

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

The following material is considered DRAFT FOR REVIEW and is being published at this time to encourage wide dissemination and comment. Comments should be forwarded via email to guidelines@asprs.org no later than January 15, 2009. The current plan is to review all comments and finalize the document for ASPRS Board approval at its March 13, 2009 meeting.

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 Practices 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 at their meeting on [TBD].

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.

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 public. Professional photogrammetry and related geospatial mapping services produce geospatial mapping deliverables and information where there is an expectation of spatial or thematic accuracy.

- Professional photogrammetry and related 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 services from technical services or products. Professional services may include automated or standardized processes that require the supervision of a qualified professional.
- This broad definition of "professional" services includes the vast majority of photogrammetry, remote sensing and related sensor-based geospatial mapping services. Off-the-shelf products and technical services fall outside the scope of this definition of professional services. Technical services include conventional aerial photography with no direct geo-referencing, imagery for display only purposes, rote digitizing and similar processes.
- Professional level photogrammetry, remote sensing and related sensor-based geospatial mapping services can be divided into two categories: 1) authoritative mapping that depicts the authoritative location of features, and 2) referential mapping that meets only general accuracies and does not depict or represent authoritative locations. Authoritative mapping is defined as "surveying" by the National Council of

Examiners for Engineering and Surveying (NCEES) Model Law and in many state laws. Referential mapping is not "surveying" by the NCEES definition. Federal and state procurement laws may apply differently to surveying and non-surveying services. Both types of services require independent judgment and professional expertise and are considered by these *Guidelines* to be professional services for procurement purposes.

- Detailed matrices are included as attachments to these *Guidelines* to further distinguish between professional authoritative mapping services, professional referential mapping services, technical services and products.

Procurement Guidelines and Recommendations

- The professional photogrammetry, remote sensing and related 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 the most appropriate means to ensure that public interests are best represented when procuring professional photogrammetry, remote sensing and related 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 low bid process that is used for construction services, product purchases or similar price-based procurements. Independent judgment and independent oversight by the contractor are critical to the success of the project.

- When price is evaluated concurrently with qualifications and influences the final selection, responding firms 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 public. Quality may be compromised and advanced technologies, innovation for the best techniques, and the most cost-effective overall approach may not be implemented.
- The federal law commonly known as the Brooks Act outlines the best model for qualifications based selection. The Brooks Act process ranks firms according to qualifications only. Cost is not a factor in the initial selection of the top ranked firm. After the top ranked firm is selected based on qualifications and capability 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 firm, 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 qualifications-based selection (QBS) process is required by law as defined in Federal Acquisition Rule (FAR) Part 36 for all federal procurement of architecture, engineering and related surveying and mapping services.
- Contracting and procurement personnel should contact the State Board of Examiners 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. Specific aspects of photogrammetric mapping and related geospatial mapping services are considered surveying and require a license to practice in many states. Many states also have "mini-Brooks Act" bills that require the Brooks Act or similar process be used for the procurement of all architecture, engineering or surveying services as defined by state law.
- State laws vary widely in their definitions of surveying and mapping. Statutes may specifically license photogrammetry, remote sensing and similar sensor-based geospatial mapping practices; or they may regulate this kind of mapping under the broader definitions of surveying or engineering.
- The FAR Part 36 definition includes many of the geospatial mapping services addressed by these *Guidelines*. Services licensed as architecture, engineering or surveying under state law in the state where the work is being performed require Brooks Act procurement under the FAR 36 definition. Further, in the absence of specific statutory language or precedent for enforcement addressing 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 that require a professional license. 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 endorses Brooks Act and similar QBS methods as the best process for procurement of all professional photogrammetry and related geospatial mapping services, including both surveying and non-surveying services. The Brooks Act QBS process is widely accepted by other professional organizations; encourages innovation and design; encourages competition among the most qualified firms; 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; therefore, procurement methods that do not follow Brooks Act-like procedures may eliminate many of the most qualified firms from competing in a price-based procurement.
- It is recognized that geospatial 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 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 the Brooks Act QBS process. In those cases, ASPRS recommends that specific minimum guidelines be implemented:
 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 firms 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 professional geospatial services apply equally to future technologies and are not limited to existing technologies or "tool-based" definitions.

