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Guidance for Tailoring DoD Request for Proposals (RFPs) to Include Modeling

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Acknowledgments

Abstract

With the advent of digital engineering and the Department of Defense (DoD) Digital Engineering strategy, programs are attempting to include digital engineering as part of their acquisition strategy. Realizing the desired benefits of digital engineering requires program offices to consider how to best acquire the models and artifacts necessary to gain the advantages of a robust digital engineering program. This report provides guidance for government program offices that are including digital engineering/modeling requirements into a request for proposal (RFP). Since RFPs can be released at many different program phases and because every program is different, the information in this report is meant to stimulate thought on the part of the program office into different areas to consider. The report provides overall guidance and more specific guidance regarding statements of work, deliverables, and Sections L and M of a request for proposal. Sample language included in this report is provided as exemplars and is not intended to be copied verbatim. We encourage program managers to use this report as a resource when partnering with contracting officers.

Introduction

This report was written to provide guidance to Department of Defense (DoD) program offices that are inserting language related to model-based engineering into their request for proposals (RFPs). It is *not* meant to provide boilerplate language. Every program and acquisition is different, and developing a meaningful RFP is difficult. This report is meant to inform how to request modeling artifacts in an RFP and provide some sample language that would need to be tailored by each program.

In the DoD, modeling falls under the scope of digital engineering. The DoD defines digital engineering as an integrated digital approach that uses authoritative sources of system data and models as a continuum across disciplines to support lifecycle activities from concept through disposal.[1]

The 2018 *DoD Digital Engineering Strategy*[2] outlines five strategic goals for digital engineering:

1. Formalize the development, integration, and use of models to inform enterprise and program decision making.

2. Provide an enduring, authoritative source of truth.

3. Incorporate technological innovation to improve the engineering practice.

4. Establish a supporting infrastructure and environment to perform activities, collaborate, and communicate across stakeholders.

5. Transform the culture and workforce to adopt and support digital engineering across the system lifecycle.

An RFP with thoughtful digital engineering/modeling additions can help fulfill all five of these elements within a program.

This report covers the following RFP-related topics:

a. The Statement of Work (SOW)/Statement of Objectives (SOO)/Performance Work Statement (PWS)

b. Contract Data Requirements List (CDRL) 1423s/Data Accession List (DAL)

c. Contract Line Items (CLINs)

d. Section L – Instructions to Offerors

e. Section M – Evaluation Criteria

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[1] For more information, see https://ac.cto.mil/wp-content/uploads/2019/06/2018-Digital-Engineering-Strategy_Approved_PrintVersion.pdf

[2] Ibid

This report assumes the reader has general acquisition knowledge. For example, this report does not try to explain the difference between a SOW, a SOO, and a PWS or explain how Data Item Descriptions (DIDs) work. For background on these terms the reader can visit www.dau.mil.

- This report uses the terms "digital engineering" and "modeling" interchangeably for simplicity in discussing RFP activities and artifacts; the breadth of digital engineering in practice is, however, broader than just modeling.
- For convenience, the term SOW is used throughout; the same advice can generally be applied to a SOO or a PWS.

General Guidelines

This section provides some general guidelines that should be considered in all RFPs that include digital engineering/modeling requirements. More detailed guidance is provided in the templates in the appendix.

The Program Office should include information on the digital engineering/modeling philosophy in the acquisition strategy. Below are some top-level questions that can assist with developing a digital engineering strategy and RFP artifacts. All these ultimately impact the RFP (and the proposals) and are discussed in some way in this report; here we have divided them into three categories associated with acquisition strategy, model usage, and specific acquisition to provide some grouping.

Top-Level Questions

Strategy-Related Questions

1. Will the models become the authoritative source of truth (ASoT)?
2. Will models need to be shared with other programs, or will models from other programs need to be used by the selected contractor(s)?
3. What data will require government purpose rights (GPR) to enable the digital engineering activities?
4. How will modeling information be turned over to the government at the end of the program, and how will the models be updated and sustained over the life of the system?
5. Will digital engineering/modeling be used in manufacturing and/or sustainment?
6. Will digital twins be used for the entire system, or only some components?[3]

Model-Usage-Related Questions

1. Will the government require models for specific types of information, or will the contractor propose how digital engineering/models will be used?
2. Does the government have requirements for any specific modeling methods and/or tools?
3. How will the program office be trained in the use of the models the contractor is using?
4. Will models be used in a simulation environment? If so, will they be expected to be used in conjunction with other models?
5. Does the government have models that will be provided as Government Furnished Information (GFI)? If so, how will those models be provided? Is the contractor expected to keep those models up to date? How will those updates be delivered?
6. Will models be used as part of validation/verification?

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[3] For more information on digital twins, see *The Digital Twin Paradigm for Future NASA and U.S. Air Force Vehicles* (https://ntrs.nasa.gov/citations/20120008178).

7. If more than one contractor is involved in developing models, who will be responsible for model integration?

8. Will models produce software code that will be used in the system?

9. Is modeling of real-time systems needed?

Acquisition/RFP-Related Questions

1. Has the government developed a model-management plan and/or style guide for the exchange of models and data between the government and the contractor?

2. Will digital engineering/modeling be used as an evaluation factor in the source selection?

3. Have the costs for government-required licenses been built into the cost estimate?

4. Will the contractor be expected to provide a plan to describe their modeling efforts?

5. For the source selection, will digital engineering/modeling be a separate subfactor under the technical factor? Or will it be part of systems engineering or another subfactor?

Acquisition Strategy: Multiple Awards

If the acquisition strategy includes multiple awards, different competitive approaches will drive different information and task requirements. If all the awardees are doing the same work leading up to a down select, then the information needed would be very similar to a source selection with a single awardee. If a multiple-award Indefinite Delivery, Indefinite Quantity (IDIQ) is envisioned, with companies competing for task orders in different areas, the program office may want to include a sample task for modeling work and ask contractors that want to be considered for modeling efforts to respond to that sample task order. If the acquisition strategy is to allow more than one contractor to work on the same model, then the government would need to include information on the GFI modeling environment.

CDRLs and DIDs

For Major Capability Acquisitions that use a System Engineering Technical Review (SETR) based process,[4] Contract Deliverable Requirements Lists (CDRLs) and Data Item Descriptions (DIDs) can be used to indicate the government's desire for contractors to provide models that will be used to support various milestone reviews. The types of models and the maturity of those models for any given review need to be specified.

For example, if the government expects contractors to provide a requirements model that will be used to support various reviews, a CDRL could be used to indicate that contractors must provide a requirements model incorporating information found in the System/Subsystem Specification (SSS) DID. The CDRL could also indicate that contractors must provide an initial version of the requirements model for use at the System Requirements Review and that contractors must mature the model, as needed, to support other reviews. Finally, the CDRL could indicate that contractors should deliver a mature requirements model after completion of the Preliminary Design Review (PDR) and an "as built" requirements model after delivery.

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4   Systems Engineering Technical Reviews (SETR)

Another approach is to create CDRLs to indicate that the government expects contractors to provide groups of related models. For example, a CDRL could be used to indicate that contractors must provide a group of models that includes the requirements, architecture, and design models, while a second CDRL could be used to indicate that contractors must provide a second group of models that includes real-time, state/mode, control, and data flow models. Grouping models in this way can help ensure that the interfaces between models are as seamless as possible.

Details about modeling activities would typically be specified in the SOW and in the DD1423s for the CDRLs. The general recommendation is to not over-specify the modeling effort, but any hard requirements must be included in the SOW and/or CDRLs. For any traditional documents represented by CDRLs, the information required in the DID may be represented in one or more models. Also, any given model may include the information specified in one or more CDRLs. Therefore, it is important to ask for some type of modeling plan or at least a mapping of what will be provided by each model and the linkages between models.

Iterative or Rapid Development

For non-traditional development efforts (Agile, rapid prototyping, DevSecOps, etc.) the RFP should require more continuous model updates and the government should be ready to review models during demonstrations or other times when capability is being delivered. The models would be expected to continue to add fidelity as more capability is added to the system being developed.

