

Guidelines for Procurement of Professional Aerial Imagery, Photogrammetry, Lidar and Related Remote Sensor-based Geospatial Mapping Services

The following material is considered final and was approved by the ASPRS Board of Directors in August 2009. This Guideline was widely disseminated for comment and all comments were considered before this final copy was prepared.

Introduction

The focus of this Guidelines document is limited to the procurement of **professional** services. Products and technical services are addressed to the extent needed to define and clarify the distinction between professional services, technical services and products. Guidance for procurement methods appropriate for products and technical services are not addressed herein. The intent of the ASPRS is to address those other procurement methods in separate documents.

Executive Summary

These *Guidelines* were prepared by the ASPRS Procurement Guidelines Committee, an ad hoc committee appointed by the ASPRS leadership. The Committee includes representation from the ASPRS Professional Practice Division, ASPRS members from state and federal government, the Management Association for Private Photogrammetric Surveyors (MAPPS) and the American Congress on Surveying and Mapping (ACSM). These *Guidelines* were formally approved by the ASPRS Board of Directors in August 2009.

The intent of these *Guidelines* is to update ASPRS policy, and guidelines first adopted in 1986, in order to provide public agencies, researchers, private entities and other organizations with an updated and current resource that they can use as a guide to help determine the best approach and methodology for procuring professional photogrammetry and related remote sensor-based geospatial mapping services. This Executive Summary highlights the key issues, considerations, recommendations and conclusions that are addressed in detail in the *Guidelines* document.

Definition of Professional Services

- “Professional” services are those services that require specialized knowledge and skill, require independent judgment, and have an expectation of ethical conduct and professional expertise such that the resulting services will represent the best interests of the client and the public. Professional photogrammetric mapping services utilize photogrammetry and related remote sensing technologies to produce geospatial mapping deliverables and information where there is an expectation of reliable spatial or thematic accuracy.
- Professional photogrammetry and related remote sensor-based geospatial mapping services are broad in scope and are not limited to those tasks that are regulated or licensed by states or other agencies. State laws vary widely and are not consistent in their definitions of which geospatial mapping services require a license. Further, licensure is intended to ensure a minimal level of competence to protect the public from serious harm. Procurement guidelines should meet a higher standard and seek to acquire services that are going to result in a successful project that best meets overall public interests.
- The level of automation or standardization does not by itself distinguish professional

continued on page 1348

I. Background and Intent

The American Society for Photogrammetry and Remote Sensing (ASPRS) is the leading scientific professional organization representing the photogrammetry and remote sensing profession. These *Guidelines* represent the best effort of the ASPRS at defining and clarifying the key issues that affect procurement of professional photogrammetry and remote sensor-based geospatial mapping services.

These *Guidelines* were prepared by the ASPRS Procurement Guidelines Committee, an ad hoc committee appointed by the ASPRS leadership. The committee includes two representatives from the ASPRS Professional Practice Division, an ASPRS representative from the federal government, an ASPRS representative from state government, two representatives from the Management Association for Private Photogrammetric Surveyors (MAPPS) and two representatives from the American Congress on Surveying and Mapping (ACSM). These *Guidelines* were formally approved by the ASPRS Board of Directors in August 2009. These *Guidelines* supersede the now outdated ASPRS document originally adopted in 1986, entitled “Guidelines for Procurement of Photogrammetric Services from Private Professional Sources.”

By better defining specific aspects of photogrammetric mapping and related remote sensing services that are professional in nature, these

Guidelines aim to support public and private end users who need to procure geospatial mapping services. The intent of these *Guidelines* is to provide public agencies, researchers, private entities and other organizations with a resource that they can use as a guide to help determine the best approach and methodology for procuring photogrammetry and related remote sensor-based geospatial mapping services.

The specific goals of these *Guidelines* are to:

1. Provide a clear and updated definition of which remote sensor-based geospatial mapping services are considered by members of this profession to be professional level services.
2. Endorse qualifications-based selection (QBS) procurement consistent with similar professions where services are professional in nature and affect public well being.
3. Recognize existing state and federal laws regulating this profession and distinguish between:
 - i) licensed activities that are defined by state law; and,
 - ii) professional services that may not require a license, but are professional in nature as determined by the ultimate use of the services, level of skill required and accepted standards of practice.
4. Distinguish between professional services and technical services or products that may fall outside the scope of that definition.
5. Provide broad-based definitions and guidance that will apply to both current and future technologies.

II. Definition of Photogrammetry and Related Remote Sensing

Remote sensing is defined as the process of gathering and processing information about an object without direct physical contact. Photogrammetry is that branch of remote sensing which is defined as the art, science, and technology of obtaining reliable information about physical objects and the environment through the processes of recording, measuring, and interpreting photographic images, patterns of electromagnetic radiant energy and other phenomena. Photogrammetry employs the use of both interpretive techniques and mensuration methods.

Historically, photogrammetric methods and technologies were limited to the use of photographic film. With advancements in technol-

ogy, the profession has expanded to apply its expertise in interpretation and mensuration of remotely-sensed data to a wide variety of other sensors. Other sensors currently used by photogrammetric professionals include passive sensors that record specific or multiple bands of electromagnetic radiant energy (such as digital cameras and multi-spectral sensors) and active sensors, which emit and then record the returned electromagnetic energy (such as lidar and radar). Sensors may be ground-based for close range photogrammetry or terrestrial lidar surveys, attached to mobile vehicles such as automobiles or boats, airborne in manned or unmanned aircraft, or satellite borne in private or government operated satellites.

Many common definitions of photogrammetry refer only to measurements made on photographs. The term “related remote sensing” or “related remote sensor-based geospatial mapping” is used throughout this document to clarify that the ASPRS definition of photogrammetry is not limited to conventional photographic imagery, but also includes imagery and measurements acquired using lidar, radar, multi-spectral imagery and other remote sensors where photogrammetric methods are used to develop the final mapping data and deliverables. This term is consistent with language used by States that specifically license and regulate photogrammetric mapping either as a branch of surveying or as a separate discipline.

III. Scope of Services Addressed by These Guidelines

These *Guidelines* are specifically intended to apply to those photogrammetry and related remote sensing services that are associated with acquiring, interpreting, processing or analyzing remotely-sensed imagery and data to create geospatial mapping deliverables. This includes services associated with measuring, locating and preparing maps, charts, or other graphical or digital presentations depicting the location of natural and man-made physical features and phenomena of the Earth.

Photogrammetry and remote sensing are applied in a variety of industries and professions for a very broad range of applications. Many of those applications are not related to geospatial mapping and are not addressed herein.

The term “professional geospatial mapping services” is used in this document in a very general context to refer to a much broader scope of geospatial mapping services than

those that involve only photogrammetry and remote sensing. It is the opinion of ASPRS that the principles and recommendations presented in this document apply equally to any geospatial mapping services that would meet the broad definition of “professional services” used herein. However, specifically determining or identifying all geospatial mapping services that should be considered “professional services” is beyond the expertise of the Procurement Guidelines Committee and is beyond the scope of this document. The primary focus of the document is on the photogrammetry, remote sensing and image-based GIS services that constitute the primary area of expertise of ASPRS and its membership.

IV. General Definition of Professional Geospatial Mapping Services

ASPRS considers professional geospatial mapping services to be those geospatial mapping services that:

1. Require specialized knowledge derived from academic education, on-the-job training, and practical experience;
2. Produce mapping deliverables and geospatial information where there is an expectation or representation of positional or thematic accuracy;
3. Require independent judgment, ethical conduct and professional expertise to ensure that the resulting maps, data and information derived from these services represent the best interests of the client and public; and,
4. Could potentially affect public welfare or result in harm to the public if not performed to professional standards.

V. Professional Nature of Photogrammetry and Remote Sensing

Photogrammetric and remote sensing professionals apply the rigorous principles of measurement science and remote sensing interpretation to develop reliable geospatial data. Photogrammetric mapping professionals utilize their knowledge and training to employ the appropriate methods and technologies to image, measure, calculate, reduce, and integrate geospatial and attribute data. They then transform this data into mapping deliverables such as vector and image maps, charts, and other graphical or digital representations.

Photogrammetrists and remote sensing specialists must have in-depth knowledge and exper-

continued on page 1348

services from technical services or products. Professional services may include automated or standardized processes that require the supervision of a qualified professional.

- This general definition of “professional” services includes a large majority of photogrammetry and related remote sensor-based geospatial mapping services. Products and technical services fall outside the scope of the definition of professional services to which these *Guidelines* apply. Technical services include conventional aerial photography with no direct geo-referencing, imagery for display only purposes, rote digitizing and similar processes. Products include existing imagery or mapping data and other maps or data where the data provider typically sets the specifications and licensing requirements. Detailed definitions and distinctions between services and products are outlined in Table 1, Comparison of Professional Services, Products and Technical Services.
- Professional level photogrammetry and related remote sensor-based geospatial mapping services can be divided into two categories: 1) surveying and mapping that depicts the authoritative location of features, and 2) referential mapping and thematic mapping that represent reliable geospatial data, but are not intended to depict or represent an authoritative spatial location or accuracy. Mapping that depicts the authoritative location of features is defined as “surveying” by the National Council of Examiners for Engineering and Surveying (NCEES) Model Law and in many state laws. Referential mapping that does not depict the authoritative location of features is not “surveying” by the NCEES definition.
- Federal and state procurement laws may apply differently to surveying and non-surveying services. It is not the tool or process that is used, but how the data are represented and the intended use of the data that are key to making this determination. However, the distinction between surveying and non-surveying services is relevant primarily only with regards to interpreting state and federal procurement laws and state licensing requirements. With regards to determining which procurement methods and processes should be used to meet the client’s best interests, the primary consideration should be the professional nature of the services, including such factors as knowledge, skill, independent judgment and other characteristics outlined herein that define professional work. Detailed examples distinguishing between “professional” and “technical” services and between “surveying” and “non-surveying” services are included in Table 2, Examples of Professional Photogrammetric Services.

Procurement Guidelines and Recommendations as Related to Professional Services

- The professional photogrammetry and related remote sensor-based geospatial mapping services addressed by these *Guidelines* play a critical role in the success of the engineering, architecture, surveying, planning, natural resources, agriculture, emergency response, disaster recovery and other applications that they support. Procurement methods should consider potential impacts to the intended end application.
- Qualifications-based procurement methods are endorsed by ASPRS and recommended for the procurement of professional photogrammetry and related remote sensor-based geospatial mapping services. Even if there is a detailed scope of service, rigid inspection and strict client quality control process in place, these types of professional services involve too many variables and complexities to facilitate the kind of price-based process that is used for construction services, product purchases or other procurements that use price as one of the primary selection criteria. Independent judgment and independent oversight by the professional in direct responsible charge of the work are critical to the success of the project.
- When price submittals influence which proposer is selected for initial negotiations, responding proposers often are forced to design their approach to a lower standard that meets only the very minimum requirements outlined in the scope of work. This may not be the approach that serves the best overall interest of the client and the public. Quality may be compromised and advanced technologies, innovation, or best techniques and the most cost-effective overall approach may not be implemented.
- The federal law, commonly known as the Brooks Act, outlines a proven and successful model for qualifications-based selection. The Brooks Act process ranks proposers according to qualifications only. Cost is not a factor in the initial selection of the top ranked proposer. After the top ranked proposer is selected based on qualifications and capability

continued on page 1350

tise of the general principles of geomatics, the sensor technologies employed, the specific processes to be implemented and the final application of the published data. Several universities offer undergraduate and graduate programs that include photogrammetry and remote sensing; many professional photogrammetrists and remote sensing specialists have specifically studied photogrammetry at the undergraduate or graduate level. Many others have more varied backgrounds in surveying, engineering, geography or related disciplines that rely on similar principles of science and measurement. The specific application of these principles to photogrammetry requires many years of practical experience and on-the-job training.