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 professions. These *Guidelines* represent the best effort of the ASPRS at defining and clarifying the key issues that affect an organization's procurement of image and 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 Practices 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 at their meeting on [TBD]. 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 geospatial 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 or may not require a license, but are defined 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 Remote Sensing and Photogrammetry

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 technology, 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 both 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 attached to vehicles such as vans or boats, airborne in manned or unmanned aircraft, or satellite based.

III. Scope of Services Addressed by These *Guidelines*

These *Guidelines* are specifically intended to apply to those photogrammetry and 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 throughout this document. This term refers to a much broader scope of geospatial mapping services than those that involve photogrammetry and remote sensing. It is the opinion of ASPRS that the principles and recommendations presented in this document apply equally to all 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 scope of expertise of the Procurement Guidelines Committee and is beyond the scope of this document. While this document presents broad-based recommendations that could also apply to many other sectors of the geospatial mapping profession, 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 information where there is an expectation or representation of geospatial or thematic accuracy;
3. Require independent judgment, ethical conduct and professional expertise to ensure that the resulting products 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 products such as vector and image maps, charts, and other graphical or digital representations.

Photogrammetrists and remote sensing specialists must have in-depth knowledge and expertise 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 professions that rely on similar principals of science and measurement. The specific applications of these principals 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 Photogrammetrist and Certified Mapping Scientist. 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. 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 experts 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 are often the only professional involved in the process that has a full understanding of what is required to meet the accuracies and quality necessary 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.

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

Qualifications-based selection (QBS) is the widely accepted method for procurement of architecture, engineering and related professional services. Federal law, as prescribed by Public Law 92-582, commonly referred to as the Brooks Act, and state laws in at least 47 of the 50 states require QBS procurement of architecture, engineering, survey and related 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 firm based solely on an evaluation of that firm's qualifications to complete the work. Cost and price are not a factor in the initial ranking of firms. Under the QBS process, costs are negotiated with one firm at a time, starting with the highest ranked firm. If a fair and reasonable cost cannot be negotiated with the highest ranked firm, then, and only then, cost and price are negotiated with the next most qualified firm.

QBS is endorsed for procurement of professional services by many other professional organizations including the American Institute of Architects (AIA), National Society of Professional Engineers (NSPE), American Public Works Association (APWA), American Water Works Association (AWWA), American Bar Association (ABA) and the Associated General Contractors of America (AGC). QBS is 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, organizations acquire the services of the most qualified firm possible while obtaining a price that is fair and reasonable.

Many professional photogrammetric mapping and 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. This application of photogrammetric mapping and related remote sensing technologies to provide products similar in nature to the type of information provided by field surveyors, would be considered surveying by most definitions. In recent years, many other 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.

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, exceptional professional expertise and professional ethics in order to develop mapping products that can be relied on to make decisions that often impact public welfare. While these tasks may not require the same level of authoritative accuracy required for architecture, engineering and survey applications, there is still an expectation of general accuracy and a level of quality and standard of performance that requires a professional level service.

With regards 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 professional photogrammetry services is vastly different from procuring 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. 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 firm competing for the work will interpret it differently. Consequently, proposals vary widely in scope and detail, creating an “apples and oranges” disparity in project details. When price is a key selection criteria, firms 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 taxpayers.

QBS, as outlined by the Brooks Act, is widely used for architecture, engineering and surveying services procurement. Professional organizations, 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 well being as the engineering, architecture, surveying, planning, natural resources, emergency services and disaster recovery 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 all procurement of professional photogrammetry and related geospatial mapping services, including both surveying and non-surveying services.

VII. Federal and State Regulations Affecting Procurement 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 imply 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 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 particularly be considered in the procurement of selected professional geospatial services. For instance, many states require a license to practice specific aspects of photogrammetric mapping and other geospatial 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 services. Contracting and procurement personnel should contact the State Board of Examiners 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 any and all state licensing laws.

State legislatures periodically review and modify their licensing laws, and State Boards of Examiners 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 geospatial services that should be licensed and referential services that do not require a license. The NCEES model identifies “surveying” services as any work, regardless of the tool used, that represents an authoritative location or measurement of features on or relative to the Earth, and which results in a “survey” product. 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, and that affect public well being, that are not directly tied to engineering, architecture or surveying, and that may not be regulated by licensing laws. Qualifications-based selection is appropriate for all professional geospatial services and not just services that require a professional license. It should also be noted that licensed individuals are not always more qualified to perform a specific “professional service” than unlicensed individuals and qualifications evaluation criteria should be applied appropriately to all qualified geospatial service providers.

