The Acquisition Community and Engineering Expertise Development

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Acquisition community members are part of a team tasked with making affordable and operationally effective procurement decisions for the Department of Defense (DoD). To achieve this goal, workforce engineers and engineering teams must have and maintain a well-balanced skill set that includes an understanding of government acquisition policies and technical skills that provide the level of expertise required for their role in the acquisition process.

Providing acquisition workforce engineers this skill set balance requires a partnership between the acquisition and technical communities within DoD. The Defense Acquisition University (DAU) has taken on the role of providing acquisition workers the skill sets required for success in learning the required acquisitions policies and procedures for various acquisition roles. The training provided is directly applicable, progressive, career-long, and relevant to a particular DoD department. On the other hand, the

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applicable technical skill set is not being maintained with as much structure, consistency, or resourcing.

Of particular concern to the acquisition community should be development of the technical skill sets needed to support complex roles requiring multisystem technical requirement apportioning, balancing system life-cycle needs during acquisition phases, and providing the capability to create affordable design engineering solutions to problems. Developing these specific technical skill sets involves lengthy and specific developmental experiences for government engineering personnel. Acquiring the necessary skills through random work experiences alone may take a substantial portion of a typical government engineering career. The barriers to developing these skill sets include outsourcing engineering work, resourcing long-term progressive training programs, lack of technical knowledge management, career transitions, and many other factors. The purpose of this effort is to identify some of the issues related to the technical side of this partnership and suggest a strategy for improving the engineering skill sets most relevant to supporting the acquisition community.

Engineers typically come into government service with a degree in a very general field of engineering (electrical, mechanical, civil, etc.). Upon entry into government service, they begin to learn how to apply these general engineering skills to the specific needs of their new employer. During the initial indoctrination period, there typically is either a formal or informal internship where new engineers learn the processes, practices, and procedures of their new jobs. In this same period, they start to become aware of their customer's needs, available resources, and working both as an individual and team member in projects. This period may last a year or two, it is very command-unique, and it is not the time of primary concern in this effort.

After the initial indoctrination, most engineers start to develop in what might be considered a mentored developmental training period, perhaps analogous to a medical residency. This will involve on-the-job training, completion of increasingly more complex assignments, and learning how to function independently as an engineer. Some will enter into specific government training programs, such a those under the Defense Acquisition Workforce Improvement Act (DAWIA). Some will just begin work as journeyman-level engineers. Some will go on to additional education with graduate academic work as they go down the technical specialist track. Others will go down a project management or engineering management track. The missing track from this list is a track providing structured long-term technical developmental programs for complex generalized roles, such as design engineer and systems engineer. These roles develop service-specific innovation and production heuristics that are the source for the sound engineering judgments and creative intuition for resolving acquisition program engineering issues. Collectively, personnel engaged in these roles are the backbone for DoD technical core competency.

The most essential element for engineers on a complex generalized track is the need to actually do the technical work under the supervision of an experienced engineering mentor. Like similar programs, substantial mentor involvement is needed initially, followed by a transitional period where mentoring is reduced and independent work becomes only occasionally reviewed. Gradually, the mentor becomes more of a colleague or consultant on a multilevel engineering team. A certain amount of actual core competency work also must be accomplished throughout a career just to stay in practice and capable of integrating new materials, technology, and systems into projects. For larger and more complex projects, you need to be able to readily immerse yourself in the technical design without spending too much time getting up to speed with the latest technological advances. Practice is in contrast to being the government technical point of contact (TPOC) controlling the work, where the engineer is the person responsible for technical oversight of a contractor's work. This is not to say controlling work should not also be part of the learning experience, but it is to say that enough work needs to be accomplished by the engineer to achieve initial proficiency in the role and then maintain proficiency in the role throughout their careers.

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As simple as this sounds, it becomes increasingly more difficult to get relevant and challenging engineering assignments that enable staying in practice as you become a more senior engineer, largely due to role shifts caused by the acquisition reform of the 1990s. In addition to these shifts, work that is difficult to contract out resulting from unusual circumstances, such as extreme schedule constraints, politically charged issues, or even availability of contracts, all tend to supersede the need for government engineers to work on core technical work. Reducing the opportunity further is the perception that contracting out such work is a cheaper way to accomplish a task and that one engineer can oversee much more than a single person can do alone. A working capital-funded program is reluctant to assume any of the financial burden associated with maintaining technical core competency of engineering workers. The long-term effect of engineers not engaging in technically challenging work also is not captured by short-term price comparisons. Not accounting for this long-term resource loss leads to a diminished and dated command collective technical resource capability. The degradation is difficult to measure and often masked by inflated technical-sounding titles given to work assignments that are in reality more administrative than technical. There also is an employee-driven general shift from technical engineering to project engineering and engineering administration because it usually is the path to greater compensation for time.

For example, one of the roles that requires a long development period and constant practice for proficiency is that of design engineer. Design engineers are the creators of the artifacts used to realize how mission requirements can be met in a safe and suitable manner. They are the front-line workers in technical risk decisions, integration of concepts, and determining a reasonable tradeoff strategy in production efforts. New engineers taking on the role of design engineer must find creative and affordable solutions to meet mission requirements using academic principles, industry products, and production practices. This involves a constant iterative comparison between product costs, most effective production process, material constraints, safety and environmental regulations, and many other factors. These solutions must be technically sound, communicated to the production workforce, tested, logistically supported, and properly archived. The time invested in this role includes learning and staying abreast of industry products, production techniques, performance of equipment in the field, and production costs. Most new designs also include the challenge of integrating them into the existing systems and operational procedures. Effective integration of new designs into existing products and systems is a skill that takes practice to learn. However, the dividends from this time investment include increased vision about the probability of success of new concepts, and understanding about the dominant design factors, knowledge of the controlling cost factors, and an ability to rapidly identify the impact of changes to operational or design requirements. These attributes are important technical support skills to be able to bring to an acquisition program. As a side note, acquisition reform and the trend to contract out the design engineering function have reduced the opportunities for design engineering development programs, particularly within the subset of acquisition workforce members.