The photogrammetry and remote sensing profession has well established certification programs, accuracy standards and expectations of ethical conduct that apply to professional practitioners. ASPRS maintains certification programs for Certified Photogrammetrists and Certified Mapping Scientists. These certifications are available to qualified photogrammetry and remote sensing professionals. These certification programs have rigorous requirements for testing, references from other professionals and experience history. Applicants must demonstrate professional level experience, a history of competence and ethical conduct, and an overall level of professional excellence that exceeds minimum levels of competence. APSRS has published a strict code of ethics that applies to mapping professionals. Many states license professionals in photogrammetry and remote sensing, and have codes of ethics and standards of practice. Several map accuracy standards have been developed by federal agencies and professional organizations. The National Standard for Spatial Data Accuracy (NSSDA), developed and published by the Federal Geographic Data Committee, is the most comprehensive and current map accuracy standard that applies to professional photogrammetric mapping. This standard incorporates the Map Accuracy Standards for Large Scale Maps that were developed by ASPRS in 1990. References for these documents are provided in the references section.

Photogrammetric mapping data are frequently used to make critical decisions that require accurate and reliable information about the location of features on the Earth. Professional photogrammetric mapping professionals may provide services and data directly to the public or may work in cooperation with other ex-

perts such as surveyors, engineers, architects, land managers and planners, remote sensing specialists, cartographers, geographers, GIS specialists, and IT professionals. The photogrammetrist in direct responsible charge of acquiring and producing the mapping data is often the only professional involved in the project who has the experience necessary to fully understand how to properly implement photogrammetry and related remote sensing technologies to support the intended uses of the data. Following are specific examples of some of the many areas of use where the accuracy and quality of photogrammetric mapping data directly affects decisions that could potentially impact public welfare:

1. Engineering of roads, bridges and public facilities;
2. Water resources planning and design;
3. Natural hazards assessment, including landslide assessment, dam site/reservoir assessment and flood hazard mapping;
4. Emergency services applications;
5. Municipal planning;
6. Disaster recovery;
7. Transportation planning; and,
8. Route planning for power distribution facilities.

VI. Qualifications-based Selection as the Accepted Method for Procurement of Professional Services

Although many selection methods exist that can be followed by clients and professionals, one that has long been endorsed by the ASPRS and has received widespread support in other professions is qualifications-based selection (QBS). QBS is an objective, fair and competitive process used by owners to select professionals based on professional qualifications and capabilities in relation to the work required; scope of work and cost of services are then negotiated to best meet project requirements. Nothing in this section or in this document is intended or should be read to prohibit any project owner, client or professional from participating in any selection competition of their choosing, within the limits and regulations of existing and applicable laws.

QBS is widely accepted for procurement of architecture, engineering and related professional services. Federal law, as prescribed in 40 U.S.C. 1101, commonly referred to as the Brooks Act, and state laws in more than 40 states, require QBS procurement methods for architecture, engineering and related surveying

and mapping services (commonly referred to as A/E services).

The QBS process, as outlined by the Brooks Act and similar state laws, requires that an agency or private party first select a professional services proposer based solely on an evaluation of that proposer's qualifications and capability to complete the work. Cost and price are not a factor in the initial ranking of proposers. Under the QBS process, costs are negotiated with one proposer at a time, starting with the highest ranked proposer. If a fair and reasonable cost cannot be negotiated with the highest ranked proposer, cost and price are then negotiated with the next most qualified proposer.

QBS is endorsed for procurement of professional services by many other professional organizations including the American Institute of Architects (AIA), American Society of Civil Engineers (ASCE), National Society of Professional Engineers (NSPE), American Public Works Association (APWA), American Council of Engineering Companies (ACEC), Design Professionals Coalition, (DPC), American Water Works Association (AWWA), American Bar Association (ABA), Management Association for Private Photogrammetric Surveyors (MAPPS), American Congress on Surveying and Mapping (ACSM), and Council on Federal Procurement of Architectural and Engineering Services (COFPAES), as well as agencies such as the U.S. Army Corps of Engineers. These organizations all endorse QBS as the best means of promoting competition for professional services. Competition among professionals is healthy and desirable and ensures that project dollars are well spent. QBS provides a level playing field that promotes fair and open competition, guaranteeing that only skilled, experienced, and able professionals are selected before price is negotiated and determined. As a result, clients acquire the services of the most qualified proposer possible while obtaining a price that is fair and reasonable.

It is also significant that the American Bar Association Model Procurement Code for State and Local Government endorses QBS for surveying and mapping services. When the Nation's leading attorneys in government acquisition evaluated all available methods, they recommended QBS for geospatial services. It is also noteworthy that Congress specifically defined QBS as a competitive procedure in the landmark Competition in Contracting Act in 1983 and has retained that law ever since.

Many professional photogrammetric mapping and related remote sensing services are directly

related to architecture and engineering or are otherwise relied upon to determine the authoritative geospatial location of features or topography. These applications of photogrammetric mapping and related remote sensing technologies to determine location and topography similar in nature to the type of information provided by field surveyors would be considered surveying by most definitions. In recent years, many other professional level geospatial applications of photogrammetric and remote sensing mapping technologies have developed that may not be directly related to architecture, engineering or the authoritative location of features typically associated with professional surveying. Examples include thematic mapping for land cover, photogrammetric mapping for GIS centerline coverages, disaster recovery assessment and similar work. Since many laws and regulations have not kept up with these advancements in the marketplace, these *Guidelines* are intended to help clarify procurement processes as they apply to current practice.

While some applications of current photogrammetric mapping technologies may not have a direct tie to architecture or engineering, they share a very similar level of reliance on the professional practitioner to implement sound judgment, professional expertise and professional ethics in order to develop mapping products that can be relied on to make decisions that impact public welfare. While these tasks may not require the same level of accuracy required for architecture, engineering and surveying applications, there is still an expectation of a level of quality and standard of performance that requires a professional level service.

With regard to a regulatory standard, states typically use the test of actual potential for harm to public health, safety and welfare to determine the minimum level of activities that should require a license. However, from a procurement guidelines perspective, the bar should not be placed at the minimum level. Rather, procurement guidelines should set the standard to achieve what is in the best interest of the public, and what is most likely to ensure a successful project.

Procuring photogrammetry services is vastly different from procuring products, basic supplies or even construction services. Often, the photogrammetric mapping professional is the only professional involved in the process that fully understands the specifications, accuracies, methodologies and approach that will support the intended end use of the data. As such, a photogrammetric mapping professional

continued on page 1350

to best perform the work, an acceptable scope of work and fair and reasonable cost are negotiated. If a fair and reasonable cost cannot be agreed on with the top ranked proposer, negotiations are initiated with the next most qualified service provider. The process continues until a fair and reasonable price can be negotiated. The Brooks Act process is not the only selection process that emphasizes qualifications; however, it is the model used for most state and federal QBS procurement laws and is the most widely accepted by professional organizations.

- The Brooks Act qualifications-based selection (QBS) process is required by law, 40 U.S.C. 1101, and implemented in the Federal Acquisition Regulation (FAR) (48 C.F.R. 36.6) for all federal procurement of architecture, engineering and related surveying and mapping services. Other federal laws may require state and local governments to use QBS when expending federal grant funds. Moreover, several states have mini-Brooks Acts.
- Contracting and procurement personnel should contact the state licensing board for surveying and/or engineering in the state(s) in which the work is to be performed to confirm what aspects of existing surveying, mapping and engineering statutes apply to their projects. In many states, specific aspects of photogrammetric mapping and related remote sensing services are considered surveying and require a license to practice. Many states also have a mini-Brooks Act that requires qualifications-based selection for the procurement of all architecture, engineering, surveying and mapping services, as defined by state law.
- State laws vary widely in their definitions of surveying and mapping. Some statutes specifically license photogrammetry and related remote sensor-based geospatial mapping practices. Others regulate certain aspects of this kind of mapping under the broader definitions of surveying or engineering.
- FAR Part 36 includes many (though not all) of the professional geospatial mapping services addressed by these *Guidelines*. Services licensed as “surveying” under state law in the state where the work is being performed require Brooks Act procurement. The U.S. Army Corps of Engineers also publishes a comprehensive definition of services subject to the Brooks Act in the Engineering Federal Acquisition Regulation Supplement (EFARS). Further, in the absence of specific statutory language or precedent for enforcement addressing professional geospatial mapping services in a given jurisdiction, ASPRS considers the National Council of Examiners for Engineering and Surveying (NCEES) Model Law, Model Rules and associated NCEES documents to be the best definitive guideline for determining which geospatial services should be considered “surveying” services. It should be noted that the NCEES Model Law and Model Rules are only guidelines for the purpose of assisting state governments in the implementation and interpretation of state licensing laws. The Model Law and Model Rules do not represent enacted legislation and do not have any specific legal authority, unless so enacted in a given state.
- ASPRS has endorsed Brooks Act and similar QBS processes for procurement of all professional photogrammetry and related geospatial mapping services, including both surveying and non-surveying services, since at least 1986. The Brooks Act QBS process is widely accepted by other professional organizations; encourages innovation and design; encourages competition among the most qualified proposers; fosters a relationship of trust between the client and provider; and is designed to ensure the most appropriate scope of work at a fair and reasonable cost. Further, in many states, licensed professionals are prohibited from submitting a cost or bid for public work. In these states, procurement methods that do not follow QBS procedures may eliminate many of the most qualified proposers from competing.
- It is recognized that professional photogrammetry and related remote sensor-based geospatial mapping services may be procured within the scope of a more extensive project, wherein the specific professional geospatial mapping services would be considered incidental to the project. Regardless of the method of procurement for the larger project, or the size of the geospatial mapping component of the project, ASPRS recommends that these *Guidelines* be implemented for all subcontracted photogrammetry and related remote sensor-based geospatial mapping services.
- ASPRS recognizes that QBS is not required by law in all cases, particularly for services acquired by organizations not subject to federal or state procurement laws, or in cases where the proposed services do not meet state or federal definitions of surveying and mapping as related to architecture and engineering. ASPRS recognizes there will be instances where an organization will choose to use an alternative procurement method other than a QBS process. In those cases, ASPRS recommends that specific minimum guidelines be implemented:

continued on page 1352

who is familiar with all aspects of the project should play an instrumental role in determining the project specifications. Determining what to include in a comprehensive request for proposal (RFP) for geospatial mapping data is a complicated task. As a result, RFPs are often vague and missing key information. When an RFP lacks sufficient detail, each proposer competing for the work will most likely interpret it differently. Consequently, proposals vary widely in scope and detail, creating an “apples and oranges” disparity in project details. When price is one of the key selection criteria, proposers often use the lowest-cost approach, which often means discounting advanced technologies, the best techniques, and the most effective overall project design. QBS improves the procurement process and, in so doing, improves service to private entities, public agencies and end users/taxpayers and ultimately provides the best value and most fair and reasonable cost to the client.

