robust and realizable AI-ready workforce that can meet all of the demands that incorporating AI into war fighting will place on the workforce. The following table summarizes the different components of the AI skills-in-depth model.

Table 1: Summary of the different layers of the expertise-in-depth model for an AI-ready, military workforce

Component	Part of Workforce	Skills Requirement	Time Requirement	Description
User	Vast majority of the workforce	How to employ relevant AI-enabled technologies with a very brief high-level knowledge of AI	A few hours to a day or two, augmented with on-the-job experience	Training meant to make members of the workforce comfortable and effective with using relevant AI-enabled technologies and understanding general capabilities and limits
Acquisitions and Leadership	Mid-to-senior leadership levels along with the acquisitions workforce	Knowledge of AI concepts and high-level workings and requirements of AI-enabled systems. Knowledge of trends an likely near-term future AI technologies	A couple of weeks to a couple of months	Short education course meant to help leaders and the acquisition workforce identify problems suitable for AI solutions and evaluate proposed solutions. Initial education followed by periodic refresher training.

AI Technician	Select individuals that have a responsibility to maintain one or more AI-enabled systems	Expertise in elements of maintaining an AI-enabled system, including model fine-tuning, model monitoring, and data monitoring	Several months to a year	Education course with supervised hands-on experience maintaining various aspects of an AI-enabled system
AI Functionary	Select individuals that have a need to create novel AI solutions and develop limited scope systems	Expertise in usage of AI-enabled systems to include designing and implementing basic AI solutions, performing exploratory data analysis, creating machine learning pipelines	2 to 4 years	Extended education course (i.e. formal academic education) that teaches both some theory of AI and application of AI to problems along with supervised hands-on experience
AI Expert	Specialty personnel whose job it is to build, design, and research AI-enabled systems for the military	Expertise in the design, theory, and usage of AI-enabled systems.	5+ years	Extended education courses (i.e. formal academic education) that covers everything from theory through implementation of AI. Research experience in an AI field and lots of practical experience with creating state-of-the-art AI and implementing AI solutions

Given the predicted profusion of AI-enabled systems and equipment on the battlefield it is likely that most military members will have to interact with AI-enabled technology and most interactions with AI-enabled technologies will occur at the user level.[11] Thus, it is necessary to train the workforce in how to properly use their AI-enabled technologies, so that users trust their equipment and can effectively and ethically use it. To achieve these effects, this training should naturally include some instruction in the high-level concepts of the technology powering the system, like machine learning. Training will also need to include how to detect/identify when the technology is not functioning properly. However, malfunctioning AI-enabled technologies will be, to a great degree, application specific (i.e. how and why Google Maps malfunctions is not the same how and why an objection detection model in a

digital camera fails). Something like New Equipment Training, which is part of the standard fielding process for the U.S. Army would be a good place to incorporate this type of user-level training.[12] Other forces, outside of the U.S., have also similarly recommended and outlined training for users of AI-enabled systems.[13] Generally, the proposed training of this layer really only requires basic knowledge of AI; users practice within their respective fields - and the practice of that field could be improved by using AI-enabled technologies - but the practice of that field does not require any hands-on, technical work in AI.

The next component in the model is the military leaders and the acquisitions components of the workforce. This education is meant to bring leaders big picture understanding of AI function and some of its technological applications to best identify problems that are amenable to AI solutions. To successfully utilize AI-enabled technologies in military operations, just like any other combat enabler, a military leader must possess sufficient knowledge of the enabler. Introducing education on AI into intermediate and senior service college curriculums would accomplish this. The U.S. Army's Military Intelligence Center of Excellence is already pioneering training of this type for their Warrant Officer Advanced Course wherein students are given a high-level overview of machine learning, what it looks like when AI-enabled systems go wrong, and in what military intelligence functions students may come across these AI-enabled technologies.[14] The course instructors also challenge students to identify a problem in their own workflows that could be addressed by an AI-enabled solution and how they could plan to implement that solution. Within the Joint community, The Chief Digital and Artificial Intelligence Office is currently experimenting with a "Lead AI" course that

pursues similar goals and strives to create awareness of AI capabilities for senior leaders.[15] Training leaders so that they know what AI can provide and challenging them to think about what functions or roles they do which could benefit for AI will greatly speed the creation of an AI-ready military.

