COMMERCIAL QUALITY STANDARDS FOR TRAINING SYSTEM SUBCONTRACTORS AND VENDORS

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ABSTRACT

Link quality assurance specialists have set out to determine a more precise definition of "best commercial practices" than is currently applied in procurement policies, which call for criteria less rigorous than those imposed under MIL-Q-9858 and MIL-I-45208. The term "best commercial practices" is understood to apply to those items which are neither complex nor critical, and such items represent the large majority of procurements made under military and commercial contracts. It has been Link's experience that quality obtained under "best commercial practices" ranges widely, from full compliance with MIL-Q-9858 to virtually no compliance whatever. Establishment of precise standards for "best commercial practice" leads to three desirable results: quality inspection costs are reduced, suppliers know precisely what is expected, and minimum standards are defined for training systems in general. Accordingly, we have developed four specifications that define "best commercial practices" to our suppliers as part of a comprehensive procurement quality assurance program.

In connection with current proposal efforts and in response to the increasing Government concern about procurement quality control policies of prime contractors, Link Quality Assurance set out to define "best commercial practices" as they apply to training system procurements. The Federal Acquisition Regulations require prime contractors who are subject to MIL-Q-9858 to pass down quality requirements to suppliers according to the criticality or complexity of the item or service to be supplied. If the item or service is both critical and complex, MIL-Q-9858 must be specified by the prime contractor in the subcontract or purchase order; if the item or service is either complex or critical, MIL-I-45208, which contains less stringent quality program requirements, must be applied; and if the item is neither complex nor critical, a commercial quality program is sufficient. For a large majority of procurements made under military (and commercial) contracts, commercial quality requirements are applied to the supplier. The FAR does not offer similar guidance for tiering software quality requirements, but we can assume that the criteria of complexity and criticality apply when determining quality requirements for all types of purchases.

Unfortunately, it has been our experience that merely specifying "best commercial practices" or a certificate of conformance on a subcontract or purchase order does not guarantee the quality of the supplied item or service. "Best commercial practices" can be taken to imply a range of quality assurance programs -- from those conforming to industry standards as stringent as MIL-Q-9858 to those that amount to virtually no quality program at all. A recent Request for Proposal for a military training system defined "best commercial practices" as conformance with the contractor's existing internal procedures, but this definition does not account for contractors whose procedures might be inadequate or for those who do not have written procedures at all. The absence of a precise definition makes the tasks of selecting, monitoring, and evaluating suppliers difficult and subjective. By establishing minimum commercial quality program criteria, the prime contractor could better perform these functions and better ensure the ultimate quality of the prime end item or service.

In setting out to define the minimum commercial quality standards, our goals were threefold: to reduce our own quality inspection costs by ensuring better incoming products and services, to define minimum quality requirements to suppliers so they would know precisely what we expect, and thereby to define the minimum commercial quality requirements for training systems in general. These goals were based upon preliminary analysis and our experience with suppliers. We assumed that most of our suppliers would be able to meet or exceed the minimum requirements, particularly if they regularly supplied items or services to military customers. Smaller companies, however, do not normally have the personnel or resources to meet the military quality standards, so the commercial quality requirements would give them a basis for developing an effective quality program. Moreover, the new requirements would give us criteria for evaluating smaller companies and recommending quality program improvements. We decided to emphasize existing quality programs wherever possible; if an existing quality program generally meets or exceeds the minimum requirements, we would not specify an alternative procedure or process. Our evaluation of the supplier's quality program would be based upon written quality procedures, if any, and on site surveys. Ensuring the quality of the supplied item or service was our primary concern, not how the supplier conducted the quality program.

Based upon these goals and assumptions, we developed four specifications to define "best commercial practices." In addition to a general

quality assurance program specification, we wrote specifications for software quality assurance, software documentation, and hardware design and construction. The remainder of this paper will discuss the contents and derivation of each of these requirements and how they might be best applied to suppliers as part of a comprehensive quality assurance program.

