State of California

Department of Technology

General Requirements Guidelines

Statewide Information Management Manual – Section 170A

August 2016

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GENERAL GUIDELINES

1. Introduction

The General Requirements Guidelines are designed to assist Agencies/state entities with the development of requirements for the Project Approval Lifecycle (PAL). These guidelines are based on proven industry practices, methods and experience from California information technology (IT) projects. These guidelines support Statewide Information Management Manual (SIMM) Section 170B Project Requirements Development Instructions which include a step by step approach for developing and managing solution requirements. Agencies/state entities may use as much or as little of these guidelines as appropriate.

Document Format Information:
- Guidance is provided in normal text.
- Samples are provided in *italicized* text.

1.1 Overview

These guidelines provide the elements needed to develop strong IT solicitation documentation, effective mid-level and detailed solution requirements, and will help reduce difficulties encountered while writing IT solicitation documentation and solution requirements. Leveraging this tool will help improve requirement consistency, quality, and usability throughout the PAL process, during IT project implementation and into maintenance and operations.

1.2 Background

Development of IT solicitation documentation and solution requirements for IT projects is inherently difficult, many times resulting in high stress for staff during implementations. Oftentimes solution requirements appear to ask for exactly what is needed but are written too broadly or in a generic manner. For example, consider this:

"The solution shall be robust and very user-friendly"

In the above requirement, it appears the solution needs to be robust and user-friendly. However, the terms "*robust*" and "*user-friendly*" cannot be objectively and fairly evaluated. Because solicitation documents effectively become legally enforceable contract documents, requirement documents should be prepared with concern and respect for their potential legal status. Every sentence should provide value to the objective of the document section. Therefore, it is critical that the documents are written using effective practical communication practices.

According to IEEE 24765:2010, a requirement is defined as, "1. a condition or capability needed by a user to solve a problem or achieve an objective. 2. a condition or capability that must be met or possessed by a system, system component, product, or service to satisfy an agreement, standard, specification, or other formally imposed documents 3. a documented representation of a condition or capability as in (1) or (2) 4. a condition or capability that must be met or possessed by a system, product, service, result, or component to satisfy a contract, standard, specification, or other formally imposed document. "

The state's newly implemented PAL process includes additional clarity in project procurement methods.   As the lifecycle is further refined, the state is simultaneously working on improving the quality of IT project requirements, which ultimately become biddable specifications. Understanding these guidelines is the first step in a comprehensive set of documents that will assist staff with the development of useful IT solicitation requirements.

Note: The guidelines, instructions and exhibits are for instructional purposes and not intended to mandate how requirements are created.

1.3 References

In addition to this document, the following documents and exhibits will assist state IT project and procurement staff in understanding what well-written requirements consist of:

DOCUMENT REFERENCES
SIMM Section 170A Exhibit A: Strong Requirement Samples
SIMM Section 170B Project Requirements Development Instructions
SIMM_Section_170B_Exhibit_B1_Expanded_Requirement_Sample
SIMM_Section_170B_Exhibit_B2_Expanded_Requirement_Sample
SIMM Section 170B Exhibit B3: Expanded Requirement Sample
SIMM Section 170B Exhibit C: Glossary Sample
SIMM Section 170B Exhibit D Requirements Development Workflow
SIMM 19B.3 – Mid-Level Solution Requirements
SIMM 19.C Stage 3 Solution Development • SIMM 19C.2 Stage 3 Solution Development Template (Part A) • SIMM 19C.3 Stage 3 Solution Development Requirement Template

2. IT Solicitation Documentation Guide

Application of the following basic language practices will improve practicality and fluidity of IT solicitation documentation and requirements. Documents should be consistent and subject to uniform interpretations. Writing style and sentence structure matter and the conceptual integrity presented is important to its interpretation. Extra unnecessary words increase the risk of confusion, misinterpretation, and contradiction.

2.1 Capitalization and Punctuation

Capitalization should be consistent throughout the solicitation document and resulting contract documents. Capitalization of the initial letter of certain specific nouns and proper names defined in a contract is appropriate.