QBS, as outlined by the Brooks Act, is widely used for architecture, engineering and surveying services procurement. Professional organizations and federal, and state lawmakers have long recognized that these kinds of services critically affect the public welfare. The QBS procurement approach best protects the taxpayers’ and clients’ interest and at the same time best safeguards public health and safety. The professional level photogrammetric mapping services outlined in these *Guidelines* share many characteristics with, are of similar nature to, and are of similar importance to the public’s health, welfare and safety as the engineering, architecture, surveying, planning, natural resources, emergency/disaster recovery services and other services that they support.

For these reasons, ASPRS endorses QBS procurement methods and recommends the Brooks Act or similar QBS procurement process be used for procurement of professional photogrammetry and related geospatial mapping services.

VII. Federal and State Regulations Affecting Procurement and Licensure

ASPRS recognizes that the practice and procurement of many aspects of professional photogrammetric services are regulated by federal, state and local laws. These *Guidelines* are not intended to be an interpretation of local, state or federal law, nor are they intended to im-

ply that all professional level services defined herein require a licensed professional. These *Guidelines* outline those services which, in the opinion of ASPRS, are professional in nature and therefore warrant consideration for procurement methods that use qualifications, and not cost, as the initial and primary selection criteria.

Many states regulate and, by statute, require a license for some aspects of professional photogrammetric services. Services outlined in this document may or may not be covered by licensure statute for a given state.

State licensing laws must be considered in the procurement of professional geospatial mapping services. For instance, many states require a license to practice specific aspects of photogrammetric mapping and other geospatial mapping services. Definitions and regulations vary widely from state to state. State statutes may refer specifically to photogrammetric mapping or may regulate mapping under broader definitions of surveying or engineering. Contracting personnel who are more accustomed to the procurement of other types of goods and services, even including more conventional engineering or surveying work, are not always knowledgeable about state laws that apply to geospatial mapping services. Contracting and procurement personnel should contact the state licensing board for surveying and engineering in the state(s) in which the work is to be performed to confirm what aspects of existing survey and engineering statutes apply to their projects. Procurement practices need to comply with state licensing laws.

State legislatures periodically review and modify their licensing laws, and state licensing boards periodically modify regulations in order to address developing technologies and evolving professional practices. To support this process, the National Council of Examiners for Engineering and Surveying (NCEES) has developed a Model Law and associated Model Rules that serve as a guide when modification of applicable statutes is deemed appropriate. The NCEES Model Law and Model Rules consider the application and intent of the work, and not the tools used, as the determining factor in distinguishing between mapping services that should be licensed and other mapping services that do not require a license. The NCEES model identifies “surveying” services as any work, regardless of the tool used, that determines or establishes an authoritative location or measurement of features on or relative to the Earth, as represented by the resulting “survey,”

map or comparable GIS data layer deliverable. This includes many remote sensing and photogrammetric services, such as controlled aerial photography, stereo feature extraction, orthophotography, lidar surveys and similar tasks.

NCEES documents are considered by ASPRS to be the best definitive guideline for determining which geospatial services should require a professional license. In the absence of specific statutory licensing language or precedent for enforcement in a given jurisdiction, procurement personnel are encouraged to use the NCEES Model Law and Model Rules as guidelines to evaluate which services may potentially be regulated under state law. However, the NCEES Model Law and Model Rules are only guidelines for the purpose of assisting state governments in the implementation and interpretation of state licensing laws. The Model Law and Model Rules do not represent enacted legislation and do not have any specific legal authority, unless so enacted in a given state.

The NCEES Model Law was developed to address licensing, not procurement. The term “professional services” is broader than, and not synonymous with, “licensed” or “regulated” services. The procurement recommendations outlined in these *Guidelines* are not limited to those “licensed” services identified by state licensing laws or NCEES Model Law recommendations. These *Guidelines* recognize that there are many geospatial mapping applications that require professional knowledge and skill that are not directly tied to engineering, architecture or surveying, and that may not be regulated by licensing laws. Qualifications-based selection is recommended for all professional geospatial mapping services and not just those services that require a professional license. It should also be specifically recognized that licensed individuals are not necessarily more qualified to perform a specific “professional service” than unlicensed individuals; qualifications evaluation criteria should be applied fairly and appropriately to all qualified service providers.

Federal procurement laws are implemented in the Federal Acquisition Regulation (FAR). Surveying and mapping services are included in the federal definition of architecture and engineering services that are subject to FAR 36.6 and which require Brooks Act QBS procurement. It is the opinion of ASPRS, that FAR 36.6 would, at minimum, apply to all federal procurement of photogrammetry and related remote sensor-based services that are defined

as surveying by individual states and, in the absence of such definition, by the NCEES Model Law and Model Rules. In some circumstances, FAR 36.6 may apply to a broader range of services, depending on the definition of surveying and specific licensing requirements applicable in the state or states in which the work is to be performed.

Many states and local jurisdictions have enacted laws and rules, based on the federal Brooks Act, which require the use of QBS for procurement of A/E services for local jurisdictions and state agencies. Other federal laws may also require state and local agencies to use QBS when expending federal grant funds for A/E, including surveying and mapping, services. A reference summarizing some of these federal grant fund requirements is provided in the references section. Furthermore, many state registration boards require their licensees (architects, engineers and surveyors) to adhere to the rules of QBS when responding to procurement announcements issued by agencies covered by the public law or state/local equivalents. In states where such laws and rules apply, licensees who do not obey those rules when responding to procurement announcements can be individually disciplined by their licensing board.

The recommended decision process for determining the procurement approach that is the most appropriate for a specific procurement scenario is outlined in Figure 1, Professional Geospatial Services Procurement Decision Model.

VIII. Guidelines for Other Procurement Methods

ASPRS recognizes that the QBS process is not required by law in all cases, particularly for services acquired by organizations not subject to federal or state procurement laws, or in cases where the requested services may not be intended to determine authoritative locations, and therefore may not meet the NCEES or State Law definitions of surveying services that are often subject to A/E and QBS procurement laws.

ASPRS has long recommended that the Brooks Act or similar qualifications-based selection methods be used for procurement of professional photogrammetry and related remote sensor-based geospatial mapping services. However, ASPRS recognizes there will be instances when an organization will choose to use a procurement method where initial price submittals influence which proposer is selected for negotiations.

continued on page 1352

1. Qualifications should be the primary selection factor and should not be influenced by cost.
 2. The scope of work must be well defined and have been developed by a professional who is qualified to ensure that the scope of work will best serve the public interests.
 3. Projects that have a significant element of design, and where the service provider's professional judgment and experience are required to develop the scope of work, should not include cost as a selection criteria.
 4. If cost data are to be required for the selection process, they should be submitted separately and considered only after proposers are ranked based on qualifications.
 5. A qualified professional (either on the client's staff or hired as a consultant) needs to be involved to ensure the work best meets the end user and public interests.
- These *Guidelines* for are intended to apply equally to future technologies and are not intended to be limited to existing technologies or "tool-based" definitions.

Myths and Misinformation Concerning Qualifications-Based Procurement

1. The QBS process lacks competition based on price

This assertion is clearly **false**—the final determination by the procuring organization in a QBS selection is based on price.

The QBS process involves a review of the submitting professional's or firm's technical qualifications and experience as only the initial step in the procurement. The second step involves ranking the top three to five firms based on their experience, knowledge, professional qualifications, geographic location, past performance, and other appropriate factors. Third, the top ranked firm is then invited to submit a fee proposal. This price submittal is the final determining factor in the solicitation.

The procuring organization works from a budget and most often an internal estimate of the expected costs to evaluate the price proposal. If the top ranked firm cannot propose the project for a price that is fair and reasonable as determined by the internal estimate—in the sole judgment of the procuring organization—then the project is not awarded to that firm and the process is repeated with the next most highly ranked firm, and so on until a successful contract is reached. There is tremendous pressure on the proposer to arrive at an acceptable price arrangement with the procuring organization—this is the direct result of the fact that the procuring organization has the ultimate control in the negotiation as they can always move on to the next most highly ranked firm.

In the QBS process, there is also significant price competition based on not only average hourly rates by classification, but also other such items as overhead rates, allowable costs, as well as direct expenses and reasonable profit. It is this competition that dictates the proposer use the most viable methods and technologies to accomplish the scope of work.

2. Relying on QBS only (to the exclusion of any cost whatsoever), opens up potential pricing abuse.

QBS is the *reform* to pricing abuse—not the *source* of such abuse.

It is important to remember that QBS is the norm for the acquisition of professional services in the United States; price competition for professional services is the abnormal. The Federal government and more than half of the States have QBS laws that apply to professional architecture, engineering, surveying and mapping services. QBS has been so successful at the Federal level that it is recommended by the American Bar Association in its model procurement code for State and local government (see *Guidelines* for reference). That Code specifically includes surveying and mapping in the scope of services for which QBS is recommended. The Code, including its QBS provision, was developed by the best procurement attorneys in the Nation. In many cases, a State or locality adopts the Model Code *after* they have had a bidding scandal.

In those cases, ASPRS emphasizes the importance of implementing procurement criteria that ensure that qualifications, not cost, is the primary selection factor. ASPRS recommends the following guidelines be applied to any procurement method that does not adhere to the process outlined by the Brooks Act or a similar QBS statute or process:

1. Qualifications should always be the primary selection factor.
2. Qualifications rankings should not be influenced by cost.
3. The scope of work must be well defined and have been developed by a professional who has extensive knowledge of the work to be performed and is qualified to ensure that the scope of work will best serve the client's interests.
4. Projects that have a significant element of design, and where the service provider's professional judgment is relied on to develop the scope of work, methodology or approach, should always use QBS and should not include cost as an initial selection criteria.
5. A registered, certified or otherwise qualified professional with specific knowledge or expertise with the services being procured (either on the client's staff or hired as a consultant) should have a significant role in the review of both the technical proposal and any cost proposals in order to ensure that the work best meets the end user and public interests.
6. If cost data are to be considered in the selection process, they should be submitted separately and considered only after proposers are ranked based on qualifications.

IX. Subcontracted Services

It is recognized that professional geospatial mapping services may be procured within the scope of a more extensive project, wherein the specific professional geospatial mapping services would be considered "incidental" to the project. In cases where the total dollar value of the geospatial mapping component of the project is small, it is understood that other procurement processes may reasonably apply. However, regardless of the method of procurement for the larger project, or the size of the geospatial mapping component of the project, ASPRS recommends that these *Guidelines* be applied to all professional geospatial mapping subcontracts.