The first step in developing the standards was to select existing Government or industry standards that could be edited to suit our needs. Because we were trying to establish minimum quality requirements, we looked for standards that would provide us with adequate protection but that would not be as costly to implement as MIL-Q-9858 or MIL-I-45208. We also wanted to edit and reidentify the standards as Link standards, so that suppliers would be less inclined to worry about the costs associated with meeting the requirements.

After studying all existing military and commercial quality standards, including NATO standards, we selected FED-STD-368 as the basis for our commercial quality requirements. FED-STD-368, "Quality Control System Requirements," has not been applied by any recent military training system procurements, to the author's knowledge. It includes most of the important quality functions, such as adequate quality organization, provisions for tracking inspection status, checking of test and inspection equipment, maintenance of inspection stations, performing end-product inspections, keeping quality records, maintaining a system to track drawing changes, adequate packing and shipping, and documenting the quality system with written procedures. The scope of the standard is to establish "minimum requirements for a quality control system to be provided and maintained by a contractor under Government contract." The standard is applicable when referenced in the contract and may be applied to suppliers when Government inspection will be performed at supplier locations. So FED-STD-368 was a good selection for our use because it was written to apply minimum requirements and it already had appropriate wording for application to suppliers.

Also, many of the requirements are written to be general rather than specific and they allow for the discretion of the buyer and the scope of the contract. Paragraph 5.1, for example, states: "The contractor shall perform all examinations and tests to substantiate conformance to specifications, using his own or any other inspection facilities or services acceptable to the Government." This and other similar statements in the standard allow the buyer to tailor the requirements to meet the specific needs of the buyer, and thereby control cost.

In editing the standard for Link use, however, we extended this concept. The "Application" paragraph now reads: "This standard is applicable to all Link procurements under commercial or military contracts when neither MIL-Q-9858 nor MIL-I-45208 will be applied to the supplier. For certain non-critical procurements this standard may be tailored at the discretion of Link Quality Assurance, provided that the quality of the end product or service will be maintained." This statement was added to increase the applicability of the standard by allowing us to specify only the quality activities we might determine to be necessary based upon our experience with a particular product or supplier. A supplier who is furnishing us negatives of a technical manual using our masters, for example, might not have a separate quality control organization and a quality manual. A small job shop could provide quality negatives if it used good photographic equipment, checked the developing solution regularly, and used an adequate light table for inspecting and working on the negatives. About half of the requirements in the quality standard could be deleted in this case without compromising the quality of the negatives.

Among the other changes to FED-STD-368 were the addition of a few phrases to make the standard applicable to documentation and artwork. Like most other military and commercial quality standards, FED-STD-368 is written to apply to manufacturing processes and must be force-fit to apply to other products. Under paragraph 5.2, for example, the supplier must keep "raw material, parts, partially assembled products, and end products segregated in accordance with their inspection status." This requirement does not seem to apply to documentation and artwork, so we inserted those items into the series.

For the most part, however, we found that FED-STD-368 could be used without too much editing, other than changing "Government" to "Link" and "contractor" to "supplier." MIL-S-52779, which we selected as the basis for our software quality standard, required somewhat more change.

Other industry and military software quality standards are generally more stringent than MIL-S-52779, "Software Quality Assurance Program Requirements," because they tend to specify a software development process, including software documentation and controlled baselines. Many military training system procurements, for example, specify MIL-STD-1644, MIL-STD-483, or their successor, DOD-STD-2167, which along with associated data items provide strict control of design, coding, and testing of software. MIL-S-52779, however, does not contain as many "how-to" requirements. It generally requires that the Software Quality Assurance Plan for the program document the procedures used to develop and control software, but it does not establish criteria for controlling software. Also, MIL-S-52779 does not require the contractor to have a documented software quality assurance program in place but to write a plan that addresses essential quality considerations such as design procedures, documentation, configuration management, quality reviews and audits, testing, corrective action, and subcontractor control. Of course, the plan may reference procedures already in place, and evaluation of the software quality program will consider the adequacy of existing procedures and those planned for the project.