Because IT solicitation documents can become legal documents, the formal rules of punctuation must be observed. Sentences should be constructed so that the misplacement or elimination of a punctuation mark will not change the meaning. Commas should be used after each item in a series, including the item preceding a conjunction, and in other locations where the clarity of the statement will be improved.

Specify capitalization and punctuation requirements when using lists.

Capitalization Examples:

Change Order:	*When issued as a modification to a contract (time and/or sum).*
Contract:	*When referring to the specific contract or agreement.*
Contractor:	*When referring to the contractor who is party to the state-contractor agreement.*
Diagrams:	*When referring to graphic portions of the contract work.*
Government:	*When a government agency is a party to the contract.*
Paragraph:	*When referring to a paragraph in deliverables or other contract documents.*
Project:	*When referring to the specific project of which the work is a part.*
Work:	*When referring to the work of a specific contract.*
No capitalization is required when the preceding examples are used in the general sense.	

2.2 Grammatical Mood

Strive to maintain the same grammatical mood throughout. Consistent use of terminology and language contributes to good communication. Whereas, two basic grammatical sentence moods can be used to convey requirements; using the **imperative mood** results in requirements that are shorter, crisper, and easier to understand. Mood conveys the attitude about the state of being of what the sentence describes. (e.g., as a fact, a command, a wish, an uncertainty):

- **Imperative mood**: The imperative mood gives direction where the subject is implied and the verb expresses command or direction. The examples below imply that the subject is the "solution", "system" or "contractor" and does not need to be stated. The imperative mood expresses a command or a request. For example:

    "Accept transactions from clients through the on-line portal."

- **Indicative mood:** The indicative mood refers to actions, events, or states that are believed to be true. For example:

"Provide the capability to accept transactions from clients via the web."

Table 1: Grammatical Mood

Imperative Mood	The imperative mood is the recommended method for directing the subject work. The verb that clearly defines the action becomes the first word in the sentence. The imperative sentence is concise and readily understandable.	*Examples:* • *"Respond to a communication request using an adapter."* • *"Install equipment in accordance with manufacturer instructions."* • *"Encode the message node within the message structure."*
Indicative Mood	The indicative mood requires the use of "shall" in nearly every statement. This sentence structure can cause unnecessary wordiness and monotony.	*Examples:* • *"Adapters shall respond to a communication request. "* • *"Equipment shall be installed in accordance with the manufacturer instructions."* • *"Each message shall be encoded within the message node."*

2.3 Grammar

When applicable, IT solicitation documents and requirements should be written in second-person language and in active voice. Second-person is often appropriate for e-mail messages, presentations, and business and technical writing. When using the second person, the subject of the sentence is the person/thing being addressed. Documents are written as though the writer is talking to the person as they carry out the instructions. This last point is easily identifiable where the results of the instructions are described. These descriptions should be given as if the results have just happened.

Poor Grammar	Better Grammar
The user presses the Delete key. (Result: The customer details will be displayed.)	*Press the Delete key. (Result: The customer details are displayed.)*
Starting the batch job starts the report. (This is Indicative, not imperative) *The report is generated by starting the batch job. (This is Passive voice; not Active)* *The operator starts the batch job to generate the report. (This is Third-person; not Second-person)*	*Start the batch job to generate the report.* *(This is imperative mood, active voice, and in second-person)*

Subject/Verb Agreement
The subject and verb must always agree in number. Singular verbs should be used with singular subjects and plural verbs with plural subjects. An error in number is easy to make when a sentence is long and complicated. The singular subject of a sentence can be confused with a plural identifier.

Parallel Construction
Good grammar also requires the use of identical style in both parts of a compound subject or predicate. The use of identical style in a series of nouns, adverbs, or prepositional phrases is also recommended.

2.4 Vocabulary

Select words carefully and use them for their precise meaning. Use conventional terminology when defining requirements. When unique terms are used, provide the definition of said term(s) and appropriately submit the terms to the project glossary. Once a word is selected, use it consistently throughout the solicitation document whenever the same meaning is intended. The following are some examples of commonly misused or ambiguous terms along with guidelines for their recommended usage in project documentation and resulting contracts.