RFP/Source Selection

The program office needs to determine what subfactors will be used under the technical factor for the source selection. If digital engineering/modeling will be a major part of the program, consider using a separate subfactor. Typically, modeling would be included in the systems engineering subfactor since they are closely related.

The program office needs to determine if modeling should be used as one of the of the evaluation criteria. Typically, there are two reasons to include something as part of the evaluation criteria: either it is a significant source of risk to the program or is expected to be a significant differentiator between bidders. Thus, if the program office expects different offerors to propose different methods of responding to the modeling requirements and wants to use those differences as possible differentiators in the source selection process, modeling should be part of the RFP's evaluation criteria. Another potential reason to include modeling as one of the evaluation criteria is if it is important to make sure the offerors have a reasonable plan or can demonstrate experience in meeting SOW requirements related to modeling.

Another consideration for programs that are planning an extensive digital engineering/modeling effort is the Work Breakdown Structure (WBS) per MIL-STD-881E. Appendix K of MIL-STD-881E, Common Elements Definitions, includes modeling under core systems engineering and in several other areas, including test and evaluation. If the program will have a large modeling effort, it will be beneficial to make the associated costs visible in the cost reporting (that traces back to the WBS).

It is important to ensure that the digital engineering/modeling requirements in the RFP are consistent across the RFP and with other requirements, especially those for system engineering and software engineering.

Also, ensure the contracting officer, contracting specialist, contracting officer representative, and legal representative are involved in developing any model-related RFP/contracting language. There are several places in this report where we reiterate the importance of working with the contracting officer. These are areas where it is critical to get contracting office input early in the process.

Guidance for Contract Language for Digital Engineering/Modeling

This section provides some general guidance for developing contract language for modeling. More specific information is included in the appendices.

Statement of Work/Statement of Objectives/Performance Work Statement

If the government wants to include a digital engineering/modeling effort on a contract, they must include instructions related to modeling. This is needed whether they use a SOW, a SOO, or a PWS. Such instructions can be as simple as stating that some specific aspects of the system must be modeled or as complex as specifying the use of one or more GFI models and continuing to develop models using specific techniques and tools. In Appendix A of this report, we provide some guidance to inform SOW requirements based on a program's specific needs.

CDRL 1423s/DAL

The program office will need to determine the most appropriate method of specifying the data to be delivered from the digital engineering/modeling effort. There are several factors to consider when making this decision, including: development lifecycle (major capability, iterative or rapid, etc.), the extent of the modeling efforts (just a few models or the entire system), and where the program is in the acquisition development lifecycle (competitive phase, development phase, sustainment). Whether the program chooses to use one CDRL to specify the data needed from the entire modeling effort, or chooses to use multiple CDRLs, the program office will need to consider which DIDs to use, how to tailor the DIDs, and how to specify delivery of the modeling data. It is also possible to develop a form similar to a DD1423 that can be used to provide specifics of data that can be provided as part of the Data Accession List (DAL) versus using a CDRL. Typically providing this data as part of the DAL is faster and less expensive for a contractor than delivering it as a CDRL. If government approval is not required, consider using the DAL versus a CDRL. Appendix B (CDRL/DAL Templates) provides templates for CDRLs for several existing documents (SSS, DoD Architecture Framework Documentation [DoDAF], and a Software Architecture Document [SAD]). Models can also be included in Technical Data Package CDRLs if those are used in the program. Appendix B of this report also contains a sample for an inclusive modeling CDRL and a sample form that can be used to specify DAL deliveries.

CLINs

Contract Line Numbers (CLINs) identify the supplies or services to be acquired as separately identified line items on a contract that provides for accounting traceability. The program's specific CLIN structure will depend on the program. For example, if the entire system is being modeled, there might be one CLIN to get the model data delivered. But, if the program is requesting only a few independent models, those might be delivered under CLINs for those capabilities. For example, a survivability model could be delivered under the CLIN for the

survivability effort. Be sure to coordinate with the contracting officer to find out their recommended approach to CLINs before defining how the modeling data will be defined in the CLIN structure. This report does not provide a template provided for CLIN wording; we recommend the program office work with the contracting officer.

Section L – Instructions to Offerors

When performing a source section, the instructions to offerors are instrumental in ensuring the proposals cover what the program office needs to know regarding digital engineering/modeling. For some programs, there will not be language in Section L on modeling; for others, there could be a requirement to provide extensive details. There may even be a Section L requirement to provide a draft modeling plan or possibly comments against a government-provided modeling plan. Some contracts may request sample models as part of a sample task, extensions to GFI models, or other exercises to demonstrate modeling experience. If Section L asks for a lot of details on modeling, then that typically indicates that modeling will be used as one of the evaluation criteria.

Different methods can be used to include modeling in Section L. Digital engineering/modeling might be its own subfactor as part of the technical factor. In that approach, include instructions to describe the linkages between the modeling subfactor and the systems engineering/software subfactors (as appropriate). If modeling is included in the systems engineering subfactor, ensure the specific information requested regarding modeling information is clear. Detailed guidance for Section L is provided in Appendix C of this report.

Basis of Estimates (BOEs)

It is important to ensure the BOEs include the costs for the modeling efforts, especially if modeling is used as one of the evaluation criteria. Even if modeling is not one of the evaluation criteria, it is often important to understand the level of effort that is being applied to modeling and how it contributes to program cost. The BOEs typically follow the WBS, so ensure modeling is visible in the government WBS if it needs to be visible in the BOEs. Also, ensure the technical team will have access to the BOEs as part of their evaluation. A contractor can propose the best modeling plan in the world, but if the BOEs do not include sufficient hours for the work, then that will cause problems during execution.

Data Rights Information

Model data and/or tools may be considered proprietary by the contractor, so it is important to establish what rights are required and what rights will be provided as part of the RFP/proposal. There are many ways to handle data rights; the rights for model data are not appreciably different from other rights, so talk to the contracting officer and legal advisor. Rights for proprietary modeling tools could be more difficult to negotiate, so the program office may want to require justification for any proprietary modeling tools proposed and require a plan to transition the data from those tools to the government at the end of the contract. An alternative could be to allow proprietary tools if the output can be used by non-proprietary tools. Many tools output to Extensible Markup Language (XML) Metadata Interchange (XMI) that can be imported to other tools with appropriate plug-ins with minimal or no data loss.

Incentive Plan Information

Modeling can be included in an incentive plan. It is easier to include this information if you're using award fee because subjective measures can then be used (for example, how much the modeling effort is contributing to program office understanding of the design). However, incentives based on model completion could be developed. The most likely incentive fee would be linked to schedule (e.g., whether the models were completed by the expected date), or cost (e.g., whether the cost for one or more specific modeling tasks was within budget). As with any incentives, care is required to ensure the desired behaviors are incentivized and that unintended consequences are minimized.

Government Furnished Information

If the program office is providing models to the contractors, ensure these are included on a GFI listing and that the contractor assesses the models within a specific time frame. Also require that the contractor(s) must notify the government if the data is satisfactory within a reasonable time frame. The government may also need to provide modeling tools (or access to those tools) or ensure that contractors have what they need to view government-provided models by providing postscript data file (PDF) views or web views.

Key Personnel

If the program office is using a key personnel clause and modeling is an important part of your acquisition, then consider adding someone with modeling experience to the key personnel list. If the program office is not using a key personnel list, it probably is not worth adding one just for modeling personnel.

Section M – Evaluation Criteria

Many programs may not include digital engineering/modeling as one of the evaluation criteria. As stated above, typically evaluation criteria are selected based on either areas of risk to the program or areas where the program believes there will be discriminators between offerors. If the program decides to include modeling as one of the evaluation criteria, thought must be given to how the modeling criteria will be evaluated. The RFP could request submittal of a draft modeling plan for evaluation. It could also require submission of one or more actual models. If model submissions are required, make sure to specify that contractors are expected to provide models in a format that can be reviewed using tools that are available at the source selection facility (e.g., specific modeling tools, web browsers, Microsoft® Office products). The RFP might also require extracts of models be presented within Section L as diagrams. Another possibility is to include a demonstration of the modeling functionality. This is often more difficult to arrange, especially with multiple offerors, but can often provide more insight into the offeror's modeling capabilities. Detailed guidance for Section M is provided in Appendix D of this report.

