Anatomy of the Future DoD Cost Estimator

Abstract

Change is defined as "the act or process through which something becomes different." In response to National Defense Authorization Act (NDAA) and Weapon Systems Acquisition Reform Act (WSARA) calls for a specialized, properly qualified Department of Defense (DoD) cost estimating workforce, change was inevitable. Arguably the most significant change is the establishment of the cost analyst as a specialized career field/function and the subsequent migration of DoD cost analyst civilians from the 501 Financial Administration and Program series to the 1515 Operations Research series. We analyze the origins of this change, the implications for the current workforce, and then discuss the anatomy of the future defense cost estimator. While the focus of this paper centers on recent changes occurring within the United States Air Force civilian cost workforce, the future implications are relevant to all Services.

Anatomy of the Future DoD Cost Estimator

Change is defined as "the act or process through which something becomes different" (1). In response to National Defense Authorization Act (NDAA), Acquisition Improvement Plan (AIP) and Weapon Systems Acquisition Reform Act (WSARA) calls for a specialized, properly qualified Department of Defense (DoD) cost estimating workforce, change was inevitable. Arguably the most significant change is the establishment of the cost analyst as a specialized career field/function and the subsequent migration of DoD cost analyst civilians from the 501 Financial Administration and Program job series to the 1515 Operations Research job series. We analyze the origins of this change, the implications for the current workforce, and then discuss the anatomy of the future defense cost estimator. While the focus of this paper centers on recent changes occurring within the United States Air Force civilian cost workforce, the future implications are relevant to all Services.

Change brings about a wide range of human emotions: from anxiety and frustration to excitement and anticipation. Inevitable we ask ourselves "why is this happening?" and "how is this going to affect me?" Emotionally charged reactions are particularly counterproductive when based on misinformation or rumors. While not a panacea for assuaging these emotions, properly informed individuals are able to internalize and adapt to the change in a more expedient and productive manner. Thus, understanding the origins of the changes that have occurred as defense cost analysts migrate to the operations research series can alleviate some of these emotions.

"We are all Operations Research Analysts Now!"

Milton Friedman, a free-market noble prize winning economist is famously quoted as saying "We are all Keynesians Now!" in a 1965 *Time* magazine article (2). President Richard Nixon reluctantly utilized the same phrase in the 1970s in response to enacting interventionist government policies that he was philosophically opposed to. Keynesian theory was the orthodox consensus view in the late 1960s and early 1970s (3). Keynesian theory is based on the belief that the economy does not automatically operate at efficient levels and activist government policies can and should be used to effectively steer and guide the economy towards increased productivity, incomes and employment (4). Thus, there is great irony that this phrase is associated with Friedman and Nixon, whose economic philosophies are anathema to government interventionist policies.

Perhaps today's cost analyst can commiserate with Friedman and Nixon. Only their mantra is "We are all Operations Research Analysts Now!" The 1515 job series has quantitative education requirements that did not previously exist for the 501 job series employee. Undoubtedly, some individuals may not philosophically agree with the change. Regardless, the

shift to a more technical/math oriented skill-set is indisputably underway. Understanding the factors undergirding the shift is needed.

For the Navy and Army, civilian cost analysts have been part of the 1515 Operations Research series for years. The Air Force, however, was historically segregated with parts of the workforce as 1515s (e.g the Air Force Cost Analysis Agency), but many others coded as the 501 series (e.g. Life Cycle Management Center at Wright Patterson AFB). That segregation in the Air Force ended in 2014/2015 as the remaining cost-coded positions were moved into the 1515 job series. What prompted this change? The National Defense Authorization Acts of 2006 and 2007 cited concerns with Air Force cost estimates and highlighted the need for properly qualified estimators (5) (6). In 2008, RAND completed a study as part of their Project Air Force series on "The Acquisition Cost-Estimating Workforce" (7). Among other things, RAND concluded that the lack of a specialized cost estimator career path with viable upward mobility was an impediment to attracting and retaining civilian cost estimators.