Table 3: Vocabulary Use

Selected Word		Do Not Use	Do Use
Any	The word "any" is imprecise in number permitting discretion by the reader/bidder.	*Example* *"Data published to the queue is received by any client subscriber"* could mean some of the client subscribers; or it may include all of them. This language is imprecise.	*Example* *"Data published to the queue is received by the client subscribers"* This clearly means all client subscribers.
And, Or, And/Or	The word "and" connects elements that are to be taken jointly. It may also mean plus, or added to a preceding quantity. "Or" is used to introduce any of the possibilities in a series. Two words together (and/or) represent a hybrid term often used in legal and business documents as a grammatical shortcut. Avoid using the term "and/or".	*Example* *"Clients with child dependents and/or positive employment status will receive notifications"* This could mean that notifications will be sent if the client has a child dependent and employment status or only one of the two conditions are met. This language is imprecise.	*Example* *"Clients with child dependents and positive employment status will receive notifications"* This clearly means that the client needs both conditions to receive notifications. *Example* *"Clients with child dependents or positive employment status will receive notifications"* This clearly means that the client only needs to satisfy one of the two conditions to receive notifications.

Selected Word		Do Not Use	Do Use
Either and Both	The word "either" implies a choice between two options, while the word "both" is inclusive. Make clear whether the intent is to have "either" or "both" but not both.	*Example* *"Provide advance notice of either or both types of paternity hearings to the requestor"* This could mean one of two types of hearings or both of the two types of hearings. The language is imprecise	*Example* *"Provide advance notice of hearings that may result in either paternity establishment, or establishment of an order."* *"Provide advance notice of hearings that may result in both paternity establishment, and establishment of an order."*
Furnish, Install, and Provide	"Furnish" means to supply and deliver to the project, ready for use. "Install" means to place in position for service or use. "Provide" is commonly accepted in IT project documentation to mean furnish and install, complete and ready for intended use.	These definitions should not be placed in conditions in various deliverables, requirements, or specifications.	These definitions should be placed in the conditions of the contract.
Observe and Supervise	"Observe" means to watch or view the execution or performance of work, while "supervise" means to oversee and to have control and direction of the work.		

	Selected Word	Do Not Use	Do Use
Party and Entity	The word "party" refers to a signer of a contract, such as the Agency/state entity and contractor in a state contract. When the intent is to refer to persons or firms, such as subcontractors and others who are involved in the construction process, but are <u>not</u> signers of the contract, the generic term "entity" is recommended.		
Shall and Will	"Shall" is used as an imperative in reference to work required to be done by a party. "Will" is optional and is used in connection with acts and actions required of parties to the contract.	The words "must" and "is to" are not recommended.	

2.5 Cross-referencing and Information Placement

Information should be stated ONE time and in the correct place. Information in one document should not be repeated in other documents or multiple places within the same document; rather they should be cross-referenced. Each document has a specific purpose and should be used precisely for that purpose. This simplifies the retrieval of information and substantially reduces the possibility of conflicts and discrepancies. Everyone involved with a project benefits from this standardized approach to the placement of information within the document(s).

Specific sections of the solicitation document should be referenced as needed for proper coordination. References should be made to section numbers rather than to a document, article or page numbers, which may change with subsequent revisions to the specifications.

2.6 Audience

Instructions should be addressed to the party responsible for the work being specified. Words, such as "*the {contractor} shall*," should be omitted but may be added for clarity when more than one party is mentioned in the same section or paragraph.

Avoid addressing individual subcontractors or disciplines. References to a specific responsibility should be made to the appropriate specification section. For example, *"Data transformation is specified in Section 123456,"* rather than, *"The Database administrator is responsible for all data transformation."* The intent is to avoid unnecessary words and potential confusion.

2.7 Workmanship

Although quality does depend on software products, it is also affected by the workmanship of humans. Thus, it is a combination of quality of software products and quality of workmanship that results in the final quality of the product. Workmanship relating to the design, build, integration, and testing is equally important to ensure good project outcomes. IT projects are made up of many interrelated products and each product may require specialized skills to make it a functional part of the project solution.