Other Sections

Compliance Standards

The program office will need to decide if it wants to include any compliance standards related to modeling, and if so, which standards. This would be very dependent on what types of models are being used. If the contractor is allowed to select the modeling languages and tools, the program office may want to include a requirement for the contractor to include the appropriate standards for those specific languages in their proposed contractual language or in the modeling plan. See the SOW Template in Appendix A for information about possible standards to include.

H Clauses for Contractor Review

If the program office is planning to have System Engineering and Technical Assistance (SETA) or FFRDC[5] support during source selection or contract execution and they will be assisting with evaluating contractor models, include the appropriate H clauses, if required. Coordinate with the contracting officer for recommendations on how to properly use this support.

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[5]   Federally Funded Research and Development Center

Conclusion

The information provided in the main section of this report provides general guidelines for including digital engineering/modeling in acquisition documents. The templates and guidance provided in the appendices provide more detailed information for specific acquisition artifacts.

The guidance provided in this report is intended to help program offices decide how to include digital engineering and modeling in their acquisitions and provide improved support for program lifecycle activities.

Templates and Detailed Guidance

Templates or detailed guidance is provided in the appendices for the following documents:

Appendix A: SOW/SOO/PWS Template
Appendix B: CDRLs/DAL
      DD1423 for System/Subsystem Specification Tailoring
      DD1423 for DoDAF Tailoring
      DD1423 for Software Architecture Document Tailoring
      Sample DAL form
      Potential DD1423 for models
Appendix C: Detailed guidance for Section L – Instructions to Offerors
Appendix D: Detailed guidance for Section M – Evaluation Criteria

Appendix A   SOW/SOO/PWS Template for Sections Focused on Modeling

A.1   General Instructions

This appendix provides exemplar language for a variety of elements of the SOW/SOO/PWS. The paragraphs below are not meant to be copied verbatim. The program office first must determine which exemplars are applicable, then determine how to tailor them to meet their specific needs.

In many instances, the wording would not be in a separate modeling paragraph but would be included in a SOW paragraph on that specific topic. For example, the language below on reliability modeling would most likely be included in the reliability section of the SOW. Most of this language could apply to a SOW, SOO, or PWS but is written with a SOW in mind. Generally, SOO language is at a higher level than SOW language, and PWS language describes the desired results but not how those results should be accomplished.

The blue-shaded boxes include sample language, and the grey-shaded boxes include notes to the person preparing the document.

A.2   Digital Engineering Environment

The following is sample language for setting up a digital environment.

> "The contractor shall develop a digital engineering environment and produce an authoritative source of truth (ASoT) that will be used to manage the engineering artifacts and models used to create and develop the models and interconnections of the system." See NASA's Digital Engineering Acquisition Framework[6] for guidance.[7]
>
> The contractor shall establish an integrated digital environment to provide a compilation of data, models, and tools for collaboration, analysis, and visualization across functional domains. An Integrated Development Environment (IDE) includes the methodology and specification for data, models, and tools arrangement with processes and procedures to exploit informational results.[8] The contractor shall establish and manage a digital thread that links models and digital artifacts. The contractor shall update digital artifacts throughout the system lifecycle to maintain a digital twin of the system.

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[6]   For more information, see: https://standards.nasa.gov/file/38386/download?token=LdmxVVcB

[7]   For more information, see the *Architecture-Centric Virtual Integration Process (ACVIP) Acquisition Management Handbook Volume II* (January 2021, SEI—Limited Distribution).

[8]   For more information, see the official memorandum template: *USAF SAF/AQ Guidance for e-Program Designations*, May 2021 (https://software.af.mil/wp-content/uploads/2021/05/Digital-Building-Code-and-Scorecard-Memo-v15.pdf).

Note to Preparer: The digital environment requirement and the ASoT requirement can be separate paragraphs if desired. The digital environment paragraph can be expanded, especially if the environment will be hosted by the government or by a different contractor. If the environment will be transitioned to the government at the end of the contract, that information should also be included along with a CDRL that describes the environment to include set-up and usage.

A.3 Use of Architecture Centric Virtual Integration Process (ACVIP)

If the program is using ACVIP,[9] include language specifically referencing the ACVIP environment and processes.

The contractor shall develop and maintain an ACVIP environment that incorporates appropriate considerations for reconfigurability, portability, maintainability, technology insertion, vendor independence, reusability, scalability, interoperability, upgradeability, and long-term supportability. As part of this contract, the contractor shall align ACVIP activities to an Open Systems Management Plan (OSMP) [DI-MGMT-82099 2018]. *[CDRL XXX]*

Note to Preparer: ACVIP is a compositional, quantitative, architecture-centric, model-based approach enabling virtual integration analysis in the early phases and throughout the lifecycle to detect and remove defects that currently are not found until software, hardware, and systems integration and acceptance test.[10] If the program is using ACVIP, ensure the SOW language is aligned with what is expected from the contractor(s). If multiple contractors are involved, ensure the language includes sharing of ACVIP artifacts.

A.4 Model Integration

Sample language:

If there is only one contractor performing modeling, the wording might be as simple as:

The contractor shall ensure all models are integrated as described in the Modeling Plan.

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[9]   For more information, see the *Architecture-Centric Virtual Integration Process (ACVIP) Acquisition Management Handbook Volume II* (January 2021, SEI, Distro C—Limited Distribution).

[10]   For more information, see *Architecture Centric Virtual Integration Process (ACVIP)*: *A Key Component of the DoD Digital Engineering Strategy* [Boydston 2019].

If there are multiple contractors with one of them responsible for integrating the models:

Sample wording for integrator:

> The contractor shall be responsible for specifying integration requirements and time frames for other contractors developing models for the system. This information shall be provided in a Model Integration Appendix to the Modeling Plan that is releasable to all contractors. *[CDRL XXX Modeling Plan]*

Sample wording for the other contractors:

> The contractor shall provide their models to the model integrator as per the Model Integration Appendix.

If there are multiple contractors with the government responsible for integrating the models:

> The contractor shall provide their models to the government as per the government's modeling plan.

> Note to Preparer: More specific information regarding model integration may need to be included. If more than one contractor is developing models, consider using incentives to help encourage a cooperative effort. Consider any GFI models that could have multiple contributions from the contractor team.

A.5 Modeling Tool/Technique Training

If the modeling method is not specified by the government, consider using this sample language:

> The contractor shall provide training for all the modeling techniques/tools used on the program for government and government support contractors. The contractor shall propose a reasonable training schedule for each modeling technique/tool but not less than X.

> Note to Preparer: Fill in what is good for the program with respect to training frequency, recommend not less than once a year or perhaps something like at least one course three months prior to each major review.

A.6 Model Development

Sample language:

> The contractor shall develop one or more models/views to represent the system being developed. The contractor can determine what models and modeling languages/tools best fit their development processes. The contractor shall provide the government with a plan for how the modeling activities will be organized. The plan shall provide the program office with information about what is in each model, and how the combination of models can provide the information required by the SOW (and any other information the contractor deems necessary for their modeling efforts). The SEI publication *Modeling to Support Lifecycle Events* can be used as a guide.[11]

> Note to Preparer: If the program has any specific requirements for the plan, these can be included in in the SOW or the DD1423.[12]

A.6.1 Architecture Models

Include information on requirements for system architecture modeling. This can include general language or require the use of DoDAF. Also include requirements for any specific software architecture modeling methods.

Sample language:

If the program office is using DoDAF,

> The contractor shall create and/or update and maintain DoD Architecture Framework (DoDAF) Documentation views and models as needed to document the applicable system architecture. *[CDRL XXX]*

If the program office is not requiring DoDAF,

> The contractor shall create and/or update and maintain models/views as needed to document the applicable system architecture. *[CDRL XXX]*
>
> The contractor shall ensure all models are integrated as described in the Modeling Plan.

For the software architecture,

> The contractor shall create and /or update and maintain software architecture views and models as needed to document the applicable software architecture. *[CDRL XXX]*

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11 For more information, see *Modeling to Support Lifecycle Events* [Cohen 2022].