Then in 2009, WSARA echoed the importance of qualified cost estimators as the legislation called for an expansion of independent cost estimates (8). Subsequently, the defense department took action. The Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L) broke apart the Business, Cost Estimating and Financial Management Career field into two separate career paths: one for Business-Financial Management (BUS-FM) and one for Business-Cost Estimating (BUS-CE) (9). Thus, new training and experience standards were established for Acquisition Professional Development Program (APDP) certification for the cost workforce. In conjunction with these changes, SAF/FM directed the establishment of a specialized cost estimating workforce through conversions of the workforce to 1515 Operations Research Analysts. That conversion process is finally reaching completion in the Air Force.

Math?!? Math is scary….

The change to an Operations Research job series has implications for education requirements. The aforementioned 2008 RAND study found that the current cost estimating workforce was not ideally postured for the educational requirements. Through a survey of current estimators they found:

> "There was a consensus among our respondents that an engineering or technical background, although not absolutely necessary, would be particularly useful for understanding the technologies involved in acquisition programs, staying abreast of new developments, and obtaining more-detailed information from engineers. Estimators with these backgrounds were thought to be able to ask deeper questions than those with an accounting or financial background. A mathematics or operations research background was also seen as good preparation for a cost-estimating career" (10).

RAND's analysis of the educational background of the Air Force workforce did not corroborate with the desire mathematical, engineering, or other technical degrees. In fact, nearly 75% of the Air Force cost estimators were business management, finance, or accounting professionals (See Figure 1).

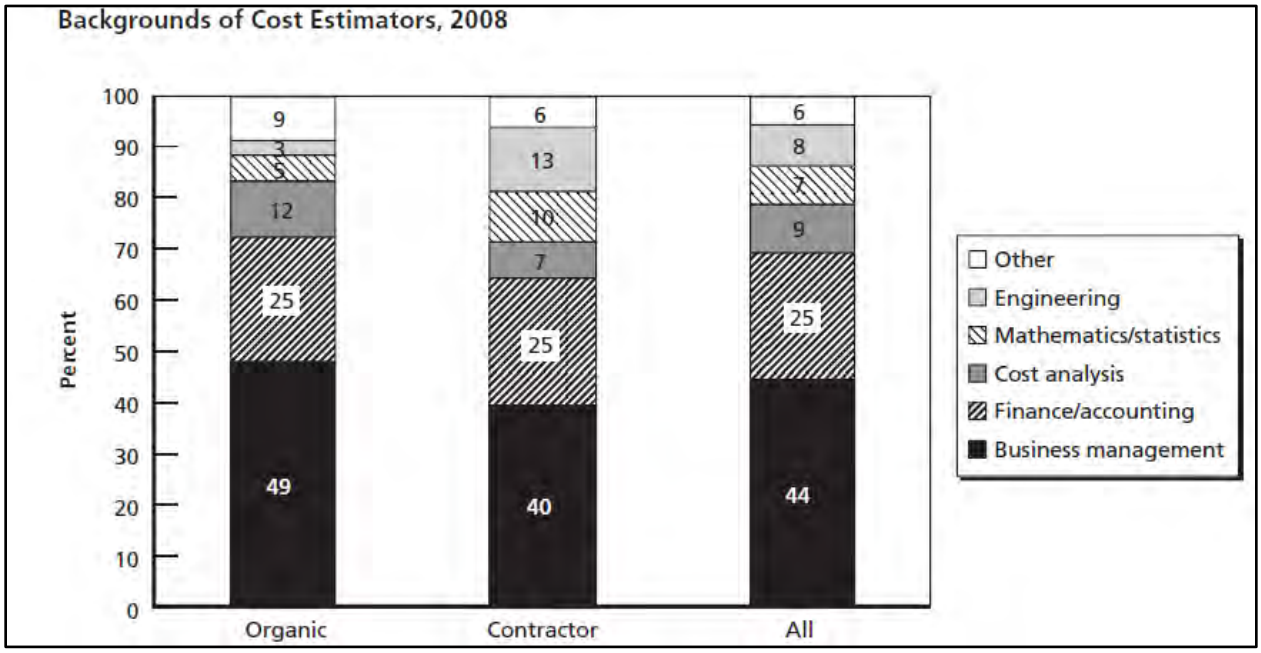

Figure 1: Education Degrees of Air Force Cost Estimators (reprinted from RAND 2008) (11)