Specify workmanship requirements, referred to as non-functional requirements, in a manner appropriate to the needs of the project. These specification statements should be reasonable. Solicitation document requirements should be specified without demanding conformance to unattainable measures.

Workmanship statements can be ambiguous if not properly worded. Make positive statements and avoid broad generalities such as "best possible" or "best practice." The word "best" can be open to many interpretations by those reading the solicitation document (future contract).

Appropriate methods for achieving desired workmanship include:

- Requiring that work be tested according to an applicable standard or some previously agreed and documented measure recorded in the appropriate project or contract document
- Requiring samples, prototypes, or mock-ups, when necessary, to establish an acceptable level of quality and a basis for judging subsequent work
- Establishing inspection requirements
- Referring to applicable standards

2.8 Contractor Responsibility

Also referred to as project/transition requirements, contractor requirements clearly identify the responsibilities, activities, and deliverables provided by the contractor.
Do not use generalized statements, such as:

"The contractor will work in concert with the State to provide/develop/design the solution."

This statement suggests that the activities for the development/design provided by both the contractor and the State will be combined. This langue has the potential for miscommunication once the vendor contract is signed, as it suggests that the state hasn't figured out exactly what their requirement is but plans to discover it later. Statements such as this can spawn finger pointing and expensive change orders and schedule delays.

Provide specific boundaries around both contractor and state responsibilities. The separate responsibilities may be combined to produce an expected outcome, however, specific tasks and activities should be accountable to one and only one party. Additionally, language such as, "including but not limited to…." fosters ability to object, confusion, and misunderstanding and should not be used when describing deliverable contents.

2.9 Deliverables

Solicitations for IT systems should always pay for performance or outcomes as opposed to paying for paper deliverables. This is usually the result of an excessive numbers of plans required by the state for vendors to produce without requiring that the vendor's solution perform at various stages of delivery. Oftentimes project plans call upon execution of processes and procedures that fall outside the scope of the vendor's contract leaving the state empty handed. Instead, focus vendor payments on the validation of solution milestone performance; if the solution doesn't perform as required and documented in the requirements then payment is not issued.

This allows the project to focus on fundamentals – including professional services, labor, software and equipment; as well as responsibility for cost, schedule, quality, and management. By focusing on performance or outcomes the project also avoids considerable administrative effort managing materials of limited value (short or long term).

Deliverables should be functional and as few as possible. Attempt to limit the number of deliverables to be provided after contract award and require coordination of those few deliverables with the submitted proposal. Consider converting many, if not all, administrative deliverables into "general requirements."

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Table 4: Deliverables

Deliverables that can be included with a proposal	Deliverable Examples
Administrative	• *Professional services detail* • *Labor detail* • *Materials and equipment schedules (lists)* • *Cost control estimate* • *Schedule addressed in general requirements (the bidder has to do / prepare these things to make a proposal)* • *Architectural Design (AD)* ➢ *Derived from and directly related to requirements (solicitation performance specifications) and solicitation reference materials/standards (e.g., CAEAF & related RA's); this includes diagrams and architect's specifications*

Design	• *Outline Schematic Design (SD) for Business, Application, and Information*
	
	   ➢ *Each specifically coordinated with the AD*
	   ➢ *Each specifically coordinated with the others*
	   ➢ *Includes diagrams and engineering specifications/calculations if needed*
	   ➢ *Each to be refined during the design development phase(s) of work*

Additionally, direct the contractor to submit diagrams that contain:

- Standard notation (i.e. ArchiMate 2.0 Specification)
- Sheet identification
- Standard sheet sizes and layout
- A title block

Both diagrams and design specifications are needed to fully describe an IT project. The diagrams are a graphic representation of the proposed work showing form, relationship, generic type, and identification of the system being constructed. Design specifications define the qualitative requirements for software, software products, and workmanship upon which the project proposal is based.