12 Ibid

Note to Preparer: Tailor the information needed for architecture model information to suit the program's needs. If using DoDAF, the specific views can be specified in the DD1423. If the program requires the use of a specific method for documenting the software architecture, that should be included in the SOW.

A.6.2   Requirements Models

Sample language:

The contractor shall model requirements-related information for the program. The contractor shall provide all the required elements in the guidance in *Modeling to Support Lifecycle Events*.[11] The requirements model shall integrate with the architecture model(s) and the design model(s) at a minimum. [CDRL XXX –this could be the SSS, SSS + IRS, or a modeling CDRL]

The contractor shall construct models to enable the following to be traced from the requirements: analysis of requirements, system architecture design, allocations, interfaces, certifications, and functional thread analysis.

Note to Preparer: Tailor the information needed for requirements-model information to suit the program's needs. Use *Modeling to Support Lifecycle Events*[11] as guidance or add that as a required guidance document. Items that are listed as "required" should not be tailored out. Those that are listed as optional can be tailored in as needed. Ensure directions are provided with respect to interface requirements as well. These can often be delivered under a separate CDRL/DID. If there is any reason the interface information needs to be deliverable in a stand-alone form, be sure to include this in the SOW. If any specific modeling techniques or tools are required for the requirements model(s), specify that here.

A.6.3   Design Models

Sample language:

The contractor shall create and/or update digital system model(s) as needed to document the design of the system.

Note to Preparer: Tailor the information needed for design model information to suit program needs. Use *Modeling to Support Lifecycle Events* as guidance. [11] The program office may also need to provide information on what level of design to model if the entire system will not be modeled. If any specific modeling techniques or tools are required, specify that here. The delivery of models to specific maturity levels to support SETR events is typically included in the DD1423 and not in the SOW, but if needed, that type of information can be included in the SOW.

A.6.4 Data Models

Sample language:

> The contractor shall create and/or update the digital system model(s) as needed to document the data used or produced by the system.

> Note to Preparer: Tailor the information needed for model data to suit the program's needs. If any specific modeling techniques or tools are required, specify that here. If data is being shared with other programs, or different contractors are developing different subsystems, sharing model data may require specification of appropriate formats. The government could also consider using DoDAF views to obtain this data.

A.6.5 Software Runtime Models

Sample language:

> The contractor shall create and/or update the digital system model(s) as needed to predict and/or document the real-time performance of the system. These models shall be capable of (1) performing virtual system integration and (2) being used for test and verification.

> Note to Preparer: Real-time modeling languages such as the SAE AS 5506 Architecture Analysis and Design Language (AADL) standard can provide end-to-end latency, functional integration, port connection consistency, weight, electrical power, compute resource budget (memory, processor, bus bandwidth), error modeling and safety analysis, structural model verification, compositional verification, and behavioral modeling. If any of these are specific requirements, they can be included in the SOW.

A.6.6 Software/Firmware Code from Models

Sample language:

> All code generated from models must be tested/validated using the same methods used for code generated by developers. The contractor must specify the qualification methods they will use to test the code.

Note to Preparer: The contractor(s) need to say what elements of the system will contain code generated from models, what specific functions the model generated code will perform, and what qualification methods will be used. Information on qualification methods could be included in the test plan and test procedures CDRLs. Ensure any required language from others with certification interests (safety, airworthiness, security, etc.) are included in the SOW. Alternately, the program office can prohibit generation of code from models. See *Model-Driven Engineering: Automatic Code Generation and Beyond* for more information.[13]

A.6.7   Supportability

Sample language:

The contractor shall develop/update the models and modeling tools used to analyze the supportability of the system. These can include Level of Repair Analysis, Maintenance Task Analysis, and Reliability, Maintainability, and Availability analyses.

Note to Preparer: The program office will need to supply the details of whether this is for both system and software. The program office will need to determine the specific models required. The list above is not all inclusive and models can be added or removed as needed.

A.6.8   Survivability/Vulnerability Models (If Needed)

Sample language:

The contractor shall develop/update the models and modeling tools used to analyze the survivability and vulnerability of the system. The contractor shall update models based on changes in threats and combat missions.

Note to Preparer: This can be included in the survivability section of the SOW.

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[13]   *Model-Driven Engineering: Automatic Code Generation and Beyond*
(https://resources.sei.cmu.edu/library/asset-view.cfm?assetid=435414)

A.6.9   Reliability Modeling

If the program requires the use of specific models for reliability, include this type of requirement in the reliability section of the SOW.

Sample language:

> The contractors shall use modeling (completely or in part) to perform the following analyses:
> - Failure Modes and Effects Criticality Analysis (FMECA)
> - Failure Modes Effects Analysis (FMEA)
> - Fault Tree Analysis
> - Subsystem Hazard Analysis (SSHA)
> - Modeling Using the Logistics Composite Model Analysis Toolkit (LCOM)
>
> (CDRL XXX – Reliability Report)

> Note to Preparer: It is likely that not all these analysis methods will be needed, and more information would need to be provided on the extent modeling is required for these analyses. This section should be included in a broader reliability section, and the program office will need to decide to what extent it wants to require modeling be used to fulfill the reliability analysis requirements.

A.7   Model Access

Sample language for modeling tools hosted by the contractor:

> The contractor shall provide the government (and/or government support contractors) on-demand electronic access for models, virtual integration-related artifacts, and data, including metrics and analysis that the environment may generate. This shall include the ability to download these artifacts throughout the term of the contract. If the government is hosting the modeling tools, there will need to be language requiring the contractors to integrate their models into the government hosted model. In addition, if models will be delivered to the government, ensure all the information needed is included in the delivery information (for example model profiles). Depending on the contract length, the government may want to include a provision that the modeling tool(s) be updated to the latest version prior to model delivery. That way, if the models were developed on a version of the tool that is no longer supported, the contractor will need to make sure it will run on the latest version of the tool.

> Note to Preparer: Access to models and/or model data is critical for a program office. If there are requirements for tool access, that can also be included.

A.8 Model Data Storage/Sharing

This section provides requirements for how the model data will be stored and shared. The program office also needs to be concerned with data marking. If any of the model data is Controlled Unclassified Information (CUI), classified, personally identifiable information (PII), or for multi-national programs only releasable to specific countries, then the model data must be tagged, and views should be made available that conform to specific marking requirements.

Sample language when the government owns the environment:

> The contractor shall ensure all modeling data, including metadata, is stored in the government modeling/development environment. The contractor shall ensure requests for more storage space are submitted a minimum of X days before the need date. The contractor shall provide details of model storage in their Modeling Plan. *[CDRL XXX]*
>
> For data marking, the contractor shall ensure proper marking of all model elements and ensure views with specific markings can be produced (for example views that do not contain any CUI or classified information). NOTE: This type of information should also be included in the CDRL DD1423 form.

Sample language when the contractor owns the environment:

> The contractor shall provide details of model storage in their Modeling Plan. *[CDRL XXX]*
>
> The contractor shall ensure proper marking of all model elements and ensure views with specific markings can be produced (for example views that do not contain any CUI or classified information). NOTE: This type of information should also be included in the CDRL DD1423 form.

For data marking:

> The contractor shall ensure proper marking of all model elements and ensure views with specific markings can be produced (for example views that do not contain any CUI or classified information). NOTE: This type of information should also be included in the CDRL DD1423 form.

> Note to Preparer: This section will be very program dependent. If there is a government-owned modeling/development environment, ensure model data is required to be saved to that environment. If the contractor is hosting the modeling/development, then the data storage should be included in the modeling plan, and this paragraph may not be needed. If data will be shared outside the program, include that information here or in another section.

A.9 Model Usage

If the program office does not want to include separate sections for all or some of the modeling requirements, these could be combined into a single SOW paragraph. This paragraph would include any specific requirements on how the model will be used that were not included in separate sections. If the program office chooses to include such a section, use wording from the other SOW sections included in this appendix. For example, if the SOW will include model requirements for testing and architecture evaluation but separate paragraphs are not wanted, these could be combined under this heading.