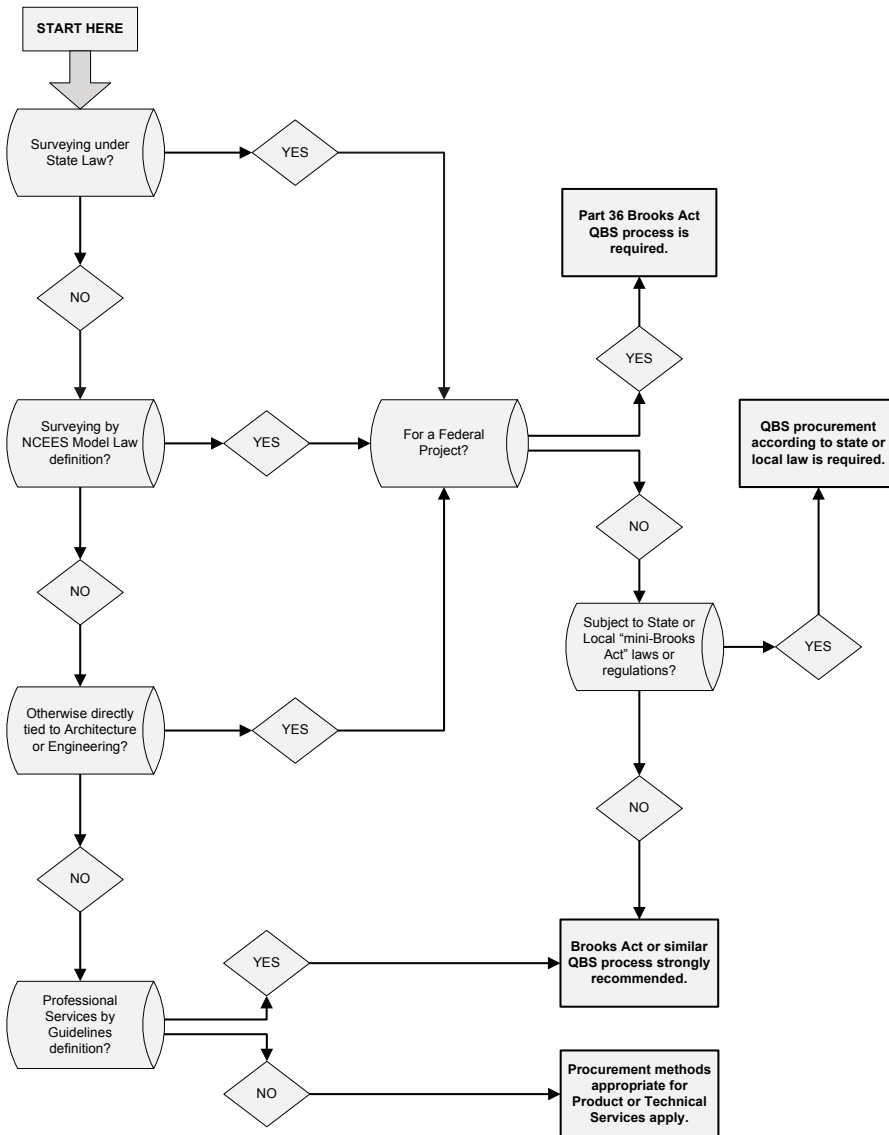


Figure 1. Professional Geospatial Services Procurement Decision Model

X. Specific Examples of Professional Photogrammetric Services

This section provides examples of specific task items that meet the definition of “professional” photogrammetric services. Some implementations of the tasks listed may be considered surveying by state law, depending on the nature of the work and end use of the data; other implementations may not meet state law or NCEES definitions of surveying, but still require the level of professional expertise and ethical conduct that define professional service. In the opinion of ASPRS, projects and contracts that include any of the following services should always use procurement methods that rely on qualifications as the primary selection criteria; the most widely accepted example of which is the Brooks Act QBS process. The list be-

low provides examples of services for which ASPRS *recommends* qualifications-based procurement.

1. **Ground Control.** Remote sensing imagery is often combined with the geospatial coordinates of identifiable points, known as ground control, to accurately georeference the imagery using photogrammetric techniques. Defining the location, distribution, accuracy requirements and number of ground control points is critical to achieving the required geospatial accuracy for subsequent mapping tasks.
2. **Flight Layout for Orthophotography and Photogrammetric Mapping.** Aerial imagery that is intended to be the source

for orthophoto or photogrammetric mapping with an expectation of geospatial accuracy is considered a professional service. Flight coverage, equipment/calibration requirements, flight altitude, flight window, overlap and other acquisition specifications directly affect the quality and accuracy of all subsequent mapping tasks.

3. **Directly Georeferenced Aerial Image Acquisition (airborne-GPS, Inertial Measurement Unit/IMU or similar technologies).** These technologies involve the direct determination, during image acquisition, of some or all of the image georeferencing parameters. Imagery acquisition for which specific coordinate and orientation parameters are required as a deliverable implies an expectation of accuracy and requires professional services to ensure reliable results that will support intended applications.
4. **Aerial Triangulation.** This process combines the ground control with the sensor metric parameters, and then applies precise photogrammetric measurements to accurately georeference the imagery. The accuracy and reliability of the aerial triangulation process affects all subsequent mapping tasks.
5. **Determination of Topographic, Elevation Model, or Planimetric Feature Mapping.** Point and feature extraction from remotely-sensed data for the purposes of mapping topographic features, planimetric features or development of elevation and terrain models have an expectation of accuracy and affect subsequent decisions and activities that affect the public welfare. Feature extraction requires precise photogrammetric orientations and measurements, specific knowledge and skill using the photogrammetric mapping technologies and a broad understanding of the intended applications. Professional expertise is critical to adequately represent planimetric, topographic and elevation model features within expected accuracies.
6. **Digital Orthophoto Mapping.** A digital orthophoto by definition is an image that has been differentially rectified to within a specific 2-dimensional (2D) geospatial accuracy and resolution. Rectifying and georeferencing remote sensing imagery to systematically correct for image orientation parameters, distortion, and earth surface topography requires rigorous

continued on page 1354

The QBS process relies on price as the **final** determining factor—it merely puts the qualifications portion of the selection process first. No matter how highly ranked a professional or firm’s qualifications are, they will not be awarded a contract without an agreed price which best meets the specific needs of the procuring organization. True, the QBS process is not designed to achieve the cheapest possible price. Low bid processes are notorious for pricing abuse, including change orders and pricing changes at a later time when it is discovered that actual project requirements exceed what was proposed for the original cost. The purpose of QBS is to avoid these problems by acquiring services that will best serve the intended purpose of the project at a price that is “fair and reasonable.”

Typically, the procuring organization has very specific guidelines for preparing a price proposal. This includes backup information such as average expected hourly rates, audited overhead rates, anticipated direct expenses, travel, etc. as detailed for each category of service. Once the procuring organization and the proposer deemed most qualified agree on a scope of services, the negotiation occurs based solely on pricing. As a result, any attempted price abuse would be very transparent, given the level of detail and information held by both sides in the negotiation.

Finally, and perhaps most importantly, at the conclusion of a QBS project, typically a written evaluation of the firm’s performance is produced by the procuring organization—in essence a Report Card. These report cards are recorded and are required to be shared with any organization procuring professional services from the firm in the future. As a result, as part of the first step in evaluating a firm’s qualifications, the procuring organization has the ability to determine how the firm has performed on prior similar projects, thereby creating a living history of the firm’s ability to perform both technically and on budget.

3. In a price competition, ethical firms should be able to provide the same product and service at the same price they would have offered through the QBS process. If that were not true, then you are admitting that QBS will inflate prices and supply products and services that go beyond what is required.

Without evaluating qualifications independent of cost, how do you determine which firms are ethical or not? And what precludes unethical firms from under-bidding a project, cutting corners or proposing a substandard approach, unless qualifications are the primary selection factor?

For a price competition, the procuring organization awards the contract based primarily on a proposer’s statement that they can do the work and will meet the accuracies at the proposed price. The firm’s proposal may demonstrate a minimum level of qualifications, but in fact they may or may not have adequate staff and may or may not truly have the capability to meet the client’s quality expectations for the price proposed. They may be expecting to outsource the work without direct control over the results or may be overly optimistic about the capability of outdated or other low cost technology to yield the results the client is seeking. These types of problems are common and are difficult to avoid with solicitations that weigh cost on a similar basis as key qualifications criteria.

The QBS process fosters a partnering relationship between a professional/firm and the procuring organization, with the mutual goal of ensuring the proper service is provided at a reasonable price. Typically the organization has guidelines in place to ensure that all costs are understood, and that all proposed services are within the scope of the project. As a result, neither prices nor scope are inflated—in fact the procuring organization will likely be the first to say “no, we are outside the scope of the work”, or “no, this is the level of effort that we want for this particular task”.

4. QBS favors established firms and is unfair to new firms with new approaches.

There are clearly isolated cases where, in order to lower risk on a very high-risk project, the procuring organization may favor a firm with a strong track record in that particular type of practice to the exclusion of other firms which may be new to the profession. However, high risk projects are not the norm and history shows that new firms, often comprised of key principles that have left larger more experienced firms, are clearly competitive even though the first discriminator is qualifications. Further, there are many

continued on page 1356

knowledge of photogrammetric mapping principles and technologies. Production of orthophotography is considered a professional level service if the resulting orthophotography is to be published for use by the public or other professionals in any application where the reliability of the geospatial accuracy is of critical importance. Such uses may include planning, engineering, natural resources, agriculture, disaster recovery, emergency services, and development of other mapping layers or other similar applications.

7. Lidar Acquisition and Processing.

Lidar is an active remote sensor that emits short wave electromagnetic energy (light), records the reflected return signal, and provides a direct measurement of the location and elevation of features on the Earth. The lidar sensor must be continuously georeferenced during its operation by use of airborne-GPS and IMU. Extensive knowledge of all these systems, their calibration and operational integration, and related mathematics and physics necessary to post process the data are essential for accurate 3-dimensional (3D) measurement and representation of the Earth’s surface. Lidar may be employed from a ground station, aircraft, moving vehicle or other platform.

8. Radar Measurements for Topographic Mapping.

This well established technology is similar to lidar in being an active system that directly measures features on the Earth. Modern remote sensing radar systems emit polarized long wave electromagnetic (radio) energy, with the ability to penetrate cloud cover, and record the return signal to create an image of the landscape below. Radar systems have been extensively developed so that they are now measurement systems as well. Utilizing complex technologies such as synthetic apertures and interference pattern measurements, radar topographic data have been collected from aircraft, satellites, and the Space Shuttle. This technology requires specialized knowledge in its use and application for geospatial mapping.

9. Image Interpretations and Thematic Mapping.

Image interpretation and thematic mapping services involve elements of thematic accuracy rather than geospatial accuracy. These applications of remote sensing technology would not be

considered surveying by the Model Law definition and, in the absence of a specific state law that may include these services, would not be subject to the federal laws that govern architecture and engineering procurement. However, these services do share the elements of knowledge, skill, expertise, professional judgment and potential impact to the public welfare that define a professional level service. While not services subject to Model Law licensure, these services would be considered professional level services as defined in this document.

XI. Future Technologies

Geospatial mapping, remote sensing and photogrammetry are very dynamic fields. As new technologies become available in the future, photogrammetric mapping professionals will continue to develop new ways of implementing photogrammetry and remote sensing principles and processes to produce geospatial mapping data.