Caution: Design specifications supplement, but should not repeat, information shown on diagrams, nor should the diagrams repeat information contained in design specifications. If a requirement is repeated on the diagrams and in the specifications, an opportunity arises for a discrepancy between the two. Last-minute changes are likely to create discrepancies and cause misunderstandings, oftentimes resulting in extra work.

3. Requirements Guide

3.1 FOUR "C'S"

It is important to strive for simplicity when documenting requirements. Compound requirements are more difficult to score, implement, and verify. In order to ensure simplicity, requirements should adhere to the four "C's" (IEEE standards practice), as follows:

- **C**lear - Use correct grammar and simple sentence construction to avoid ambiguity. Carefully select words that convey exact meaning.

- **C**orrect - Present information accurately and precisely.

- **C**omplete - Include important information.

- **C**oncise - Eliminate unnecessary words, but not at the expense of clarity, correctness, or completeness.

Avoid duplicating or contradicting requirements contained elsewhere in project documents. Refer to Section 2.5 Cross-referencing and Information Placement above. Inconsistencies discovered should be corrected, and corrections should be broadcast to all personnel working on the project.

3.2 Requirements: Do, Do Not and Avoid

This table contains information that should be referenced when creating IT solicitation documentation and when writing requirements. The application of this quick-use guide will help create clear and concise requirements. **Refer to SIMM Section 170A Exhibit A: Strong Requirement Samples.**

Table 5: Requirements Do, Do Not and Avoid

Do	Do Not	Avoid
• Document requirements in a sequential (and not duplicative) numbering schema. • Use simple sentences. • Choose words and terms that are simple and clearly understood. • Select words carefully and use them for precise meaning. Once a word is selected, use it consistently throughout the document(s) whenever the same meaning is intended. • Use positive expression to convey ideas. Example: "Applies to all claims that have not been modified.... " • Spell out acronyms on first use. Subsequent use of the acronym in the document is preferred. • Capitalize the initial letter of certain project specific nouns and proper names defined in a solicitation. • Omit unnecessary words.	• Use the nouns: "ability" or "capability". • Write requirements that make reference to future "deliverables." • Use the term "workflow," "seamless/seamlessness," or "performance" without first formally defining. • Use the term "proven practice" – unless there is written "proof" attached/provided. • Rely on a bidder's/contractor's subjective opinion as how a requirement was intended. • Use negative expression to convey ideas. Example: "Does not apply to claims with modification <X>". • Use the word "same" as a pronoun. For example, "The interface must be user friendly and the application the same." • Use adjectives like "excessive," "adequate," and "sufficient." These words are problematic. • Use ambiguous words like "support," "open," "consider," or "avoid."	• Compound requirements. • Unclear terms such as "real-time." If the intent is to set a minimum amount of time allowable for a process or function to occur, consider specifying a measurable limit (e.g., number of milliseconds). If you must use terms like "real-time", be sure to add a glossary item for the term so that the project's expectations are defined. • Complicated sentences in which omission or insertion of punctuation could change the meaning or create ambiguity. • Abbreviations with more than one meaning whenever possible—"When in doubt, spell it out." • Abbreviations of short words that save one or two characters. • Using words that have missing objects like "as appropriate," "as indicated," "as necessary," "as required," or "as directed."
Do	**Do Not**	**Avoid**

• Repeat nouns as opposed to using pronouns to minimize the possibility of misunderstanding.	• Broad brush the solution to adhere to an entire standard set. The project will accurately be able to identify compliance/noncompliance.	• Using terms "any or all," "etc.," and "such as."
• Consider each requirement as having a monetary value. They represent actual project costs.		• Using the terms and expressions like "to the satisfaction of [entity]," "shall function as intended," "best practice," and "best practices." Best is only "best" according to those that wrote them.
• Consider whether a court of law would side with *how* the requirement asked for the work to be conducted.		• Using "a" and "an"; as they need not be used in most cases.
• Write self-contained requirements that avoid references to diagrams, charts, other sections of the contract/solicitation document.		• Using adverbs like "hereinafter," "hereinbefore," "herewith," and "wherein."
• Provide accurate metrics where available. It is helpful if these align with metrics provided in PAL Stages 1 Business Analysis and Stage 2 Alternatives Analysis.		
• Specify how 'in use' will be defined. Does the bidder's solution need to be fully deployed with no additional implementation phases in the future, or will pilot phases be considered "in use"? A fully vetted system may be desired, not a system in pilot.		
• Refer to standards for which solutions must comply by identifying the standard sections and/or parts of the standard for which compliance is required. Also provide purpose for the adherence.		