A.10 Modeling in Architecture Assessment

If the program office requires an architecture assessment and wants to use modeling as part of that assessment, this paragraph can be used, or this information can be included in the architecture assessment section of the SOW.

Sample language:

> System and software models shall be available to support all architecture assessments. Specific models/views shall include [add any specific information required]

> Note to Preparer: The program office will need to supply the details of whether this applies to both the system and software architecture. This information should be included in the architecture assessment portion of the SOW.

A.11 Modeling to Help Assess Key Performance Parameters (KPPs)

If the program office requires modeling to support assessment of KPPs, include that requirement in the SOW.

Sample language:

> The contractor shall use modeling during design, development, and test to assess the achievement of the KPPs. The methods for meeting this requirement will be included in the modeling plan. *[CDRL XXX Modeling Plan]*

> Note to Preparer: The program office will need to supply the details of any specific modeling techniques it requires for KPP assessment This section should be included in the SOW section on KPPs.

A.12 Modeling in Test and Evaluation

Include program office requirements for modeling to support test and evaluation.

Sample language:

> The contractor shall use modeling to support test and evaluation activities. The use of modeling in test and evaluation will be included in the modeling plan. *[CDRL XXX Modeling Plan]*
>
> Prior to integration testing, the modeling data shall be updated to match the as-built system.
>
> Digital twins shall be used to perform testing whenever practical, as delineated in the Modeling Plan.
>
> Any models needed for Developmental Test and Evaluation and/or Operational Test and Evaluation shall complete validation/verification prior to use.
>
> [CDRLS could include Modeling Plan, Test Plans, Test Procedures, Test Results (for modeling validation/verification)]

> Note to Preparer: Use of models in test and evaluation is a complicated topic. The wording above provides simple language to help program offices consider the requirements. In practice, these SOW requirements will likely be more detailed. In addition, the government Test and Evaluation Master Plan (TEMP) should include information on any models needed to support Developmental Test & Evaluation (DT&E)/ Operational Test and Evaluation (OT&E) (both contractor and government developed).

A.13 Model Validation and Verification

Sample language:

> For models used for capability verification, the contractor shall perform model and data verification, validation, and accreditation (VV&A) per the Modeling Plan, for the following types of models:
>
> - Virtual environments/simulations
> - Hardware in the loop
> - Safety/airworthiness/nuclear
> - Joint modeling environment
>
> *[CDRL XXX – Modeling Plan]*, *[CDRL YYYY – V&V&A Results]*

If independent VV&A is required, include language such as:

> The contractor shall support an independent VV&A of the following models. (Insert specific model types.)

Note to Preparer: Tailor the information needed for model verification activities. Unless the program has very specific requirements for model V&V, we recommend leaving the details for the plan. Then the program office staff can review the plan and suggest changes.

Tailor the sample language to list the specific types of models the program office wants to include.

If the government has prepared a modeling plan, include the reference here.

If the program needs to see more specific V&V procedures as a deliverable, include another CDRL here.

A.14 Non-Software Related Models

This report focuses mainly on software-related models and does not provide exemplars for mechanical models; however, these should be included in the SOW as well. Add paragraphs for any other needed models, such as mechanical properties, wind tunnel, thermal, power, etc.

A.15 Other Sections That Might Be Affected

A.15.1 Configuration Management

Ensure the configuration management sections of the SOW include management of model data and audits of that data. If the program is using a Configuration Management Plan CDRL, it should include model data as well. Ensure that modeling that is ready for government review is delineated from modeling work still in progress. This information could be in the Modeling Plan, the Configuration Management Plan, or both.

A.15.2 Subcontractors

Ensure all the modeling requirements flow down to sub-contractors as needed.

A.15.3 Technical Orders/Manuals

If any modeling data will be used in technical manuals, be sure that is included in the technical order section of the SOW.

A.15.4 Manufacturing

The program should consider how manufacturing models might be linked to other models. Also, if changes are made during manufacturing that impact system models, then these models will need to be updated. This information should be included in the SOW if manufacturing is involved.

A.15.5 Certification Programs

There are several possible certifications that DoD systems might have to attain. These could include safety, airworthiness, survivability, spectrum, interoperability, cybersecurity, and nuclear certification. If models will be used to provide evidence for one or more specific certifications, ensure the model views, the verification requirements, and data required are specifically called out in the SOW.

A.15.6 Specification Tree

Models can replace some or all of the items in a typical specification tree. If the program office plans to include a specific tree as a deliverable, ensure that this can either be delivered as a model, or at least parts of the tree can be provided as models.

A.15.7 Metrics

If the program office plans to collect metrics on the modeling efforts, that can be handled in different ways. The program office could require the modeling plan to include the metrics the contractor will supply to the government. Another possibility is for the government to specify some or all the metrics. The Goals-Questions-Indicators-Metrics[14] (GQIM) technique is a good way to develop metrics. Some items to consider when developing modeling metrics include model size change, progress, predictions of effort to complete, connectivity between models, and model usage in testing.

A.15.8 Standards

The program office must determine which standards will be compliance or reference standards in the RFP related to the digital engineering/modeling effort. Below are some possibilities, but the standards list to include in an RFP must be specifically selected by the program office.

a. ASME Y14.41   Digital Product Definition Data Practices

b. ASME Y14.47   Model Organization Practices

c. IEEE 1471-2000 - Recommended Practice for Architectural Description of Software-Intensive Systems (ANSI/IEEE 2000) (ISO/IEC 2007)

d. Architecture Analysis and Design Language (AADL) (SAE 2009)

e. Modeling and Analysis for Real-Time and Embedded Systems (MARTE) (OMG 2009)

f. Unified Modeling Language (UML) (OMG 2010b)

g. Unified Profile for United States Department of Defense Architecture Framework (DoDAF) and United Kingdom Ministry of Defence Architecture Framework (MODAF) (OMG 2011e)

h. The Open Group. FACE™ Technical Standard, Edition 3.1. July 2020. https://publications.opengroup.org/standards/face/c207

i. OMG System Modeling Language specification (About the OMG System Modeling Language Specification Version 1.2)

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14   For more information, see The Making of Software website (https://makingofsoftware.com/2010/08/goalquestionmetric-gqm/).

Appendix B   CDRLs/DAL Templates

This appendix provides samples of a selection of CDRL DD1423s that contain sample language regarding modeling. The first three samples are typical CDRLs used in development projects. The modeling language in these CRDLs can be extrapolated for use in other CDRLs. The sample DAL form section contains both a blank form and one filled out with the same information that is in the sample Software Architecture Description. The final file is a 1423 that could be tailored if a program office wants to have a specific modeling CDRL.

B.1 DD1423 for System/Subsystem Specification Tailoring

CONTRACT DATA REQUIREMENTS LIST (1 Data Item)		*Form Approved* OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 110 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding thus burden estimate or any other aspect of this collection o f information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget. Paperwork Reduction Project (0704-0188), Washington, DC 20503. Please DO NOT RETURN your form to either of these addresses. Send completed form to the Government Issuing Contracting Officer for the Contract| PR No. listed in Block E.

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY: TDP TM OTHER	

D. SYSTEM|ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR

1. DATA ITEM NO.	2. TITLE OF DATA ITEM **System/Subsystem Specification (SSS)**	3. SUBTITLE	

4. AUTHORITY *(Data Acquisition Document No.)* **DI-IPSC-81431A/T**	5. CONTRACT REFERENCE	6. REQUIRING OFFICE

17. PRICE GROUP

18. ESTIMATED TOTAL PRICE

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY SEE BLOCK 16	12. DATE OF FIRST SUBMISSION **SEE BLOCK 16**	14. DISTRIBUTION	

				a. ADDRESSEE	b. COPIES
8. APP CODE		11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION **SEE BLOCK 16**		DRAFT / FINAL (Reg / Repro)

16. REMARKS

(*Note: The SSS mainly conveys requirements. If you are using the SSS to document interface requirements then tailor the 1423 appropriately. Use the appropriate sections of the Modeling Guidelines to help tailor the DID. In general, the SRR guidelines for requirements are most appropriate but the requirements model should mature as the program progresses. If there are requirements for interfaces they can be in the SSS or in one or more Interface Requirements Specifications (IRSs) (DI-IPSC-81434A) referenced from the SSS.*)

Block 4:
DI-IPSC-81431A is tailored as follows:

Paragraph 3 is edited to read, "3. Format. Following are the format requirements: The information that makes up the specification shall be in contractor format using an approved modeling tool(s). (***add in the names of any specific models required***) Note: The SSS information must document the requirements information. Other information in the SSS may be provided in models identified in other CDRLS/DAL items)

Paragraph 4. Content is edited as follows:
- The information in paragraphs 1-3 shall be provided either in document form or as part of the information included in the model
- The information in the remainder of the paragraphs shall be provided using one or more approved models. (***add in the names of any specific models required***)

Block 10:
The model(s) shall be available on-demand as read-only files. The versions used to support the following reviews (***add in reviews such as SRR, SDR, PDR, etc.***)

Block 11: As of date will be the date the models that are the basis of the review are posted to the shared data site.