Within the past two decades, new sensors, new software and vastly improved computer processing capabilities have dramatically transformed the level of automation in photogrammetric mapping. Many tasks that had required a highly skilled technician with many years of training can now be either partially or fully automated to the extent that a much less skilled individual can perform that same task. This trend will undoubtedly continue.

The professional nature of a service should be evaluated based on the nature and intended use of the deliverables, regardless of the technologies or tools used. The level of automation or standardization does not by itself distinguish professional services from technical services or products. Professional services often implement automated or standardized processes. Professional services are distinguished from technical services in that the nature of the deliverables for professional level work requires the overall supervision of a qualified professional. Although aspects of the work may be automated, professional knowledge, skill and expertise is required for project design, supervision of automated processes and final quality assurance.

As new technologies develop and become common-place in the mapping community, it is the intent of these *Guidelines* that the same general criteria applied herein to assist in evaluating the professional nature of current technologies be applied equally to new technologies as

they develop and become common-place in the mapping community.

XII. Technical Services and Products

ASPRS recognizes that there are applications for geospatial mapping technologies and imagery that do not fall within the scope of professional level services as outlined herein. Alternate, and in some cases, less stringent procurement requirements may be appropriate in those instances. Specifically, this applies to technical level services and product sales. Each is discussed below. Detailed criteria for distinguishing between professional services, technical services and product sales are outlined in Table 1, Comparison of Professional Services, Products and Technical Services.

Technical Services

Not all geospatial services require independent professional judgment or have the same element of impact to the public that warrants professional level work. This includes services wherein the data are not to be presented to the public in any way that would imply an expectation of authoritative positional or thematic accuracy and where misrepresentation of positional or thematic accuracy will not result in potential harm to the public or to the business purpose of the client. Resource or habitat related aerial photography acquisition that is not geo-referenced, image processing for display only purposes and processing or formatting of existing data for referential purposes fall into this category. Nevertheless, knowledge of geospatial services, accuracy specifications, and the impact on the public, is required to make a determination as to whether or not the services requested require professional expertise. Therefore, ASPRS recommends that a qualified professional, with expertise in geospatial mapping, be actively involved in such evaluations.

Services that meet all of the following criteria would be considered technical services:

1. The client/purchaser is a qualified professional, is taking responsibility for all project design, layout, specifications and quality control assurance and assumes all liability that the final products and deliverables will meet project requirements.
2. The data are not going to be presented to the public in a manner that would state or otherwise imply an expectation of accuracy for the measurement or location of features on the Earth.

3. There is minimal risk of harm to the public.
4. The client is responsible for final quality control and can easily verify that the data meet contract specifications.

Examples of technical photogrammetry and remote sensing services include:

1. Reference mapping that does not have published coordinates or a coordinate grid;
2. Aerial photography or mosaics for reference or resource use (not georeferenced); and,
3. Digitizing, scanning or formatting of existing photogrammetry or remote sensing data, where the data are to be published only for referential, and not authoritative, purposes.

Product Sales

Professional and technical services contracts are not the only means of acquiring geospatial data. Increasingly, geospatial data products are being produced and sold on a product sales and nonexclusive license basis. Typically, these are highly standardized data products produced to a range of specifications as set by the provider. Examples of geospatial data commonly sold via a nonexclusive license basis include orthophotography, satellite imagery, image control points, Digital Elevation Model (DEM) data, road network data, oblique imagery, radar generated terrain elevation data and other mapping products.

There is significant overlap in geospatial data that can be purchased as a product and geospatial data that are provided through services contracts. It is not the technology required, the level of standardization applied, or the sophistication of the deliverable specifications that distinguishes between products and services.

Table 1, Comparison of Professional Services, Products and Technical Services, provides a detailed comparison of those characteristics that distinguish products and services.

In general, products are produced to a limited range of specifications that are determined by the provider. Also, products are usually offered under a license agreement that typically includes limitations on what the data can be used for or how it can be distributed. In contrast, services are provided by individuals within a proposer or project team to meet specifications that are set by the client. While the service provider often provides significant input through the negotiation and development of a technical

continued on page 1356

procurement programs that are specifically designed to “incubate” small firms—after all, it is often to the procuring agencies’ benefit to ensure a growing field of expertise in critical professional services. This is especially important for small business concerns.

5. QBS is a closed door process that stifles competition and innovation; QBS precludes a fair comparison between different approaches and firms, which is essential to fostering innovation and making an informed client decision.

These statements are not only **false**; they ignore the fact that price-based competition is itself a closed-door process that stifles competition and innovation. First, agencies that typically use QBS have more firms competing for their contracts, with a greater range of technical ability, than do agencies that use other procurement methods. Second, when an entity uses price to select a firm, it is often closing the process and limiting competition to firms that operate on a low bid basis. Third, price competition itself precludes “a fair comparison between different approaches and firms;” rather price competition focuses on price, not the approach, innovation, experience and/or past performance of the professional/firm.

Most procuring organizations that use QBS will tell you one of the primary benefits of QBS is the innovation it brings. Since a firm is selected based on their technical expertise and professional qualifications, they are afforded an opportunity to make suggestions and provide technical input during the negotiation process, step one of which is agreeing to a technical scope of services. This process facilitates transparent discussion, often face-to-face, weighing the pros and cons of new approaches and is much more inviting of innovation and new technologies than a cost-based process in which proposers are all required to price the exact same rigid scope of work and detailed specifications. For cost-based solicitations, questions are often restricted to a very formal paper-based process and it is often impossible to have a candid discussion with the procuring organization about options for alternatives to the RFP scope.

Examples of QBS facilitating innovation abound, including: multi-year mapping contracts when firms first adopted GPS technology, or airborne GPS technology, or inertial motion units for aerotriangulation; implementation of digital cameras in the second year of five-year imagery contracts; the use of lidar, both airborne and ground based, for topographic surveys; the use of lidar (lidargrammetry) for establishing breaklines for terrain modeling. All of these processes have been successfully introduced midway through various multi-year QBS contracts, and all have either reduced cost to the agency and/or improved the quality of deliverables. No other procurement process provides for similar flexibility and opportunity for innovation.

6. Most local jurisdictions and regional Government agencies do not have the luxury of devoting staff resources and time needed to develop a comprehensive base of potential remote sensing providers. Cost information contained in proposals provides a starting point for groups with limited experience and in-house resources.

When an organization has limited in-house resources and experience, it is almost always the best time to take advantage of the experience and expertise available through partnering, which is fundamental to the qualifications-based processes and is almost completely absent from price-based processes.

If an organization does not have adequate staff resources to develop and evaluate qualifications from a list of potential firms for competition, how does it follow that that organization has the experience or resources needed to adequately establish or adopt a strict scope of work and/or critically evaluate price proposals? Or have sufficient expertise to determine if the price and proposed scope of work they are getting is even suitable to meet their minimum requirements, much less provide the best value to their organization?

Many States provide procurement resources to help local jurisdictions with limited capability. Some of these are identified in the References section of the *Procurement Guidelines*. Professional organizations can also help disseminate requests for

continued on page 1358

scope of work, the client makes the final determination as to approach, methodology and final deliverables. Under services contracts, resulting geospatial data deliverables and information are owned by the client. When procuring services, the client is not solely purchasing deliverables, but is purchasing the entire process, including the ability to take advantage of the expertise, knowledge and capability of the service provider to develop the final approach and specifications.

For certain applications, geospatial data products are well suited to meet the user’s requirement(s). However, knowledge of geospatial services, accuracy specifications, and potential impact on the public is required to make a determination as to whether or not a geospatial data product is best suited to meet the user’s requirement(s). Therefore, similarly to the evaluation of professional / technical services, ASPRS recommends that a qualified professional be actively involved in this decision process.

Once it has been determined that a product is the best way to meet the user’s requirements, there are many factors to consider in procurement. Geospatial data products can vary widely in terms of specifications, licensing terms, cost, and delivery schedule, among other factors. Detailed guidance on the procurement of geospatial data products is beyond the scope of this document. Procurement personnel are encouraged to research information provided by product providers, industry groups and professional organizations, such as the ASPRS and other groups, to identify key issues that should be considered in purchasing geospatial data products.

XIII. Implementation Steps for Professional Services Procurement

There are several distinct steps in implementing the procurement of professional services. Many states and professional organizations have resources available that outline the Request for Proposal and professional services procurement process in detail for engineering, architecture and surveying. Most of these handbooks and processes can be applied equally to the procurement of photogrammetry and related remote sensing work.

One suggested resource is the American Public Works Association Red Book, “Selection and Use of Engineers, Architects and Professional

Table 1. Comparison of Professional Services, Products and Technical Services

Offering Type/ Differentiators	Professional Service	Product	Technical Service
Level of Standardization	Varies Service varies from client to client and from project to project. Service standards are established in some vertical markets. Service provider exercises independent professional judgment and quality control.	High Standardization Provider offers a set of standard features from which the client may choose.	High Standardization Provider offers a standardized service. Specific methodology prescribed solely by client. Service provider exercises only a minimal level of independent judgment.
Specifications	Set by Client with critical input from service provider	Set by Provider	Set by Client; may or may not have input from service provider
Ownership	In most cases, the client owns all resulting work and deliverables.	In most cases, the provider owns the source information and deliverables are offered under license to the client.	In most cases, task is to support subsequent work by the client and client owns all resulting work and data.
Certification / Warranty	Typically certified by a professional in responsible charge of the work, such as a land surveyor, photogrammetrist, engineer or GIS professional. Professional registration or licensure may or may not be required to oversee the work, depending on applicable state licensure laws.	No professional seal or certification. Warranty may be offered by provider that the product meets specified standards.	No professional seal or certification. Client is solely responsible for quality control and for verifying that deliverables meet specifications and expectations.
Protection of Public Welfare	Professional liability may apply Provider is responsible for quality control and ensuring services and deliverables meet specifications and standards. Provider is expected to comply with ethical and professional standards to protect public interest.	Product liability applies Product developer is responsible for ensuring deliverables meet stated specifications and requirements.	No professional liability Client is responsible for quality control, ensuring services and deliverables meet expectations and ensuring services and deliverables protect the best interest of the public.
Procurement Method	Qualifications based selection	Primarily cost based	Either an evaluation of both cost and qualifications or qualifications based
Pricing	Typically negotiated between provider and client based on level of effort and negotiated rates. May be contracted as fixed price or as cost plus fixed fee.	Published pricing. Total price determined as a function of units times a standard price of the unit.	Estimates may be negotiated based on labor hours times hourly rate or as published pricing per unit.

Citation: Adapted from information developed by the National Research Council licensing study and a derivative Products vs. Services matrix developed by the MAPPS Board of Directors.

Consultants, Guidelines for Public Agencies.” Another is the American Bar Association Model Procurement Code. In addition, many states have formed QBS coalitions that can be valuable resources. These organizations have state specific resources available and also have staff available to assist organizations or answer specific organizations questions. The Michigan QBS Coalition publishes a handbook entitled “Detailed Workbook for Qualifications-based Selection.” Other state coalitions provide similar resources. The References section of this document provides references and links to selected procurement resources. To the extent laws and regulations permit, details of the pro-

cess should be tailored to the nature and magnitude of the services desired. However, these resources provide very good general guidance on specific steps, evaluation criteria and processes that should be considered.