In studying MIL-S-52779 and comparing it to other industry and military standards, we realized that suppliers who were working to some of the industry standards might not meet the letter of the specification. Because we did not want to discourage suppliers who had effective software quality programs in place, we edited the few sections that specified how to perform the quality function. In paragraph 3.2.2, which requires review of design documentation, for example, we struck out the criteria for design reviews and the requirement that the reviews be conducted independently. We edited the section on testing in a similar manner to eliminate criteria for reviews of software requirements and test requirements. We also eliminated the requirements for trend analysis because we assumed that trend analysis is generally most meaningful in the development of large systems or a series of systems, which lie outside the scope of our standard. For a large software system, particularly one to be developed under a military program, we would apply the prime contract quality requirements as a minimum on the supplier. Finally, we added to this standard the same statement regarding tailoring that we added to the quality assurance program standard.

Choosing a standard for software documentation was somewhat more difficult because software documentation is an effective management tool, but it is unfortunately considered by most developers to be a major cost consideration. We decided that design specifications -- rather than user documentation, such as listings and technical manuals -- were probably the most costly and the least necessary for the size and complexity of the system our standards would be used to procure, not because of the information the design specifications provide, which we feel is essential, but because the standard format might be unfamiliar to some of our potential commercial suppliers. For this reason we selected ASTM E 919, "Standard Specification for Software Documentation for a Computerized System," which requires documentation that closely resembles the user information supplied with commercially available computers but does not require a particular format. The documentation is divided into three major categories: documentation for all programs, documentation for all users, and documentation for maintenance and enhancement. For most procurements a complete set of documentation will be required. The package will provide detailed program descriptions, including theory of operation, structure, flow, and test data. This standard required the least editing for our use.

The most difficult standard to develop was the design and construction standard, which we based on ASD Exhibit 75-2 and MIL-T-23991, "Design and Construction Standard for Training Equipment." The process of developing this standard consisted of combining the requirements of ASD Exhibit 75-2 and MIL-T-23991, removing redundancies and inconsistencies, and removing references to military specifications. We substituted industry standards for the military standards wherever we could and inserted the wording or requirements from the military specifications when no industry standards applied. In many cases, we allowed the supplier to identify the standards to be used, which might include internal standards. For major referenced requirements of MIL-T-23991 -- Safety, Thermal Design, Dissimilar Metals, and Workmanship -- we developed appendices to our standard based upon the applicable military and industry standards. Like the other commercial standards we developed, the design and construction standard can be tailored to suit the complexity and criticality of the system to be procured. Applying design and construction standards to a small system would not be cost-effective.

In general, the process of developing commercial quality standards for our suppliers led us to conclude that more tiering and tailoring of quality requirements would lead to more effective and efficient control of suppliers. Applying too many requirements without regard to mission or the criticality and complexity of the item or service drives up cost without ensuring higher quality. Suppliers are more likely to meet or exceed requirements willingly when they know that the requirements have been developed and tailored to meet the genuine needs of the buyer. Link has applied the draft standards to prospective suppliers as part of one of our proposal efforts, and the experiment has been successful. Both Link and supplier representatives agree that "best commercial practices" is a term that has been too long undefined.

The standards are currently under coordination among Link activities and locations. Although it is certain that they will undergo a series of revisions before all procurement and quality functions agree on their content, their eventual application appears imminent. Among the comments we have received thus far are suggestions that software quality requirements be addressed in the FAR as hardware quality requirements are and that standards such as these be applied in military contracts when more stringent requirements are unnecessary. For procurements of all types, we must be careful to specify appropriate requirements and achieve mutual understanding of those requirements among the procuring activity, the contractor, and all suppliers.

About the Author

Terry Tierney is the Manager of Software Quality Assurance Engineering at The Singer Company -- Link Flight Simulation Division in Binghamton, New York. In his ten years at Link, he has worked in mechanical design and technical publications, in addition to spending eight years in various quality assurance functions. He has served as Quality Assurance Manager on a number of military projects, his duties focusing primarily on software quality issues and project-related quality tasks. He holds BA and MA degrees from SUNY Binghamton.