.

15. Total

G. PREPARED BY	H. DATE	I. APPROVED BY	J. DATE

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B.2 DD1423 for DoDAF Tailoring

CONTRACT DATA REQUIREMENTS LIST (1 Data Item)			*Form Approved* *OMB No. 0704-0188*		

Public reporting burden for this collection of information is estimated to average 110 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding thus burden estimate or any other aspect of this collection o f information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget. Paperwork Reduction Project (0704-0188), Washington, DC 20503. Please DO NOT RETURN your form to either of these addresses. Send completed form to the Government Issuing Contracting Officer for the Contract| PR No. listed in Block E.

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY:		
		TDP TM OTHER		

D. SYSTEM|ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE
	DoD Architecture Framework Documentation	

4. AUTHORITY *(Data Acquisition Document No.)*	5. CONTRACT REFERENCE	6. REQUIRING OFFICE
DI-MGMT-81644B/T		

17. PRICE GROUP

18. ESTIMATED TOTAL PRICE

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION	14. DISTRIBUTION		
		SEE BLOCK 16	**SEE BLOCK 16**		b. COPIES	
8. APP CODE		11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION	a. ADDRESSEE	DRAFT	FINAL
			SEE BLOCK 16			Reg / Repro

16. REMARKS

Block 4:
DI-MGMT-81644B is tailored as follows:

Paragraph 2 is edited to read, "2. Content and Format. Following are the format requirements: The content shall be in contractor format using an approved modeling tool(s). (***add in the names of any specific models required***)

The following DoDAF views and/or models from Table 1 are required:
(***list the required views from Table 1 of the DID***)

Block 9: The contractor shall ensure proper marking of all model elements and ensure views with specific markings can be produced (or example views that do not contain any CUI or classified information).

Block 10:
The model(s) shall be available on-demand as read-only files. The versions used to support the following reviews (***add in reviews such as SRR, SDR, PDR, etc.)*** shall be available (***# of days)*** business days prior to the review.

For Agile development:
The contractor shall submit incremental updates as part of the agile development process (***# of days)*** business days prior to the ***increment review (insert the name of your review meetings)*** meeting.

Block 11: As of date will be the date the models to be used as part of specific review are posted to the shared data site.

Block 12:
The first submission will be model used to support (***enter name of first review).***

(***Add for agile developments – tailor wording as needed)***
Incremental updates shall be developed as part of the agile development process and a draft posted to the (***shared data repository) NLT*** 5 business days prior to the Increment review for a deployable Increment

15. Total

B.3   DD1423 for Software Architecture Description Tailoring

CONTRACT DATA REQUIREMENTS LIST	*Form Approved*
(1 Data Item)	*OMB No. 0704-0188*

Public reporting burden for this collection of information is estimated to average 110 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding thus burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget. Paperwork Reduction Project (0704-0188), Washington, DC 20503. Please DO NOT RETURN your form to either of these addresses. Send completed form to the Government Issuing Contracting Officer for the Contract| PR No. listed in Block E.

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY: TDP TM OTHER

D. SYSTEM|ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR

1. DATA ITEM NO.	2. TITLE OF DATA ITEM **Software Architecture Description**	3. SUBTITLE

4. AUTHORITY *(Data Acquisition Document No.)* **DI-SESS-82176/T**	5. CONTRACT REFERENCE	6. REQUIRING OFFICE

17. PRICE GROUP

18. ESTIMATED TOTAL PRICE

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY **SEE BLOCK 16**	12. DATE OF FIRST SUBMISSION **SEE BLOCK 16**	14. DISTRIBUTION

				b. COPIES
8. APP CODE		11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION **SEE BLOCK 16**	a. ADDRESSEE	DRAFT	FINAL
						Reg	Repro

16. REMARKS

Block 4:
DI-IPSC-82176 is tailored as follows:

The information required in Section 3 shall be provided as a part of a model/models. ***(Add any specific models or tools required by the program)***

Block 10:
The model(s) shall be available on-demand as read-only files. The versions used to support the following reviews (***add in reviews such as SRR, SDR, PDR, etc.)*** shall be available (***# of days)*** business days prior to the review.

For Agile development:
The contractor shall submit incremental updates as part of the agile development process (***# of days)*** business days prior to the ***increment review (insert the name of your review meetings)*** meeting.

Block 11: As of date will be the date the models to be used as part of specific review are posted to the shared data site.

Block 12:
The first submission will be model used to support (***enter name of first review).***

Block 13:
The contractor shall submit incremental updates as part of the agile development process (***# of days)*** business days prior to the increment review meeting.

Final updates shall be made to match the as-built system at least ***(# of days)*** prior to the end of the contract.

.

15. Total

G. PREPARED BY	H. DATE	I. APPROVED BY	J. DATE

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B.4   Sample DAL Form

The first form is blank; the second form is an example of the DD1423 for the Software Architecture Description in DAL format.

PROGRAM NAME Data Accession List (DAL) Item		
1 DAL Item Number Click or tap here to enter text.	2 Title of DAL Item Click or tap here to enter text.	3 Subtitle of DAL Item See Block 11
4 Authority (DAL Document Number) DI-IPSC-81441A/T		
5 Contract Reference See Block 11	6 Frequency See Block 11	
7 Date of First Submission See Block 11	8 As of Date See Block 11	
9 Date of Subsequent Submission See Block 11	10 Designated Repository See Block 11	
11 Remarks 		

PROGRAM NAME Data Accession List (DAL) Item		
1 DAL Item Number Click or tap here to enter text.	2 Title of DAL Item Software Architecture Description	3 Subtitle of DAL Item
4 Authority (DAL Document Number) DI-SESS-82176/T		
5 Contract Reference See Block 11	6 Frequency See Block 11	
7 Date of First Submission See Block 11	8 As of Date See Block 11	
9 Date of Subsequent Submission See Block 11	10 Designated Repository See Block 11	

11

The contractor shall ensure proper marking of all model elements and ensure views with specific markings can be produced (or example views that do not contain any CUI or classified information).

Block 4:

DI-IPSC-82176 is tailored as follows:

The information required in Section 3 shall be provided as a part of a model/models. **(Add any specific models or tools required by the program)**

Block 6:

The model(s) shall be available on-demand as read-only files. The versions used to support the following reviews (**add in reviews such as SRR, SDR, PDR, etc.)** shall be available (**# of days**) business days prior to the review.

For Agile development:

The contractor shall submit incremental updates as part of the agile development process (**# of days**) business days prior to the **increment review (insert the name of your review meetings)** meeting.

Block 8: As of date will be the date the models to be used as part of specific review are posted to the shared data site.

Block 7: The first submission will be model used to support (**enter name of first review).**

(**Add for agile developments – tailor wording as needed)**

Incremental updates shall be developed as part of the agile development process and a draft posted to the (**shared data repository) NLT** 5 business days prior to the Increment review for a deployable Increment

Block 9:

The contractor shall submit the final data item, 5 business days prior to the TRR for Formal Contractor Test at each site.

For any changes after TRR, the contractor shall submit the data item identifying recommended changes no later than 15 business days

after the change.

Final updates shall be made to match the as-built system at least (**# of days**) prior to the end of the contract.