3.3 Assigning Priority to Requirements

Assigning priority to a set of requirements is no easy task. Stakeholders may compete for and assign priority to requirements that affect their discipline, while other requirements may have no proponents, yet are equally if not more important. To establish and determine requirement priorities:

- Communicate how the requirements development process will work with stakeholders.

- Schedule and conduct both working and review requirements development meetings with stakeholders.

- Establish a set of rules and a strategy for dealing with conflict. Without rules of governance, meetings will not produce effectual results. Maintaining control, while listening to stakeholder concerns, is critical to proper requirements development.

- Determine how many requests are actually being made in the requirement.

- If business requirements specify more than one request, determine if it can or should be broken down further. A specification in a requirement should not be coupled with unlike requests. For instance, asking for an online submission form while requesting internet protocol (IP) security controls may involve very separate disciplines (and costs). Focus on the area of business need, which will become more important later when organizing requirements into logical groups.

- Determine if the requirement states environmental or temporary conditions that may not affect or be pertinent to the request. For example, *"The department needs to enable engineers to assess levy satellite imagery during a category 4 storm, in real-time."* A web programmer probably isn't going to write code for a service that only works well during poor weather. They may provide safeguards to make sure the service performs under extreme conditions, but the real requirement is simply to state the criticality of the need for the service or the minimum expectations of the service. An improvement might be, "*Engineers must have access to at least three different weather satellite feeds."*

3.4 Requirement Traceability

During requirements development, it becomes increasingly important, if not critical or mandatory, to keep track of changes to the original requirements. Generally this is referred to as "traceability" of the requirements. Determine responsibility level needed and assign staff to maintain accurate requirement traceability information. Use of tracked changes can be very helpful but if the requirements will go through multiple iterations, filters, approvers and reviewers, then tracked changes documents can become nearly impossible to manage. Refer to SIMM Section 170B Project Requirements Development Instructions for additional assistance applying requirements traceability.

Though some requirement statements appear to be clear, under further scrutiny it may become obvious that more information is needed to describe what is being requested. Review requirements as if being asked of someone who has no prior knowledge of the business. For instance, would someone who's never submitted a form online understand what a "web submission" is? There is a point where a requirement *can* be further defined; however, at times a specific term may be accepted to explain the requirement. Avoid making assumptions, even the word "form" should face scrutiny as to whether it should be further defined. When a term looks as if it could be up for interpretation, it's best to define it in a glossary or elsewhere as appropriate.

Various methods are used for requirements traceability. Some projects use tracked changes cyclically until some point in time, accept all changes (with the stakeholder's and working group's approval), and then start over with fresh tracked changes. Other projects with a large number of requirements, or that have a large number of stakeholders to review requirements, may use a requirements development tool. These tools can be costly, but when the cost of the project is in the millions of dollars, the expense may be feasible for achieving project success.

Many mid-sized to smaller projects will be successful using basic tools like MS Excel or Word to manage requirements. Choosing an enterprise requirements tool to manage a small project may be too burdensome and have too steep of a learning curve. Select the right tool for the right requirements task. Whichever method is selected, the goal should be to manage the requirement changes with accuracy and efficiency, while providing everyone involved the chance to participate in or be advised of the changes.

Requirements tracking may also provide an opportunity to perform initial cleanup of out-of-scope, out-of-budget, and time consuming requirements. For example, *asking for super-cooled, gold plated mouse pads may improve staff's work performance, however, if it's unrealistic for the project, it may be removed or be reduced to asking for BPA-free, ergonomic mouse pads.*

Refer to SIMM 170B Project Requirements Development Instructions for additional step-by-step requirements development information and details as they relate to the PAL process.