Federal procurement is regulated by the Federal Acquisition Rules. Surveying and mapping services are included in the federal definition of architecture and engineering services subject to

VIII. Guidelines for Other Procurement Methods

ASPRS recognizes that the Brooks Act 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 meet the test for authoritative accuracy as used by the NCEES model and many state laws to distinguish between surveying services and other referential mapping services. When Brooks Act or similar QBS procurement practices are not required by law or regulation, procuring organizations have the autonomy to select other procurement methods.

ASPRS recommends that Brooks Act QBS or similar methods be used for procurement of all professional geospatial mapping services, regardless of whether or not a professional license is required or whether or not the Brooks Act process is specifically required by law or regulation. However, ASPRS recognizes there will be instances when an organization will choose to use a procurement method other than the Brooks Act process and that in many cases cost will be one of the selection criteria. In those cases, ASPRS emphasizes the importance of selecting 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 preferred process outlined by the Brooks Act.

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 Brooks Act QBS and should not include cost as 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

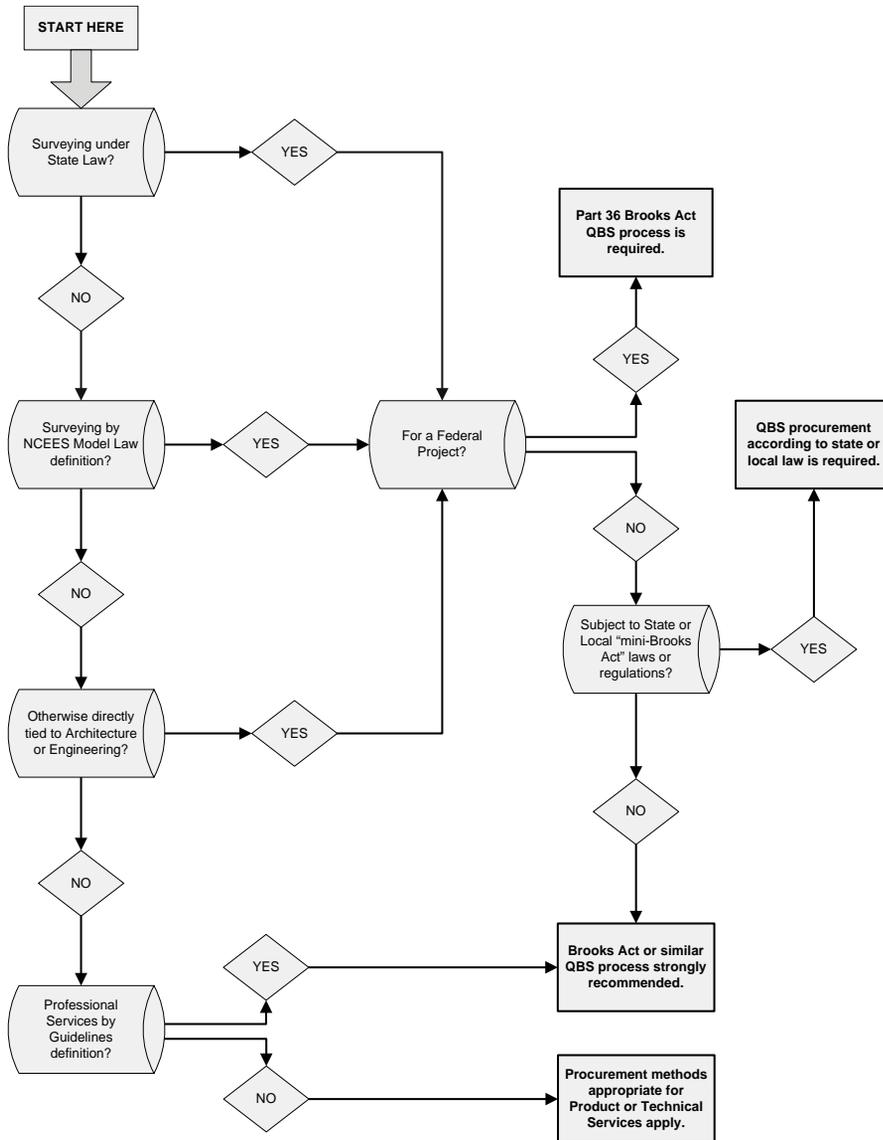


Figure 1. Professional Geospatial Services Procurement Decision Model

Subpart FAR 36.6 which requires the Brooks Act QBS procurement process for those services. It is the opinion of ASPRS, that Subpart FAR 36.6 would, at minimum, apply to all federal procurement of photogrammetry and remote sensing services that are defined as surveying by individual states and, in the absence of such definition, by the NCEES Model Law and Model Rules. Subpart FAR 36.6 may apply to a broader range of photogrammetry services, depending on the definition of surveying and licensing requirements applicable in the specific 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 laws, which require the use of QBS for procurement of A/E services for local

jurisdictions and state agencies. 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.

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, it should be submitted separately and considered only after firms are ranked based on qualifications.

IX. Subcontracted Services

It is recognized that geospatial services may be procured within the scope of a more extensive project, wherein the specific geospatial services would be considered “incidental” to the project. In cases where the total dollar value of the geospatial 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 component of the project, if the primary contractor utilizes one or more subcontractors to acquire specialized geospatial services, then those geospatial subcontracts are also considered to be subject to these *Guidelines*.

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 best example of which is the Brooks Act QBS process.

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. Selection of the appropriate geospatial datum and mapping projection is also essential.