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If we want engineers to stay in these complex general role tracks, a structured development plan is needed for quantifying and achieving the expertise, matched by a compensation plan that equates their importance to the acquisition program.

Senior engineers traditionally have been informally charged with mentoring the next generation, communicating the knowledge associated with specific past experiences, and providing life-cycle engineering support for past and present acquisitions. The new trend appears to be project engineering, where the oversight of many contracts or projects amplifies the influence of an engineer. However, such a work strategy precludes engineers from having the time to accomplish complex engineering developmental assignments that demand continuity of thought and focus on a specific complex set of issues. A sad byproduct of this strategy also is a diminished capacity to mentor. Loss of the opportunity to complete complex technical core competency engineering assignments equates to reduced engineering proficiency.

A loss in opportunity to transfer knowledge or mentor young engineers is a lost training opportunity. Engineering managers face balancing the challenges and technical problems of paying customers with training the workforce in a "working capital funding" environment. Often, training must take a back seat to product delivery. This creates a learning environment that is often sporadic, inconsistent, and fragmented. Engineering roles requiring long developmental training periods are particularly hurt by this type of learning environment. A structured development program for these roles would assist in managing these resources. A technical version of what DAU provides DAWIA workers would provide a means to manage the training of engineering resources to support the complex roles associated with large acquisition programs.

A second role that requires a long development period is that of systems engineer for complex systems. The technical side of systems engineering involves at least a functional understanding of how systems work, how they interact with the environment, and how they interact with other systems. In the case of complex equipment, systems engineers need to understand the balance between individual system performance and the overarching performance of the total mission system. For example, typically desirable skill sets include understanding issues such as apportionment of power resources or weight allowance for different systems to optimize total performance of a vehicle.

Keeping abreast of the various systems, given the rate of change in many industries, can be a full-time job. However, systems engineers also need to know and understand the acquisition process and understand how to work through issues associated with the different steps in the process. Because each acquisition is different, this often involves learning how to apply and adapt procedures to situations at hand in addition to knowing the defined procedures. Frequently, systems engineers start in one discipline (such as mechanical, electrical, or structural), then learn how systems in their field interact with other systems in complex equipment. Consequently, in addition to keeping current with systems in their field and acquisition procedures, considerable time is spent learning and understanding the changes in system interaction as a result of changes to other systems. Systems engineers often can find their time constrained by involvement in many parallel projects, often at different phases of an acquisition, and must keep up with changes to acquisition procedures at all phases. For their investment of time in learning the breadth of systems and interrelationships, systems engineers become essential in providing acquisition programs guidance on how to handle changes during the life cycle of an asset. These may be subtle changes, such as cost changes or equipment performance characteristic variations, or massive changes involving replacement of one or more entire systems. Accurate and efficient determination of cost, logistics support, overall performance, and similar impacts of changes for the program manager can play a major role in overall success of a program.

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Despite their importance to the acquisition process and overall engineering health of DoD, the health and relevancy of the technical skill level of personnel in key roles such as design engineer and systems engineer is not collectively monitored. Both roles typically have no formal structured technical training within the government to capture the technical level of individual practitioners within the discipline. There are no formal metrics to provide managers a measure of the skill level of groups of practitioners within a branch, division, or command. There also is no means of technical knowledge management for either role that could compare to the knowledge management method provided by the online services of DAU. Knowledge in both systems engineering and design engineering is acquired through direct experience, individual investigation, and direct mentorship from more experienced personnel.

While these methods all have positive attributes, they also often lead to an inconsistent technical message going forward. There is enough commonality of information in both roles for there to be substantial benefit in an "online" technical knowledge management system for both roles within the government. Such a system would not only capture the information, but allow it to be maintained and monitored in a manner consistent with the individual technical authorities within DoD. Ideally, a technical knowledge management system also would permit capturing the "lessons learned" by the workforce as well as delivering the policies of technical authorities.

The DoD acquisition process is designed to provide a delicate balance between flexibility and risk that needs an effective technical leg with awareness of acquisition policies and products. Creation and implementation of these products by the acquisition workforce in an affordable and operationally effective manner depends on the existence and management of several key complex roles that require both substantial technical training and a working level knowledge of the acquisition process. There is sufficient risk in loss of these skill sets to warrant a structured in-house curriculum to add order to a currently chaotic experiential learning process associated with various on-the-job engineering assignments.

Management of the development and status of these roles needs to include a monitored and structured developmental process, have measurable milestones, and permit the command to capture the technical health of its personnel in key roles within the acquisition community at any time. The acquisition community needs engineers who offer a well-balanced technical perspective, do not allow the right process to drive them toward a bad technical decision, and who can offer acquisition guidance in a clear and succinct form. This requires more control of the development process.

Similarly, management of these roles must include capturing and managing the associated knowledge in a manner that permits easy access and a consistent technical message for delivery to developing engineers. One method of both controlling development and managing knowledge is to create a supportable and well-maintained online training and knowledge management system, similar to that used by DAU. This will enable the technical side of the partnership between the acquisition and technical communities to function consistently when supporting acquisition programs in meeting future DoD acquisition challenges.

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