Once approved by Government Program Office, submit to Sustainment Provider for integration into technical baselines.

(**Add for agile developments – tailor wording as needed)**

The contractor shall submit incremental updates as part of the agile development process (**# of days**) business days prior to the increment review meeting.

B.5 Potential DD1423 for Models (Based on NASA Digital Engineering Acquisition Framework Handbook)

(Note: The Air Force is also working on a DID for models.)

<table>
<tr><th colspan="5" align="center">PROGRAM NAME Data Accession List (DAL) Item</th></tr>
<tr>
<td>1   DAL Item Number

Click or tap here
to enter text.</td>
<td colspan="2">2   Title of DAL Item

Software Architecture Description</td>
<td colspan="2">3   Subtitle of DAL Item</td>
</tr>
<tr>
<td colspan="5">4   Authority (DAL Document Number)

DI-SESS-82176/T</td>
</tr>
<tr>
<td colspan="2">5   Contract Reference
See Block 11</td>
<td colspan="3">6   Frequency
See Block 11</td>
</tr>
<tr>
<td colspan="2">7   Date of First Submission
See Block 11</td>
<td colspan="3">8   As of Date
See Block 11</td>
</tr>
<tr>
<td colspan="2">9   Date of Subsequent Submission
See Block 11</td>
<td colspan="3">10   Designated Repository
See Block 11</td>
</tr>
<tr>
<td colspan="5">11

The contractor shall ensure proper marking of all model elements and ensure views with specific markings can be produced (or example views that do not contain any CUI or classified information).

Block 4:
DI-IPSC-82176 is tailored as follows:
The information required in Section 3 shall be provided as a part of a model/models. <i>(Add any specific models or tools required by the program)</i>

Block 6:
The model(s) shall be available on-demand as read-only files. The versions used to support the following reviews (<i>add in reviews such as SRR, SDR, PDR, etc.)</i> shall be available (<i># of days</i>) business days prior to the review.

For Agile development:
The contractor shall submit incremental updates as part of the agile development process (<i># of days)</i> business days prior to the <i>increment review (insert the name of your review meetings)</i> meeting.

Block 8: As of date will be the date the models to be used as part of specific review are posted to the shared data site.

Block 7: The first submission will be model used to support (<i>enter name of first review).</i>

(<i>Add for agile developments – tailor wording as needed)</i>
Incremental updates shall be developed as part of the agile development process and a draft posted to the (<i>shared data repository) NLT</i> 5 business days prior to the Increment review for a deployable Increment

Block 9:
The contractor shall submit the final data item, 5 business days prior to the TRR for Formal Contractor Test at each site.
For any changes after TRR, the contractor shall submit the data item identifying recommended changes no later than 15 business days
after the change.

Final updates shall be made to match the as-built system at least <i>(# of days)</i> prior to the end of the contract.

Once approved by Government Program Office, submit to Sustainment Provider for integration into technical baselines.

(<i>Add for agile developments – tailor wording as needed)</i>
The contractor shall submit incremental updates as part of the agile development process (<i># of days)</i> business days prior to the increment review meeting.</td>
</tr>
</table>

Appendix C   Section L – Instructions to Offerors

The Instructions to Offerors, Section L, typically has many sections. In this report, we cover those sections that are more likely to be affected by the use of digital engineering/modeling. For Sections L and M, we provide explanatory notes instead of templates because the approach is very program dependent. But these explanatory notes provide enough detail to help a program office determine what they should include in these RFP sections. When possible, we have included examples in blue-shaded boxes.

Different numbering schemes may also be used—the volume numbers used in this section may not match the volume numbers of your program's RFP, but all these volumes should be included in Section L.

C.1   Oral Presentations/Demonstrations

If the program office plans to include oral presentations and/or demonstrations as part of source selection, consider including modeling in some form. Some possibilities include the following.

> In the presentation, include an overview of your modeling plan, and include what will be modeled, the views and tools you plan to provide, how modeling will be used throughout the program, how modeling is integrated with different activities, how separate models are integrated, and how the government will access your models/model data.
>
> As part of the oral presentation, offerors will include a demonstration of one or more models of the type they plan to use to support the program. The data used to present the model does not need to be program data but should be representative of what would be generated for the program.
>
> As part of the oral presentation, offerors will include a demonstration of how they would model the requirements data and the system architecture data provided in the bidder's library. Include a demonstration of the linkages between the models.
>
> As part of the oral presentation, offerors will include a demonstration of how they would model the requirements data and the system architecture data provided in the bidder's library. Include a demonstration of the linkages between the models. In addition, during the demonstration the team providing the demonstration will be provided five additional requirements and you will need to demonstrate how those could be added to the models.

If the program office plans to include model demonstrations as part of the oral presentations, ensure you can provide adequate electrical power and that you tell the offerors whether Internet connectivity will be available. If the presentations will be in a location where no connectivity is possible, even with a hotspot, be sure offerors are aware of that. If the program office plans to provide data to be modeled, be sure to include this in draft RFP release so potential offerors can ask questions about the data in advance.

C.2   Page Limitations

If the program office is asking for a draft modeling plan as part of the proposal, think carefully about the page limits for the plan. If the page limit is too small, the plan may not contain all the information needed for evaluation. But if the page limit is too large, it will take more time to read and evaluate each offeror's plan.

C.3   Page Size and Format

Be sure to state whether the model diagrams can use different sizes and/or formats (e.g., font).

C.4   Volume I – Executive Summary

There will likely not be any specific mention of modeling in the instructions for the Executive Summary.

C.5   Volume II – Technical

This is likely the most impactful section of the *Instructions to Offerors* for modeling. Section L and Section M (*Evaluation Criteria*) are closely linked. If the source selection team will evaluate something in Section M, then that information needs to be requested in Section L. Section L can ask for information that is not specifically evaluated in Section M, but given typical page limitations, be careful not to ask for too many things in Section L that will not be evaluated under Section M. There are several ways modeling can be included in Volume II.

C.5.1   Subfactors

If modeling is made a subfactor, this communicates the importance of modeling to the offerors and allows the proposed modeling information to directly influence the proposal ratings. Modeling can also be included under another subfactor, such as Systems Engineering (or some other subfactor specific to a program). In addition, there can be relationships between the subfactors that need to be considered. For example, if there is a subfactor on maintainability, if the contractor provides information on how their overall modeling effort will support the use of a maintainability model, that information could be used to assess the overall modeling effort.

C.5.2   Material to Be Provided

If the program has already had a PDR and this is a down-select, then the program office may ask for more detailed models related to potential designs, software, or manufacturing. Or they may ask for information on how modeling will be used in test and evaluation. If there are parts of a system that are higher risk, these may be the focus of the modeling information requested. The program could also require extracts of models be presented as diagrams.

For new programs, the modeling information requested may lean more toward planning for how modeling will be used.

If the government plans to provide information such as requirements or architecture components and asks for those to be provided as models in Volume II, ensure the evaluation criteria in Section M is clear and that there will be at least one person on the source selection team who can evaluate the models provided. Ensure the language in Section L is clear as to the format of the models. If

the government requires a specific tool to be used, document that requirement accordingly. Clearly specify any technical limitations at the source selection facility (e.g., availability of specific browsers or other tools).

> Describe your proposed modeling approach in your draft Modeling Plan, Attachment XX. Explain how your modeling approach integrates with other disciplines such as system engineering and software engineering.
>
> Describe your approach to modeling requirements using Systems Modeling Language (SysML). Describe your approach to tagging and how requirements will trace to architecture, design, and verification.

C.5.3   Proposal Risk

Typically, proposal risk is evaluated along with technical capability. If this is the case, ensure Section L includes language to ask the offerors to describe any risks in their modeling programs. If using a separate risk subfactor, then include appropriate language to ask about any specific risks the program is tracking for modeling.

> Identify risk areas for digital engineering/modeling. For each major risk, assess the probability and consequence of the risk, and identify the responsibilities for risk reduction. Provide an analysis, including justifying rationale, of the required work in each such area. Where risk reduction is primarily the contractor's responsibility, show a proposed burn-down plan that is consistent with program milestones.
>
> Include the risks and benefits associated with each proposed model. Identify risk mitigation processes for each risk identified.