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 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 mathematical 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 Interpretation 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.

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.

However, while specific technical tasks will continue to become more automated with future technologies, the correct and prudent implementation of these new technologies will always require the level of knowledge,

expertise, ethical standards and professional conduct outlined in these *Guidelines*. As new technologies develop and become commonplace in the mapping industry, it is the intent of these *Guidelines* that the professional nature of those services be judged by the same general criteria that have been applied herein to the current technologies that have been identified.

XII. Technical Services and Products

ASPRS recognizes that there are some applications for geospatial mapping 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 many of those instances. Specifically, this would apply to technical services and product sales.

XI. Future Technologies

Geospatial mapping, remote sensing and photogrammetry are very dynamic fields. As

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

Offering Type/ Differentiators	Professional Service	Product	Technical Service
Level of Standardization	<i>Varies</i> 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.	<i>High Standardization</i> Provider offers a set of standard features from which the client may choose.	<i>High Standardization</i> 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 with minimal or no input from service provider
Ownership	In most cases, the client owns all resulting work and deliverables.	In most cases, the provider owns the data and they 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 not be required to oversee the work, as state licensure laws vary widely.	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 products meet specifications and expectations.
Protection of Public Welfare	<i>Professional liability may apply</i> Provider is responsible for quality control and ensuring products meet specifications and expectations. Provider is expected to comply with ethical and professional standards to protect public interest.	<i>Product liability applies</i> Product developer is responsible for ensuring deliverables meet stated specifications and requirements.	<i>No professional liability</i> Client is responsible for quality control, ensuring products meet expectations and ensuring products 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.

Technical Services

Not all geospatial services require independent professional judgment or have the same element of potential public harm that warrants professional level work. This would include services wherein

the data are not to be presented to the public in any way that would imply an expectation of authoritative geospatial or thematic accuracy and where misrepresentation of geospatial or thematic accuracy will not result in potential harm

to the public welfare or to the business purpose of the client. Some resource aerial photography acquisition, image processing for display only purposes and processing or formatting of existing data for referential purposes fall into this category.