Additionally, since the design and production of AI-enabled technologies is and will continue to be the domain of defense contractors it is also important for personnel involved in the acquisitions process to possess sufficient AI knowledge. Since civilian AI experts will not necessarily understand the military problems for which they will build AI solutions, and military personnel may not necessarily understand the AI technology, these personnel need to bridge that gap. It is vital to the health of the force that acquisitions personnel be able to evaluate proposed solutions and to ensure AI is properly incorporated into military systems. Other commentators have similarly remarked on this need for AI training for acquisitions personnel[16] and there has been some recent work outlining AI specific checks for military projects in development phase.[17] While this layer of the AI-enabled workforce could benefit from some practice and expertise in AI, neither of these two workforce functions require that they be practitioners of AI in order to carry out their respective organizational functions.

It should also be noted that there is considerable complexity in terms of processes and roles within the military's acquisition workforce, and that the need of AI-technical expertise will likely vary significantly across the acquisitions enterprise. For example, individuals involved in test and evaluation of a possible new system will likely require more AI technical skills than those involved in project management or

contracting. The acquisitions component in this model is meant to apply to the more major and generic functions of acquisitions.

The AI-technicians component is comprised of individuals that are primarily responsible for maintaining AI-enabled systems. As has been mentioned throughout, AI-enabled systems *will* require maintenance of their machine learning models and data pipelines. And, this maintenance requires some hands-on AI technical, but not the skills of AI experts. Students will require hands-on experience with machine learning-related skills, like model fine tuning, and running AI-enablers, like cloud instances. The Army's Artificial Intelligence Integration Center (AI2C) is set to begin the third iteration of its AI Cloud Technician's Course which serves as a good starting place for this technician-level of training and education.[18] Students in the course are taught Python programming, along with cloud administration and some basic skills in modification of machine learning models. Following the classroom instruction, the students have a utilization tour wherein they can, ideally, further hone the practice of their skills. While this program is a good start, these technician programs will likely need to be expanded and focused around certain maintenance functions of AI-enabled systems in the future, to include machine learning model maintenance and data curation. The Chief Digital and Artificial Intelligence Office has also highlighted a worker archetype, 'Embed AI', which would cover this role as well (although it does not appear to have any training associated with the role).[19] At the technician's layer, the workforce will need education that includes hands-on practice with the maintenance aspects of AI.

Closely related to AI-technicians are AI functionaries. The maintenance of AI-enabled systems will occasionally require more involved and complex skills in larger,

more-complex machine learning operations (MLOps) at higher echelons.[20] There will also be the need for ad hoc and bespoke data science and AI solutions to specific unit and battlefield problems. Some units, like the 513th Military Intelligence Brigade have already experimented with this concept by having a unit data scientist officer, who can deliver quick, simple machine learning solutions to unit problems.[21] At this layer, students will need not only a greater depth of hands-on, technical skills than the previous layer, but also a greater breadth of knowledge across more elements of an AI-enabled system. This type of work will likely require the experiential learning that can really only be imparted at this time by a higher-level education program. As an example, the Army's Artificial Intelligence Integration Center is running its second iteration of the AI Scholars Program.[22] In this program U.S. Army company-grade officers are sent to graduate school to obtain a master's degree in an AI-relevant field, followed by a utilization tour with the Artificial Intelligence Integration Center to, ideally, further refine and practice their skills. The U.S. Air Force produces similar personnel from their Air Force Accelerator program.[23] At this layer, the workforce will need both more breadth and depth of practiced skills in AI; however, there will likely be relatively few interactions that will need this level of skills within a military organization.