C.5.4   Attachments

Attachments to the Technical Performance Volume could include a draft modeling plan, specific model views, or electronic model representations. The information to be provided should be included in this section.

C.6   Volume III – Past Performance

Section L typically just asks for relevant past performance information. The criteria are in Section M.

C.7   Volume IV – Cost/Price

The cost of the digital engineering/modeling effort will need to be understood. One of the most important considerations is the WBS. It might also be helpful to have a separate CLIN for delivery of the modeling data. That can also help in understanding the total cost of the data, but not necessarily the cost of the actual modeling effort.

It is also important to understand the skill mix for the modeling effort. It may be useful to ask the offerors to describe the skills they will employ in their modeling efforts.

C.8 Volume V – Contract Documentation Including Attachments

This is where the program office requests offeror documents such as the SOW, Contractor WBS, Technical Data Restrictions, Key Personnel, and Contract Clauses.

C.8.1 SOW

The SOW was discussed in detail in Appendix A.

C.8.2 Contractor WBS

Ensure the Contractor WBS follows the government WBS and that any areas covering modeling are visible.

C.8.3 Technical Data Restrictions

Technical data restrictions typically use Defense Federal Acquisition Regulation Supplement (DFARS) provisions 252.227-7013 and 252.227-7014, which include a table to be filled out by the offeror stating anything that has limited rights. It may be useful to state in this section that all model data and all modeling information (except for the tool used to generate the model) will have either unlimited or government purpose rights unless included in the table. If the offeror is using a proprietary tool to generate any models, the government may want to consider asking for government purpose rights for that tool.

If the model data will need to be shared with other programs and there is a possibility that the data will have restrictions, it may be useful to define specific users of the data and request pricing to allow the government to buy the needed rights for that data.

C.8.4 Key Personnel

If the program office decides to ask about key personnel, consider asking about key personnel involved in the modeling effort.

C.9 Volume VI – Government Attachments

This is where the program attaches government documents such as a SOW, GFI list, any government reference models, a government modeling plan, the incentive plan (if applicable), etc.

Appendix D   Section M – Evaluation Criteria

The Evaluation Criteria, Section M, typically has several sections. The three main sections of concern for a digital engineering/modeling effort are the specific evaluation criteria, the past performance, and the cost/price sections. Appendix D follows the same format as Appendix C where sample language appears in blue-shaded boxes.

D.1   Evaluation Criteria

This section generally starts with "The proposal requirement will be met when the offeror...." For modeling criteria, what comes next could take several forms. If the program asked for a modeling plan, the criteria could be that the contractor has proposed a comprehensive modeling plan that explains how modeling will provide an ASoT and how modeling will be used throughout the lifecycle. If there is a focus on using modeling during testing, then the criteria could focus on that aspect—either as a part of the plan or based on what is provided in Volume II.

The program office should consider the risks to the program, the overall importance of the modeling effort, and whether modeling could be a useful discriminator between proposals in determining the language needed for this section.

If the program is considering using a demonstration of the modeling capability, be sure to (1) leave plenty of time to develop evaluation criteria and (2) involve the contracting officer. While demonstrations can provide a lot of good information, care needs to be taken in developing the evaluation criteria. Consider recording the demonstrations to have evidence of what was presented.

Sample wording:

> The proposal requirement will be met when the proposed modeling approach in your draft modeling plan clearly explains how modeling will be applied in the program. The approach to using modeling for requirements, architecture, design, and test are clearly explained, and the tracing between models is made explicit. The views described in the plan are sufficient to allow the government to evaluate the models to support lifecycle reviews or other decision-making processes. The integration between modeling and other disciplines such as system engineering and software engineering is clearly explained.
>
> The proposed requirement will be met when the approach to modeling requirements using SysML is clearly explained. The system for tagging requirements is robust enough to support all facets of requirements usage and how requirements can be traced to architecture, design, and verification is clearly shown.

D.2   Past Performance

Section M includes the criteria for evaluating past performance. Past performance is evaluated by a separate team. If modeling is a specific subfactor or a major section of another subfactor, ensure

someone on the past performance team has enough modeling background to evaluate the past performance information.

If digital engineering/modeling will be included in past performance, ensure the information requested under "relevancy" can differentiate between modeling efforts like those required for this program and efforts that are much simpler in nature. Be sure to include any subcontractors who may be involved in the modeling effort as well. Relevancy requirements can be considered in categories by modeling types, extent of modeling effort, use of real time models, modeling used in test, etc. Then the requirement for high relevancy can be stated as "at least one from each category and five total," for example. If the program will use real time models, try to ensure the past performance asks specifically about real time model use. The same is true of specific model types or tools that are required in the SOW: ensure the past performance asks about prior usage of those specific types and tools.

D.3 Cost/Price

While there typically is not specific language in this section regarding modeling, it is important to understand how the cost/price volume is evaluated. In some source selections, the technical team is not allowed to see the cost volume. In others, they can evaluate the hours but not the dollars. It is very important that someone on the source selection team with modeling expertise evaluate the hours proposed for the modeling effort. Cost is evaluated for reasonableness, realism, and risk. If the proposed hours are too low to accomplish the work that is being proposed, then the government can incorporate a "should cost" estimate into the evaluation. This can help prevent a proposal that bid unreasonable low hours from being rated above one that had adequate hours.

Acronym List

Acronym	Meaning
AADL	Architecture Analysis and Design Language
ACVIP	Architecture Centric Virtual Integration Process
ASoT	Authoritative Source of Truth
BOEs	Basis of Estimates
CDRL	Contract Data Requirements List
CLIN	Contract Line Item
CUI	Controlled Unclassified Information
DAL	Data Accession List
DFARS	Defense Federal Acquisition Regulation Supplement
DID	Data Item Description
DoD	Department of Defense
DoDAF	DoD Architecture Framework Documentation
DT&E	Developmental Test and Evaluation
FFRDC	Federally Funded Research and Development Center
FMEA	Failure Modes Effects Analysis
FMECA	Failure Modes and Effects Criticality Analysis
GFI	Government Furnished Information
IDE	Integrated Development Environment
IDIQ	Indefinite delivery Indefinite Quantity
IRS	Interface Requirements Specification
KPP	Key Performance Parameters

Acronym	Meaning
LCOM	Logistics Composite Model Analysis Toolkit
LORA	Level of Repair Analysis
MODAF	Ministry of Defence Architecture Framework
MTA	Maintenance Task Analysis
OSMP	Open Systems Management Plan
OT&E	Operational Test and Evaluation
PDR	Preliminary Design Review
PII	Personally Identifiable Information
PWS	Performance Work Statement
RFP	Request for Proposal
RMA	Reliability, Maintainability, and Availability
SAD	Software Architecture Document
SETA	Systems Engineering and Technical Assistance
SETR	Systems Engineering Technical Reviews
SOO	Statement of Objectives
SOW	Statement of Work
SRR	System Requirements Review
SSHA	Subsystem Hazard Analysis
SSS	System/Subsystem Specification
SysML	Systems Modeling Language
TEMP	Test and Evaluation Master Plan
UML	Unified Modeling Language
VVA	Verification, Validation, and Accreditation

Acronym	Meaning
WBS	Work Breakdown Structure
XMI	XML Metadata Interchange
XML	Extensible Markup Language

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With the advent of digital engineering and the Department of Defense (DoD) Digital Engineering strategy, programs are attempting to include digital engineering as part of their acquisition strategy. Realizing the desired benefits of digital engineering requires program offices to consider how to best acquire the models and artifacts necessary to gain the advantages of a robust digital engineering program. This report provides guidance for government program offices that are including digital engineering/modeling requirements into a request for proposal (RFP). Since RFPs can be released at many different program phases and because every program is different, the information in this report is meant to stimulate thought on the part of the program office into different areas to consider. The report provides overall guidance and more specific guidance regarding statements of work, deliverables, and Sections L and M of a request for proposal. Sample language included in this report is provided as exemplars and is not intended to be copied verbatim. We encourage program managers to use this report as a resource when partnering with contracting officers.

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