The Air Force cost estimating workforce was historically attracting those with proclivities toward business and its subfields of management, accounting, and finance. The migration to the operations research job series brings about different requirements. According to the Office of Personnel Management (OPM), the operations research job series requires college degrees to be in operations research or have "at least 24 hours in a combination of operations research, mathematics, probability, statistics, mathematical logic, science, or subject-matter courses requiring substantial competence in college-level mathematics or statistics" (12). OPM goes on to further delineate specific courses that meet the 24 hour requirement:

> "The following are illustrative of acceptable courses: optimization; mathematical modeling; queueing theory; engineering; physics (except descriptive or survey courses); econometrics; psychometrics; biometrics; experimental psychology; physical chemistry; industrial process analysis; managerial economics; computer science; measurement for management; mathematical models in social phenomena; and courses that involved application of operations research techniques and methodologies to problems of management, marketing, systems design, and other specialized fields; or other comparable quantitative analysis courses for which college-level mathematics or statistics is a prerequisite" (13).

Additionally, the operations research job series requires that three of the 24 credit hours must be in calculus (14). The requirement for calculus in university business schools (where the majority of the AF cost estimating workforce degrees historically reside) varies significantly. While some schools require all students regardless of major to take calculus as a mathematical baseline, many others go no further than college algebra.

What about grandfathering? The Air Force did not grandfather current employees. Those individuals transitioning to the Operations Research job-series are required to meet the basic qualifications. The calculus requirement has been the most problematic for transitioning the current workforce. For some individuals, this has meant that they chose to seek other opportunities outside the cost estimating field. Other have elected to go back to school to meet the calculus or other 24 technical credit hour requirement.

Options for Cost Analysis Graduate Education in the DoD

Given the requirements previous described, it is natural to examine how the academic side of the DoD is structured to meet these changes. More specifically, there are two institutions who offer graduate degrees focused in Cost Analysis: The Air Force Institute of Technology (AFIT) and the Naval Postgraduate School (NPS). Since 1982, AFIT has offered a Master of Science degree in Cost Analysis to military and civilians for their in-resident program. In 2010, NPS began offering an MS degree in Cost Analysis to military and civilians through a distance learning program. Examining the curriculum for each degree program is instructive for determining whether these institutions are postured to meet future needs.

Admission to AFIT's cost analysis program acts as a filter to ensuring a strong mathematical foundation. Prerequisites for admission include a 3.0 grade point average in mathematics, completion of one course each in calculus and statistics, and a quantitative score of 148 on the GRE. The program curriculum itself furthers the quantitative focus with two operations research classes (decision analysis and linear programming), a mathematical economics course, two statistics courses, and multiple quantitative cost analysis courses to include risk analysis (15). Thus, it appears that AFIT is well-postured to meet the more quantitative/analytical needs of the future cost estimator.

The mathematical prerequisites for NPS are not as stringent, as the only math specific requirement is one class of calculus with a "C" or better average. Unlike AFIT, there is not an entrance examination requirement or a mathematics grade point average requirement. The program curriculum, however, does have a quantitative focus with one operations research class, two statistics class, and multiple quantitative cost analysis courses to include risk analysis (16). NPS also offers the flexibility of distance learning, whereby students can achieve the academic requirements they need in concert with fulfilling their job and/or family commitments. NPS graduates are also well postured to meet the 1515 job-series requirements.

Overall the state of DoD graduate education is structured to meet the quantitative demands of the Operations Research job-series. Graduates of either of these programs will have the academic pedigree required to fill cost analyst vacancies. Thus, it appears the educational arms of the cost estimating workforce are properly aligned to fulfill a more quantitatively oriented workforce.