Owners and procurement personnel are referred to the resources described above for detailed information about the professional services procurement process. Following is a general summary of some key steps that should be implemented for the procurement of photogrammetry and related remote sensor-based professional services.

1. Pre-proposal research

Organizations should carefully evaluate their project requirements and conduct research so that they can clearly define what services and deliverables are needed to support their intended applications. Some resources and actions to consider are:

- Conferences and professional organizations -- Encouraging key personnel and technical staff to participate in professional organizations and to attend conferences and seminars can be a good way to network with professionals and to gain

continued on page 1358

qualifications and many Federal agencies will share their lists of providers. These sources give the procuring organization access to all the best firms in the profession. They can advertise and any firm can provide an adequate response, presuming that the procuring organization can adequately define their scope of services.

Using cost as the starting point more often than not results in the ending point being the starting point—no further consideration is given. Why? Because typically most firms can demonstrate a minimum level of competence on paper and there is a misperception that the organization is saving money by taking the lowest cost. However, that presumes that each cost proposal was for the same service, done with an equal level of expertise, and with equal quality deliverables. In fact, that may or may not be the case and most likely, especially in the case of organizations with limited resources, the organization never knows for sure. A typical scope of work rarely includes enough details to ensure a completely equal comparison of price submittals. This is particularly true in the case of organizations that borrow or modify RFP's from similar projects. Typically, unless a professional photogrammetrist (either in-house or outside consultant) is involved in the process, the only knowledge point is price.

7. Work product specifications are well defined for many mapping products and services.

While this statement as related to “geo-based” products may be true, with respect to services, it clearly is a myth; mapping services by their geo-based nature involve widely varying locations, conditions and external factors. Mapping is thus a professional service resulting in a deliverable rather than a product. A product is something produced to the manufacturer's own specifications, typically warranted or guaranteed to meet the advertised specifications, but not produced to the client's unique requirements. QBS would not be appropriate to procure any geo-based product.

As a simple example, the specification for aerial photography of a 1-foot pixel may in fact require different acquisition strategies and variable unit costs. For example, in the Rocky Mountains these factors vary compared to the flatlands of Kansas, or in the crowded air space of a large metro area compared to a wilderness or desert area. Cost is impacted by factors other than “well defined” specifications. There are numerous, more complex, examples of unique project-based factors that must be accounted for, and this statement holds true for digital orthophotography, lidar, planimetric mapping and the wide range of photogrammetric mapping services.

QBS should not generally be used for products. Rather it is a process designed specifically for the acquisition of professional services, where there is more than one way to achieve the project objectives. Professional services acquired through QBS processes can include certain products; for example, the procuring organization could hire a firm to perform land-use/land-cover habitat or species type mapping of a particular area and the remote sensing firm could have, as one of their direct expense items in the proposal, the acquisition of certain satellite information to be used as an intermediate or source deliverable. In other words, a firm can utilize a product as a source document for providing some additional professional services under QBS, and deliver that source document as one of several deliverables; however it is generally inappropriate to employ a QBS process to purchase existing (off-the-shelf) data for terrain modeling or standardized satellite data.

8. “Best value” qualifications weighted and technical-plus-price procurements allow all parties to know what they are getting up front, without turning it into a low-bid procurement.

There is no question that qualifications weighted and technical-plus-price procurements are always better than a low-bid procurement. Most procuring organizations recognize there is value in seeing more than a price proposal. However, going one step further a QBS process provides even greater opportunity for innovation and therefore presents even better value than either of these other types of procurement. The bottom line: QBS is qualifications / technical approach THEN price, a sequential process; that is the best approach as it permits communication, exchange of views, a partnership between professional and client, and a negotiation of price-quality tradeoffs to come up with the best approach to meet the client's budget.

continued on page 1360

specific knowledge on how remote sensing technologies can be used to support the types of work done by the organization.

- Other groups and professionals within the organization -- Often, particularly for procurement of GIS data, photogrammetric mapping and related remote sensing data are intended to support many uses throughout an organization. Engineering, surveying and other professionals within the organization may have specific knowledge or requirements that could benefit the project. The primary purpose of GIS procurement of photogrammetry and remote sensing data may not always be intended for engineering or other uses and it may not always be practical to accommodate the higher accuracies required to support this work; however, the costs and benefits of options that could benefit all users should be considered.
- “Brown bag” or informal presentations by professionals, colleagues or professional organizations -- Many consultants and/or other professionals experienced in photogrammetry and remote sensing work are often available to provide informal presentations to organizations or groups of organizations. Local chapters of professional organizations can be a resource to help organize this kind of activity.
- Review of other RFPs and other organizations' work -- A lot of good general information can be attained through evaluation of similar work by other organizations. However, it is critical to note that, except in the most standardized situations, rarely does the scope of work or project design for one project directly apply to another. Organizations must carefully perform their own evaluation of their specific project, circumstances and intended applications for the data in identifying their project requirements and approach.

2. Identify project requirements and develop a general scope of work

- Organizations need to identify the scope of project requirements need-

Table 2. Examples of Professional Photogrammetric Services

Service Type	Professional Service		Technical Service
	Surveying, as Defined by NCEES Model Law and Model Rules	May not be Surveying, Depending on State Law	
Aerial imagery (Not Rectified)	IMU or airborne GPS data that are represented to meet a specific accuracy. Conventional aerial photography for photogrammetric mapping where service provider is responsible for project design. Controlled aerial photography, service provider provides ground control or aerotriangulation.	Controlled aerial photography (conventional, IMU or airborne GPS) when used solely to produce purely referential imagery that is not represented to comply with a specific accuracy standard.	Resource photography or mosaics with no published coordinates or geo-reference data. Conventional aerial photography where all flight layout and project design is the sole responsibility of the client or professional in charge.
Orthophotography and Rectified Imagery	Orthophotography or rectified imagery that is published or represented to meet a specific accuracy. Includes the majority of all common applications of orthophotography. Specifically would include any orthophotography or other rectified imagery when used for engineering, planning, emergency response and disaster planning, natural resources and related work where the geospatial accuracy influences decisions that affect public welfare.	Imagery that is rectified solely for referential purposes and is not represented as a survey product or expected to comply with a specific accuracy standard. As the terms "orthophotography" and "rectified" imagery imply true map scale accuracy, a clear disclaimer that the final deliverables cannot be used for the measurement or location of features is required to distinguish this work from a Model Law surveying service.	Approximate scale enlargement or rubber-sheeted imagery for display only purposes and where there is no expectation of accuracy or professional judgment.
Feature Extraction	Vector and feature data that are published or represented to meet a specific accuracy. Includes the majority of all planimetric, topographic and digital terrain model feature extraction from imagery, lidar or other remotely sensed data. Specifically includes applications for engineering, planning, natural resources and related work where geospatial accuracy influences decisions that affect public welfare.	Vector and feature data extracted solely for referential purposes, not represented as surveying information or data and not expected to comply with a specific accuracy standard. Includes referential GIS layers such as inventory maps, resource management boundaries, GIS centerline data and similar applications; must be accompanied by an appropriate disclaimer stating that the mapping should not be used for measuring or locating features.	Feature extraction solely for referential purposes and where the client or a professional representing the client is responsible for all project design, quality control and final map publication.
Lidar, Radar and Photogrammetry for Terrain Modeling	Data are represented to meet a specific accuracy. Includes the vast majority of applications for terrain modeling, including photogrammetry, airborne lidar, ground based lidar, and radar.	Terrestrial scanning or other terrain model development solely for display or referential purposes.	Terrain model processing solely for referential purposes and where the client or a professional representing the client is responsible for providing the initial terrain data and for all project design, quality control and final map publication.
Digitizing, Scanning, Processing Existing Photogrammetry or Remote Sensing Maps and Data	Published for use by the public and represented as survey or mapping data depicting the authoritative location of features or boundaries.	Scanning, digitizing or formatting existing mapping data, not intended to be survey data, but where the service provider is expected to exercise professional judgment and interpretation to ensure final products are suitable for intended purpose.	Scanning, digitizing or formatting of existing mapping data to client specifications where minimal professional judgment or interpretation is required.
Image Interpretation and Thematic Mapping	Only if boundaries or feature locations are published or represented as meeting a specific geospatial accuracy statement to depict the authoritative locations of features or boundaries.	Thematic mapping or image interpretation where final deliverables have an element of thematic accuracy that requires professional judgment and expertise. This includes a majority of thematic mapping projects.	Routine classification of features where minimal professional judgment or interpretation is required.

continued on page 1360

Qualifications weighted and technical-plus-price most often results in price being considered in parallel rather than sequentially, with none of the value-added benefits of the communication and partnering. Rather than just a low price assigned to a potentially vague and broad scope of technical services, a QBS proposal allows for an extremely detailed price proposal addressing a carefully negotiated scope of work.

9. Price competition results in the most cost-effective overall approach. QBS results in inflated costs and/or services that exceed the actual project requirements.

These statements represent a canard that opponents of QBS often use, but for which there is no documented proof to justify the claim. In fact, several studies on this issue (as documented by ACEC and other QBS resource materials) show that price competition costs more than QBS due to the time and effort the client has to put into writing specifications, evaluating bids, managing the contract, and incurring in-house quality control/rework costs all to make up for the lack of trust in a professional that could have been achieved by using QBS. There is an old expression that “quality will be remembered long after price has been forgotten”. The long-term, life cycle cost of the project is what must be factored. As John Ruskin said almost 200 years ago, “There is hardly anything in the world that someone cannot make a little worse and sell a little cheaper, and the people who consider price alone are that person’s lawful prey. It is unwise to pay too much, but it is also unwise to pay too little.”

The statement “QBS results in inflated costs and/or services that exceed the actual project requirements” is a myth. Cost effective past performance and documented references to that effect, are a key factor in any QBS selection. In addition, “scope creep” is a common factor evaluated during the performance review at the conclusion of the project. Why would a company with a track record for excellence propose services that exceed the actual project requirements, thereby risking being marked as a poor performer, unless it made the project more cost efficient? And with performance evaluations and past references being available to future potential clients, any company that did attempt this kind of cost inflation would not rank well in future qualifications-based selection processes. In fact, inflated services through a low price submittal for a cost-based selection and utilization of future change orders when it is discovered that the initial scope of work was not sufficient is a much more likely scenario than for this kind of scope creep to occur through the QBS process.

10. Relying on independent judgment and independent oversight by the contractor is fundamentally flawed when the industry players themselves dispute how the terms and concepts in the industry language are to be interpreted.

If you consider photogrammetry and remote sensing to be an “industry” that produces products from vendors, the statement is true. However, these *Guidelines* address the provision of professional services by professional practitioners. This is the perfect case for holding an individual professional accountable. You can have lawyers disagree on language; you can have doctors disagree on diagnoses; however, they are all accountable for their own actions and interpretations in their own practice—so too the professional photogrammetrist.

11. Since so many of the quality/process aspects are not standardized, relying on a contractor to police itself is a recipe for uneven bidding and uneven performance.

This statement, rather than being a myth, actually makes the perfect case for QBS. What other procurement method absolutely insures a highly ethical professional is in charge and everyone is on the same page? This is true whether we are talking technically, innovatively, cost- and schedule-wise, agreeing on deliverables, etc.