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)	<p>IMU or airborne GPS data that are represented to meet a specific authoritative accuracy statement.</p> <p>Conventional aerial photography for photogrammetric mapping where service provider is responsible for project design.</p> <p>Controlled aerial photography where service provider provides ground control or aerotriangulation.</p>	<p>Controlled aerial photography (conventional, IMU or airborne GPS) when used as an intermediate product solely to produce purely referential imagery which is not represented to meet a specific or authoritative accuracy.</p> <p>This application is rare; a majority of all controlled aerial imagery meets the Model Law definition of surveying.</p>	<p>Resource photography or mosaics with no published coordinates or geo-reference data.</p> <p>Conventional aerial photography where all flight layout and project design is the sole responsibility of the client or professional in charge.</p>
Orthophotography and Rectified Imagery	<p>Orthophotography or rectified imagery that is published or represented to meet a specific accuracy.</p> <p>Includes the majority of all common applications of orthophotography. Specifically would include any orthophotography or other rectified imagery when used for engineering, planning, natural resources and related work where the geospatial accuracy influences decisions that affect public welfare.</p>	<p>Imagery that is rectified solely for referential purposes and is not represented as a survey product or expected to meet any specific or authoritative accuracy.</p> <p>As the terms "orthophotography" and "rectified" imagery imply true map scale accuracy, a clear disclaimer that the final work products cannot be used for the measurement or location of features is required to distinguish this work from a Model Law surveying service.</p>	<p>Approximate scale enlargement or rubber-sheeted imagery for display only purposes and where there is no expectation of accuracy or professional judgment.</p>
Feature Extraction	<p>Vector and feature data that are published or represented to meet a specific accuracy.</p> <p>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.</p>	<p>Vector and feature data extracted solely for referential purposes that are not represented as a survey product or expected to meet any specific or authoritative accuracy.</p> <p>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.</p>	<p>Feature extraction of easily distinguished features, solely for referential purposes, and as an intermediate process where a professional on the client's staff or hired by the client is responsible for all project design, quality control and final map preparation.</p>
Lidar, Radar Acquisition and Terrain Modeling	<p>Data are represented to meet a stated or implied authoritative accuracy.</p> <p>Includes the vast majority of all applications of terrain modeling using photogrammetry or active sensors such as airborne lidar, ground based lidar, and radar.</p>	<p>Terrain modeling or terrestrial scanning solely for display or referential purposes.</p> <p>Non-survey applications of lidar and terrain modeling are rare. Nearly all air-borne lidar projects have an element of authoritative accuracy and are considered survey services.</p>	<p>None. Terrain modeling applications require professional judgment.</p>
Digitizing, Scanning and Processing of Existing Photogrammetry or Remote Sensing Maps or Data	<p>Published for use by the public and represented as survey or mapping data depicting the authoritative location of features or boundaries.</p>	<p>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.</p>	<p>Scanning, digitizing or formatting of existing mapping data to client specifications where minimal professional judgment or interpretation is required.</p>
Image Interpretation and Thematic Mapping	<p>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.</p>	<p>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.</p>	<p>Routine classification of easily distinguished features where minimal professional judgment or interpretation is required.</p>

Nevertheless, knowledge of geospatial services, accuracy specifications, and the impact on the public is itself, is required to make a determination as to whether or not the services requested require professional expertise. Therefore, ASPRS encourages consultation with an ASPRS Certified Photogrammetrist, licensed professional or other qualified professional with expertise in the geospatial field to assist in such evaluations.

Services that meet all of the following criteria would be considered technical services that may not require professional level services or procurement methods:

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 imply an expectation of geospatial accuracy for measurement or the 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 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

Some geospatial mapping products are sold as existing or custom-order products and not procured on a professional basis. Products are developed to the provider's specifications and standards, not necessarily the purchaser's or user's. Therefore, QBS procurement methods may not be practical or required for these types of purchases. Products often are sold under license to the client (the client does not own source data, work products, or data). Products are not typically certified by a professional, but may be warranted to meet specific standards. Products are subject to product liability not professional liability.

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

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http://www.aia.org/static/state_local_resources/projectdelivery/QBS_matrix.pdf.
- American Public Works Association Position Statement* http://www.apwa.net/Documents/Advocacy/Positions/Advocacy/Qualifications_Based_Select_Prof_Svs_Consult.pdf.
- U.S. Army Corps of Engineers Engineer FAR Supplement (EFARS) (Definition of survey and mapping / refer to section 36.601-4 "Implementation")* <http://www.hq.usace.army.mil/cepr/efars/part36.pdf>.
- American Bar Association Model Procurement Code for State and Local Government (Document can be purchased from: <http://www.abanet.org>).*
- 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>.
- NCEES link to State Engineering/Surveying Boards* http://www.ncees.org/licensure/licensing_boards/.
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