Then, there are the experts in AI. These would be the professionals who are dedicated to practicing AI, with a high level of education and practical experience in their relevant AI fields. Their profession is exclusively doing AI. They are also very expensive to produce, not just from the education perspective, since they often require top-level degrees, but also from the investment of time in their practice. What is more, to really be able to grow, retain, and employ these individuals, even at a basic level, the

military would have to *significantly* change their manning practices, as has been outlined in the National Security Commission on Artificial Intelligence's Final Report and argued by other authors.[24] Because there are relatively few interactions with AI-enabled military systems that require a true expert, like with military surgeons, experts can fall out of practice with critical skills. This is costly both because of the initial investment in such specialized skills and then the loss of those skills from disuse. Because of this, while experts are absolutely needed, the force should prioritize using fewer experts more effectively until the demands of AI-enabled warfare grow and battlefield experience can clarify where investments in expertise are needed.

It is important for military decision makers not to become fixated on having the best-of-the-best AI practitioners at the expense of having broad exposure to AI skills in uniform. Finally, it is also worth pointing out, as other commentators have,[25] that a method of service like Component 3 (Army Reserve) units might be more conducive to growing AI experts for the military workforce than other modes of service, like Component 1 (Active Duty). The 75th Innovation Command is a Component 3 unit assigned to the Army Futures Command which would make for a good place to grow AI experts. Most Component 3 personnel also have a civilian career and some might already work in STEM fields to include AI/ML. Reserve Component service, combined with enablers like remote work, presents the ability for AI experts to largely stay practitioners in their fields, but the military establishment still has the ability to leverage them on the rare occasion when an AI expert is actually needed.

Finally, while there is a certain hierarchy present in the model in terms of number of people and time spent doing hands-on technical work in the model, the skills needed

for each component do not necessarily overlap. For example, a skill like fine-tuning a pre-trained model will be shared by AI technicians and all of the components above that component (AI Functionary, AI Expert), but other skills, like strategic planning for AI employment or project management, do not translate up the hierarchy. The hierarchy present in the model also does not necessarily imply level of expertise as well. For example, an AI technician could be an expert at fine-tuning computer vision models, while an AI expert in something like reinforcement learning models may only have a basic level of expertise at fine tuning computer vision models. While expertise and skills generally increase as one moves up the hierarchy in the model, this is not always the case.

Closing Thoughts

The best starting point to create organizational change toward achieving an AI-enabled workforce would be to start with the education and training for leadership and acquisitions. This level of education should also be combined with realistic experimentation exercises and wargaming on how to employ proposed or possible AI-enabled systems. Some of this occurs already with XVIIIth Airborne Corps' AI-enabled Live Fire Exercises and Army Future Command's Future Study Program.[26] Additionally, it is critical for the acquisitions personnel, who are responsible for "buying" all of the AI-enabled technology, obtain AI-enabled systems that can both meet war fighter needs and can be actually used and maintained by servicemembers. After that, as AI-enabled technologies begin to be distributed across the force, it will be important to prioritize user-level and maintenance-level training. Finally, while most of the examples and

perspectives in this article come from a U.S. Army perspective, the model and its associated roles and observations should generally apply to any military service.

A key component of a *Revolution in Military Affairs* is the ability of a military force to successfully incorporate new technologies into operations, training, doctrine and other military processes.[27] The advantages of AI will come to that military which can best employ it.[28] In order to realize the potential revolutionary value of AI technology, military organizations must work toward creating an AI-enabled workforce. The creation of this workforce should be based on the nature of AI in the military and not be based on an obsession with expertise or defaulting to AI experts due to lack of knowledge about AI. As such, I advocate for an AI skills-in-depth model which decreases focus on creating AI experts which are both costly and – given integrated AI warfighting has not fully arrived, are not yet necessary en mass as their skills would just atrophy. Creating an AI-enabled workforce requires more than just training AI experts and hoping AI will deliver revolutionary effects on the battlefield.

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