Another point to consider--inspection or quality control of a mapping project to monitor contract compliance is much more difficult than inspection of manufactured products. The project’s geographic scope is often immense and the only effective way the procuring organization can check for accuracy is to retrace the entire map. Even a trained eye cannot find a map’s critical flaws that could threaten the public’s safety or its pocketbook in future

continued on page 1362

ed to support intended applications and end uses. It is critical to consult with all potential end users the project is intended to support in order to ensure specifications and accuracies meet all intended purposes. Key factors to identify include: Project area, environmental conditions (vegetation, time of year, time of day, tides, river levels, etc.) for acquisition, accuracies required, primary deliverables, what information or other resources will be provided by the owner, schedule benchmarks and additional or unique requirements such as funding strategies or budgeting.

- QBS procurements -- For QBS procurement, the initial scope of work for the Request for Proposal can be general in nature. The scope of work needs to be of sufficient detail that responders can identify the equipment that will be used, key personnel and staff requirements, overall approach and similar qualifications information. A specific project design and scope of work will be negotiated after the initial selection is made. This is an efficient and cost effective process, as organizations do not need to hire additional consultants or incur extensive in-house or other costs to develop a detailed project design and scope of work.
- Non-QBS procurements -- If cost estimates are solicited, the scope of work needs to be much more narrowly defined and must include detailed specifications and requirements for the work to be performed. The exact specifications required are project dependent. While other RFPs can be used as a guide, a qualified professional needs to be involved to both identify what design criteria need to be specified and what those design criteria are. If an organization does not have this capability in-house, QBS selection of a consultant to provide these services may be required. In either case, while this process may incur additional in-house or external costs, it is an essential step if cost submittals are to be evaluated fairly.

3. Advertisement of intent to procure services

- If the procurer is a public agency, this is usually done by publishing notices and advertising according to the organization's established procedures.
- If the procurer is a private entity, the process is often less formal. Contacts can be made directly with professional service providers identified through referrals or from other sources.
- Many local jurisdictions and other organizations maintain professional services rosters that can be used to identify interested and qualified proposers to be contacted when requesting proposals for specific services. Typically, these rosters require annual or periodic submissions from interested proposers that include a Statement of Interest or Statement of Qualifications specifying the categories of service the service provider is interested in and enough minimal qualifications information to allow the organization to determine what proposers meet minimum criteria for work in a specific service category.

4. Submittal and Evaluation of Qualifications.

This can be done on a formal written basis, as is the case with most public agencies. In the case of procurement by private clients, this is usually done on a personal basis and can be quite informal. An evaluation should then be made to determine the professional mapping proposer judged to have the best talent for the project. Some factors to consider include:

- Project team experience and expertise -- Owners should evaluate a broad spectrum of related experience and expertise and not limit evaluations to only a few selected references or project examples. Considerations include 1) a listing and the number of years of experience of all proposers included on the project team, 2) organization chart and relationship between prime proposer and proposed subcontractors, 3) project examples related to proposed work.

- Project Management and Key Personnel -- Considerations include 1) background and training, 2) number of years experience with current proposer, 3) participation and involvement in professional organizations, 4) involvement with projects listed as project examples, and 5) individual experience related to proposed work and that demonstrates an understanding of the specific work to be performed.
- Project understanding, methodology and approach.
- Ability and capacity to meet project requirements -- This includes 1) staff resources including the location where key personnel are going to be performing the work, 2) equipment capabilities, and 3) other project concurrent project commitments.
- Quality assurance and quality control procedures.
- Past performance -- Past performance criteria should be broad in scope and include 1) demonstrated ability to meet deadlines and budgets, 2) evaluation of accepted/rejected deliverables and demonstrated ability to meet project quality requirements, and 3) disclosure of any projects where the contract was terminated by either the owner or the provider and reasons why. 4) Project references, including those provided by the proposer or references determined through research of other similar work the service provider has performed.

5. Communication between client and mapping professional to negotiate a detailed scope of work.

This is the single most important step of the procurement process. For QBS procurement, this is a straight-forward process as QBS facilitates and early understanding of project scope and requirements. For non-QBS procurements where a price bid is submitted based on a detailed scope of work defined solely by the client, it is necessary to involve a qualified professional in the detailed design and development of the RFP scope. For either process, it is critical that the client do sufficient research to have a clear understanding of what their project requirements are and to have a general understanding of the available options and "ballpark" costs needed to meet

those requirements. Communications and development of a final scope of work should at least address the following factors:

- A general discussion of the project is important so that the professional photogrammetrist will have a solid understanding of the background of the project.
- A disclosure of the purpose of the project is necessary. This will assist the photogrammetrist in the design of the photogrammetric procedures to be employed.
- Further discussions should involve final negotiations for the scope of the project in order to define the area to be covered, map specifications as to scale and accuracy, control surveys and deliverables, data formats and deliverables, field checks, quality control procedures, etc.
- Schedule expectations must be clearly stated and negotiated.
- The client should mention any cost constraints or budget limitations that may be imposed on a project.
- An understanding should be reached between the client and the professional photogrammetrists as to mutual responsibility on the project, clearly outlining expectations both for what tasks the client is responsible for (and the schedule for timely completion of those tasks) and what tasks the service provider is responsible for.

6. Negotiation of price and contract. This final step should address the following:

- Basis of final price as 1) cost plus fixed fee, 2) time and material, 3) lump sum, 4) Cost plus percent of cost, or 5) other.
- Payment schedule as monthly billing, retainage, lump sum, terms (30 days preferred), etc.
- Insurance requirements.
- Other contracting considerations.

7. Project implementation considerations and approval of deliverables.

For non-QBS procurements, and depending on the size and characteristics of the project, in-house capabilities of the owner and other considerations, it may be beneficial to hire a third party for independent quality control

continued on page 1362

years. Unlike materials, a map cannot be adequately sampled before and thoroughly tested after production. The client or owner is totally dependent upon the integrity of the mapping professional -- for even a bad mapping plan can look good. It often takes months or years before errors and problems are discovered.

The accuracy of a map depends upon the manner and the conditions under which the work is performed and not just on the accuracy of closures or spot checks. A map could pass final tests and checks within specified tolerances, but still have hidden problems because of poor project design, lack of quality control oversight during production, and/or poor oversight of interim processes.

By requesting bids, a client assumes the responsibility for defining the scope of the services required and thus does not take any advantage of the knowledge and background of the qualified professional engaged in providing such services. Few administrators, and even engineers, are knowledgeable in mapping, and their inadequacy in this regard is apparent in their requests for bids. The knowledgeable person is aware of the indeterminate nature of mapping. The reputable professional, if he is to bid, must either attempt to anticipate the many possible problems, determine which problems he feels will occur, and bid accordingly, or bid so high that he can include every possible condition (in which case he undoubtedly will not be the successful bidder). If an honest attempt is made and unforeseen conditions occur, the professional faces the decision to adhere to the specifications thereby producing an inferior product (which he cannot ethically do), request a change order which will certainly drive costs higher, or perform the work to the best of their ability thereby operating at a loss—an approach not likely taken by many who expect to remain in business. In nearly every case the client is the ultimate loser.

12. A much better approach than solely relying on qualifications-based selection for quality work is to utilize independent QA/QC.

This is a case of treating the symptom rather than the disease, and will most assuredly increase overall end-to-end project costs. For example, if a price competition results in a less than favorable technical outcome for the project, augmenting the price competition process with outside QA/QC support may be sufficient to identify some of the problems that require rework. However, it will likely not identify all of them, and regardless the results will almost never be as good as if it were done right the first time.

It is far better to use a fully responsive procurement process that results in hiring a highly ethical and responsible professional from the beginning. With QBS there is a detailed scope of services and the reasonable expectation (because qualifications and past performance were primary factors in their selection) that the company will adequately perform quality assurance to ensure satisfactory delivery of the project. And further, the client holds the professional fully accountable through the performance evaluation--which is the professional's life blood for future work. You have built-in protection.

However, if the original selection is based on price, and then an independent QA/QC contractor is hired to ensure quality, often this adds 10% to 15% to the total cost of the project (you are paying someone to do the job you would have already paid someone to do under QBS). QBS provides for the selection of an experienced and qualified professional in the first place. When all the additional administrative costs of handling the bids, potentially hiring a consultant to write the scope, doing all the extra contract management, and then bringing in an outside QA/QC consultant are added together and factored in with the increased project risk of a price-based competition, doing the project right the first time with QBS is clearly the "best value."

and review of final deliverables. For QBS procurements, specific quality control steps (including those to be provided by the owner and those to be provided by the contractor) would typically be negotiated as part of the scope of work. Another factor to consider, regardless of procurement process selected, is the requirement for "pilot area" deliverables early in the project. This allows the owner to confirm and finalize all aspects of the scope of work deliverables early in the project.

Supporting Documents

- Executive Summary (Side Bar)
- Comparison of Professional Services, Products and Technical Services (Table 1)
- Examples of Professional Photogrammetric Services (Table 2)
- Professional Geospatial Services Procurement Model (Figure 1)

References

ASPRS, 1987. Guidelines for procurement of photogrammetric services from private professional sources, *PE&RS*, 53(2), pp. 207-212.

Applicable QBS Laws and General Information

Brooks Act (40 U.S.C. 1101), FAR 36.6:
http://www.acquisition.gov/far/current/html/Subpart%2036_6.html
 American Public Works Association Position Statement http://www.apwa.net/Documents/Advocacy/Positions/Advocacy/Qualifications_Based_Selec_Prof_Svs_Consult.pdf

American Council of Engineering Companies description of QBS requirements for projects funded by federal grants
http://www.acec.org/advocacy/committees/qbs_matrix_8-16-04.cfm

American Council of Engineering Companies general QBS resources page
<http://www.acec.org/advocacy/committees/qbs.cfm>

U.S. Army Corps of Engineers Engineer FAR Supplement (EFARS definition of survey and mapping, refer to section 36.601-4)
<http://www.hq.usace.army.mil/cepr/efars/part36.pdf>

Professional Services Procurement Resources

American Public Works Association "Red Book" on Qualifications-Based Selection Guidelines for Public Agencies
 (Document can be purchased from: <http://www.apwa.net/bookstore/>)

American Bar Association Model Procurement Code for State and Local Government

(Document can be purchased from: <http://www.abanet.org>)

Michigan QBS Coalition, Workbook for QBS Procurement

http://www.qbs-mi.org/QBS_reference_PDF.cfm

Accuracy and Professional Standards Information

National Standard for Spatial Data

Accuracy (NSSDA)

<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3>

ASPRS Code of Ethics

http://www.asprs.org/membership/certification/appendix_a.html

ASPRS Certification Program

<http://www.asprs.org/membership/certification/index.html>

ASPRS Standards Page

http://www.asprs.org/society/committees/standards/standards_comm.html

Licensing Information

ASPRS Licensure Committee

http://www.asprs.org/society/divisions/ppd/licensing/licensure_comm.htm

NCEES link to State Engineering/Surveying Boards

http://www.ncees.org/licensure/licensing_boards

NCEES Model Law

http://www.ncees.org/introduction/about_ncees/ncees_model_law.pdf

NCEES Model Rules

http://www.ncees.org/introduction/about_ncees/ncees_model_rules.pdf

NCEES Multi-Organization Task Force Materials and Reports

<http://www.asprs.org/news/ncees/>

Glossary of Terms

This glossary represents a summary of definitions of selected key terms and phrases that are used throughout the *Guidelines* document. Many of these terms are defined in greater detail within the full text of the document. This glossary is intended to clarify potentially confusing terms in the context of procurement of professional photogrammetry and related remote sensing services. This glossary is not intended to be a comprehensive list of definitions of geospatial mapping terms and phrases.