Analytics Are Becoming Ubiquitous

As discussed thus far, change towards a more mathematically proficient cost estimating workforce is underway. Whether or not that is change is "good" is a normative claim. That being said, analysis of trends happening in the civilian sector provide insight. We highlight two paradigm shifts. First, mathematical analysis has become the norm in even the most traditional of professions where subjective human judgment and personal experience were considered king. Consider the case of "*Moneyball*". *Moneyball* is the title of the book (and subsequent movie) detailing the story of the Oakland A's reliance on innovative mathematical relationships to field a competitive baseball team despite a dearth of financial resources (17). Baseball is known for its unwritten rules and scouting experts who have historically stuck to a small subset of metrics to gauge player value. *Moneyball* tells the story of how the Oakland A's used a group of operations research analysts to turn the conventional wisdom on its head and made the A's contenders. The success of the A's has resulted in a burgeoning demand for operations research analysts in all professional sports from baseball to basketball to football. The second trend involves Big Data. Big Data refers to large datasets that traditional data processing applications were unable to handle. Big Data is currently being leveraged in civilian sectors such as manufacturing, and healthcare. The government is also recognizing the paradigm shift. In 2012 the Obama administration announced the Big Data Research and Development Initiative in an effort to examine how Big Data could be used to address important governmental problems (18).

As these trends suggest, mathematical skills to leverage increased accessibility to data and the ability to process large data sets is seeping into many different facets of the civilian sector. The cost estimating process is a natural area where the government can operate at the cutting edge of these trends. Why? We have both the data and the computing power to utilize the data. There is more and more data available to the government analyst through databases collecting Operations and Support data (e.g. AFTOC or VAMOSC) and other data repositories (e.g. CADE). Additionally, analytics are on senior leaders minds. We see this change in everyday government vernacular. How often have you heard that we need to provide "decision support" or "data driven decisions?" Development of the human capital within the government to capitalize on this endeavor is the final step.

Projecting the Anatomy of the Future Cost Estimator

So what does the cost estimator of tomorrow look like? Are we destined to be a group of left-brained, introverted, socially-awkward math geeks? Probably not. Cost estimating is well known to be both a science and an art. The increase in mathematical proclivity that will be required of future cost estimators is undeniable. This is the science piece. But the "art" part of cost estimating will still be necessary to be a successful cost analyst. The "art" skills involve various right-brained qualities. Individuals must be creative and intuitive. Cost estimating often involves breaking new ground by estimating the cost of technologies that can claim no contractual histories. They must be detectives. They must be able to take the output from the mathematical analysis and understand the context in which it is applicable. Communication will remain a necessary skill. The inter-personal communication skills that are needed today to talk

with engineers, logisticians, test professionals, etc. to understand a program (and thus be able to cost it out) will remain of paramount importance. Additionally, communicating the end product (the estimate) to senior leadership (general officers) will remain crucial. Even the most technically sound estimate is doomed to fail if it is not communicated in a way that senior leaders understand.

What does this all mean? Essentially, the cost estimator of tomorrow will have more quantitative skills than the estimator of yester-year. We are likely to see the educational background be different: less business administration and more technical degrees. Those individuals will be better postured to run regression, optimization and other statistical models. They will likely possess programming skills in applications like "r" and have significant database prowess. The "science" aspects of cost estimating are expected to be superior. But only those individuals who possess a well-rounded balance of personal skills will be successful estimators. Thus, the "art" aspects of cost estimating will remain of paramount importance. Analysts will still need to be able to effectively communicate with others in order to develop estimates and subsequently communicate results to decision makers. Successful analysts will not be math-geeks sitting alone in their cubicle crunching data. Context for the data analysis comes from the "art" side of cost estimating. These unique skills will be retained.

Change is often scary but also inevitable. Understanding how and why the change came about is critical to alleviating fears and garnering support for the change. Today's cost analyst should not have trepidation about the composition of the future cost estimator. The need for an infusion in the "science" aspects of the cost analyst is a response to the identified problems of the past. That change does not necessarily fundamentally alter tomorrow's cost estimator to something unrecognizable today. Rather, these changes will enhance tomorrow's cost estimator with greater analytic skills while retaining the basic skill-set necessary to fulfill the "art" aspects of cost estimating. If successful, the outcome will be better cost estimates conducted by a sustainable, professional cost estimating workforce.

DISCLAIMER: The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the United States Air Force.

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