- **Accuracy:** The degree of conformity of a measured or calculated value compared to the actual value. Accuracy relates to the

quality of a result and is distinguished from precision, which relates to the quality of the operation by which the result is obtained.

- **Authoritative:** Highly reliable; Final word and basis on which other determinations are made.
- **Authoritative location:** An authoritative location is a location that can be relied on as the basis for making other determinations. Mapping data represented to meet a specific accuracy requirement is considered to represent authoritative locations. Establishing or determining the authoritative locations of features and boundaries is considered the practice of surveying. Refer to NCEES materials cited in the references section for further clarification and examples of how this term applies to surveying and mapping.
- **Deliverables (geospatial, mapping):** Maps, data and information that must be completed according to a specific scope of work and process and delivered under the terms of an agreement or contract.
- **Direct Georeferencing:** The direct measurement of exterior orientation parameters, i.e. position (x/y/z coordinates) and attitude (roll/pitch/heading) at the instant an aerial photograph is taken, to aid or replace aerial triangulation. The term is also applicable to the position and orientation of airborne lidar or IFSAR sensors.
- **Georeference:** To associate imagery, feature data and information with a location in physical space; that is, determining and establishing the relationship of vector features, raster images and other geographical features to map projections or coordinate systems.
- **Geospatial mapping:** Mapping, information and data that identify the geographic location and characteristics of natural or constructed features or boundaries on the earth.
- **Geospatial accuracy:** Accuracy of geospatial mapping data and information. Map accuracies include both positional accuracies and thematic accuracies:
 - **Positional accuracy:** Accuracy of the horizontal and/or vertical coordinates that define the location of features represented by geospatial maps, data or information.
 - **Thematic accuracy:** Accuracy of the feature characteristics or attributes

represented by the geospatial maps, data or information.

- **Photogrammetry:** The art, science, and technology of obtaining reliable information about physical objects and the environment, through processes of recording, measuring, and interpreting images and patterns of electromagnetic radiant energy and other phenomena.
- **Photogrammetry and related remote sensing:** This term is used throughout the document to clarify that the ASPRS definition of photogrammetry is not limited to conventional photographic imagery, but also includes imagery and measurements acquired using lidar, radar, multi-spectral imagery and other remote sensors.
- **Orthophotograph:** A photograph prepared from a perspective photograph by removing those displacements of points caused by tilt, relief and central projection (perspective). The removal of the relief due to terrain change is often in zones and not specific. Sometimes called an orthophotomap, an orthophoto is georeferenced and is geometrically corrected such that the scale is uniform: the photo has the same lack of distortion as a map and can be used to measure distances, locations and the relationships between objects on the earth to within a specified accuracy. Accuracy depends on process and project design parameters.
- **Product Sales:** Sale of standardized products, usually according to an established pricing structure and often offered under license agreements for specific uses; specifications are established by the provider, though the purchaser may be able to choose from several options. Refer to Table 1 for a detailed description of product sales.
- **Professional Services:** Services that require specialized knowledge and skill, require independent judgment, and require a level of professional expertise and ethical conduct to ensure that the work meets the best interests of the client and public. Refer to Table 1 for a detailed description of professional services.
- **Qualifications-based selection:** Qualifications -based selection (QBS) is an objective and fair competitive process used by owners to procure services based on a professional's qualifications in relation to the work required.

continued on page 1365

Case Studies: Applying the Guidelines for Procurement of Professional Services

Case 1 — IMU controlled aerial photography

Scenario: A firm is subcontracted to fly a project site with a digital camera equipped with air-borne GPS and IMU to support 0.5' pixel orthophotos at 1"=100' map scale accuracies. The aerial photography subcontractor is responsible for all flight planning, acquisition and data reduction, including selecting and monitoring appropriate base stations located at previously established survey control point and/or using existing CORS data. Deliverables include digital images with direct georeference control, reduced and processed to the local state plane system at suitable accuracies to be used for the intended mapping work. The contracting organization intends to use the photography for mapping purposes, using either their in-house capability or an outside consultant.

Is it a professional service: Yes

The work involves making critical project design decisions regarding determining geodetic control requirements, selecting appropriate base station locations, addressing datum/projection issues and processing resulting control data to support a stated map accuracy standard.

Is it surveying under the model law: Yes

The geo-reference data, by virtue of being represented as being suitable to support stated map accuracy standards, represents an "authoritative location" (the basis on which other location related decisions are made). The geographic position and other photo elements, as represented by that data, is relied upon to determine all future location based measurements and is therefore an "authoritative location." Depending on specific state laws, this work would likely need to be done under the supervision of a professional with the proper license in the state where the work is being performed.

Contracting considerations: QBS or similar procedures are recommended. QBS would likely be *required* for: Federal project, State project (depending on specific State survey and QBS statutes), federally funded project (in some cases).

What if: The aerial photography firm is responsible only for acquiring the data, according to a flight plan provided by or supervised by the client (or the client's consultant), and is not responsible for any project design, survey control layout, GPS/IMU data reduction or other tasks related to having oversight and ultimate responsibility for the accuracy of the georeference data or suitability of the data to meet intended mapping requirements?

In this case, the firm is not performing surveying under the Model Law, since their deliverables are not represented as authoritative. It is the responsibility of the client or a professional consultant designing the project and taking responsibility for the control to determine whether or not the imagery and georeference data is suitable for the mapping products they intend to produce. However, digital imagery, IMU and GPS data collection requires significant independent judgment and oversight in order to be successful. Errors made in the collection process unquestionably impact future work and may not be readily identifiable in initial quality control checks. In that regard, while it may not be surveying under the model law, the data acquisition would still require professional oversight and independent judgment and therefore is considered professional in nature by the ASPRS *Procurement Guidelines* criteria.

The question of whether it is a professional service or a technical service for contracting process purposes depends on where in the acquisition chain the responsibility is undertaken for the final deliverables. If

the imaging collection process is planned and overseen by a firm with appropriate photogrammetric professionals responsible for the project, and that firm takes delivery of the raw data from the image acquiring firm and performs final processing and/or verification of that data, then the original image acquisition may be considered a technical service. However, if the imaging acquisition service is performed for an end user or agency which relies on the independent judgment of the image acquiring organization for the adequacy of the final deliverable, then it is a professional service.

Alternatively, conventional photography with no GPS/IMU component would always be considered a technical service. In summary, air-borne GPS/IMU data collection requires professional oversight of the operations in the acquisition chain, is professional in nature, and the location of that oversight in the acquisition chain dictates the type of appropriate procurement process.

Contracting considerations: If not a technical service, QBS or similar alternatives are recommended according to ASPRS policy. QBS may be required in States that have a more strict or encompassing definition of surveying than the Model Law.

Case 2 — 0.5 meter Orthophotography

Scenario: A photogrammetry firm is contracted to provide 0.5 meter digital orthophotos, flown during leaf-off conditions and produced from photography that has a 0.5 meter or better ground sample distance resolution. The client will retain full ownership of all deliverables and intermediate data. Final orthophotos are to be designed to meet a horizontal accuracy standard of +/- 6 meters at a 95% confidence level. Field survey tests are not required. The contractor is responsible for all project design and production tasks, including flight planning, control, determining a suitable DEM source and quality control.

Is it a professional service: Yes

The organization is purchasing a service for hire, rather than a product that has been independently verified or carries a manufacturer's warranty and is available for resale to multiple organizations. The professional services contractor is responsible for making all critical project design decisions regarding flight altitudes, control, appropriate DEM sources and all orthophoto production processes necessary to meet client expectations for final deliverables. The contractor is directly responsible for the final outcome, quality and suitability of the deliverables to meet the clients' needs as they have defined them.

Is it surveying under the model law: Yes

The orthophotographs represent an "authoritative location" of features (a location upon which other location based decisions are to be made) within the stated map accuracies. Although it is a very coarse accuracy specification relative to the final pixel resolution (likely in order to allow cost savings by using existing DEM sources), it is still a very specific accuracy statement intended to allow end users to make authoritative decisions within the limits of the stated accuracies. Depending on specific state laws, this work would likely require the supervision of a professional with the proper license in the state where the work is being performed.

Contracting considerations: QBS or similar procedures are recommended. QBS would likely be *required* for: Federal project, State project (depending on specific State survey and QBS statutes), federally funded project (in some cases).

Case 2A — What if: A specific map accuracy is not required and instead the County includes a disclaimer that the imagery is to be used for referential purposes only and is not intended to be used to locate or measure features on the map?

In this case, the services would not be considered surveying under the Model Law. However, this would still be considered a professional service. The contractor would still be solely responsible for project design and quality control to meet all other client expectations for final deliverables (other than geospatial locations to within map accuracies). The contractor is still directly responsible for the final outcome, quality and suitability of the deliverables to meet the clients' needs.

Contracting considerations: QBS or similar alternatives are recommended according to ASPRS policy. QBS would not be *required* in most cases. QBS may be required in States that have a stricter or more encompassing definition of surveying than the Model Law.

Case 2B — What if: The client is not requesting a service for hire, but is instead requesting a product that meets their general requirements, with detailed product specifications specified by the data provider. Use of the imagery will be granted to the contracting organization under license, with ownership to be retained by the data provider for future resale.

In this case, the orthophotography being requested is a product, not a service. The contracting organization is solely responsible for determining whether or not the quality of the imagery and specifications, as dictated by the data provider, are suitable for intended purposes.

Contracting considerations: Product purchasing processes would apply. These are not addressed in the *Guidelines for Procurement of Professional Services*.

continued from page 1363

- **Remote Sensing:** Gathering and processing information about an object without direct physical contact.
- **Rectified imagery:** Rectify -- to correct by calculation or adjustment. Rectified imagery is imagery that has been transformed and processed to be projected onto a common surface. Historically, rectification was defined as the process of correcting a photograph for displacement due to camera tilt only. Currently, the term is often used more generally to apply to a wider array of transformation processes used to project imagery onto a common coordinate system. "Ortho-rectified" imagery is corrected for camera tilt, distortion and terrain relief. "Rectified imagery" is a more general term and implies that a less robust transformation, which typically would not directly correct for terrain relief, was used.
- **Referential mapping:** Mapping that does not represent authoritative locations or survey data. General mapping for reference purposes only and not for the purpose of determining reliable locations to be used as the basis for making measurements or other determinations. Locations of features are approximate and are not expected to comply with a specific positional accuracy requirement. Refer to NCEES materials cited in the references section for further clarification and examples for applying this term.
- **Technical Services:** Standardized services for specific tasks that do not require independent professional judgment, and where the client is responsible for ensuring that the scope of work and outcome best meet client and public interests. Refer to Table 1 for a detailed description of technical services.