S²MARTS Project 20-07: Printed Circuit Board Analysis Tool

Request for Solutions (RFS) Questions & Answers | Posted July 24, 2020

1. **Question Regarding Data Sets:**
   a. Question: Does the training/testing dataset exist and has it been labelled?
   b. Question: Does Crane have an image library of master and suspect PC boards (preferably with ground truth information) that will be made available as part of this effort? Can you please provide more detail around what data sets will be provided as part of this effort overall? If not, is the expectation that respondents will be responsible for digitizing PC boards with all modalities mentioned in the RFS, or will Crane technicians be owning this effort? This would also require a lot of actual PC boards including many that are "suspect".
   c. Question: Will Crane make digital imaging equipment available capable of thermal imaging, acoustic microscopy, infrared, x-ray, and terahertz imaging, or is the expectation that respondents provide the necessary image capture equipment? If not made directly available, will we have the ability to interface with technicians operating this equipment on behalf of Crane in order to set up the necessary image captures?
   d. Question: Does the Government expect or anticipate that performers generate their own imagery for development purposes and training of machine learning algorithms?
   e. Question: What Government datasets will be available to be provided to the performer for neural network training? Would these data sets include inspection results such as cold solders, blacktopped components, rework, and general examples of existing workflows?

   Response: The Government will provide training datasets to performers who do not already have existing datasets to leverage at the request of the performer. The training dataset provided by the Government will be delivered in sections—a dataset focused on optical imagery required to automatically generate a bill of materials will be provided before phase two and a dataset featuring various modalities of images with multiple desired inspection results will be delivered before phase three.

   Performers who have an existing dataset should provide an overview of the dataset in their phase one deliverables.

   The test dataset will also be created by the Government.

2. **Question Regarding Deliverables GFI Format:**
   a. Question: Can the Government provide more information on the GFI-defined interface for exporting to existing workflows (Item 5. In PCBAT Capabilities Table on Page 3 of the RFS)? Would an Automated Programming Interface be an appropriate approach to solution integration?
   b. Question: Can the Government provide the format or example of the GFI binary format as part of this solicitation?
   c. Question: Can the Government provide an interface control document to support the GFI-defined interface for exporting to existing workflows as part of this solicitation?

d. Question: Does the Government intend to utilize standard GFI test articles to support quantification of the success metrics outlined in the Phase 2-4 sections? Can performers propose development of test articles to provide support to the validation and demonstration of systems as part of PCBAT?

Response: PCBAT is funded through the Trusted and Assured Microelectronics program and is intended to provide a BOM to the automated microelectronics analysis and reports optimization (AMARO) supply chain illumination (SCI) tool. Since AMARO* is still being develop an ASCII (American Standard Code for Information Interchange) CSV (Comma Separated) file will be acceptable. Fields for the elements in the standardized BOM (when included within the part marking)—logo, manufacturer, part number, country of origin, date/lot code, pin count, or package type. Including information from the assembly (COTS Manufacture, Part Number, Serial) would be desired as well.

*AMARO is being developed by KSM consulting (https://www.ksmconsulting.com/)

3. **Questions Regarding Deliverables Formats:**
   a. Question: Each of the phases require delivery of software and hardware as part of the progress demonstrations. Does the Government intend that the performer will continue to exercise and iterate on the same system for the next phase or is the system to remain with NSWC Crane after each phase demonstration and this result in several potential deliveries or field upgrades?
   b. Question: Does the Government anticipate performers will deliver both software and hardware tools and technologies as part of a larger data acquisition tool delivery that include elements providing both data analysis and data acquisition systems?
   c. Question: What is the intended data ingestion format? Should proposed PCBAT solutions be configured to load image files from the computer's hard drive, or will they be expected to integrate with imaging devices?

Response: The Government prefers to have performers deliver software, but understands hardware development/modifications may improve the data analysis within the software. The date of delivery for said hardware will be a function of the hardware capability and therefore should be determined at a later date. A minor change to the RFS has been made, eliminating hardware deliverables for Progress Demonstrations in phases two through four.

PCBAT solutions should be configured to load image files from the computer's hard drive; it will not be expected to be integrated with imaging devices.

4. **Question:** PCBAT is expected to run on a Windows 10 platform, but will the tool be able to access GovCloud or similar online resources or will Cyber/Information Assurance concerns prevent that?

Response: The tool is to be used a multiple Government agencies with various Information Assurance policies. The tool shall support a non-networked environment, but the ability to provide updates to databases maintained by the tool is acceptable.

Question: The requirement states that the performer shall identify, in advance, third-party software that will be integrated within PCBAT. Is it the Government's intent to identify 3rd party software that is anticipated to be integrated, or to restrict future development activities that may leverage 3rd party software?

Response: In general, our intent is not to restrict future development activities that may leverage third party software/databases. Rather, our intent is to provide us amble time to acquire access to any third party dataset/application that could assist in resolving part characteristics—for example, a database with

high resolution, historical logos from common manufacturers that could be used to flag minor modifications counterfeiters make to logos to avoid trademark infringement. Performers should investigate AMARO to see if there is some way that AMARO can assist in the data resolution process.

Questions Regarding Metrics:

a. Question: What metrics are being used for performance targets, i.e. what is accuracy?
b. Question: Can the Government provide the definition of the metric used to score accuracy in detection, identification and categorization?
c. Question: Can the Government provide additional clarification on how accuracy will be measured for the reference designator and BOM population tasks? Will accuracy be calculated across the population distribution of components, or will it be calculated for each class? How will inaccessible information be scored, for example the country of origin on unmarked resistors.

Response: The accuracy will be calculated for each class of components. Inaccessible information due to lack of part markings on a device will not be scored.

Detection: Did the machine learning algorithm correctly detect a device is present at the particular mapped location? Did the machine learning algorithm correctly detect there are part markings on the particular device? Did the machine learning algorithm correctly detect the reference designator?

Identification: Did the machine learning algorithm identify the detected device as the correct type of component? Did the machine learning algorithm accurately translate the detected part markings (or reference designator) into their respective field (each field could be treated separately)?

Categorization: Did the machine learning algorithm correctly associate the detected device with the other devices in the same class of components? Categorization is considered to be the lowest priority here.

5. **Question:** If performers have solutions that have existing demonstrable system solutions, will the government consider performers moving directly to phase 2?

   Response: The purpose of Phase One is to gain insight into the methodologies and approaches the performer intends to use in subsequent phases. In software development, some approaches are inherently more flexible and self-correcting than others; these approaches have been proven to provide better results. The Government feels PCBAT will require new and novel approaches and believes it would be beneficial to gain this insight up front.
   The Government will select performers in part because the government feels the performer's approaches and methodologies described in phase one will provide the best chance for success. Therefore, any deviations from those methodologies and approaches must have approval from NSWC Crane.
   In addition, if the performer has an existing demonstrable solution, the government asks the performer still complete the requirements of phase one, in order to provide the necessary insight into the approach the performer ultimately chose to use and why the performer feels their approach will work best in subsequent phases.

6. **Question**: The RFS states for Phase 2 that, "The methodologies and approaches proposed in phase one shall be used unless approval to deviate from NSWC Crane is acquired." Does this mean that any deviation in methodology or approach from Phase 1 requires NSWC Crane approval or can you clarify this requirement?

   Response: Please see the answer above.

7. **Question**: Does the Government expect the deliverable to identify the entire list of components listed in IEEE 315? If only a subset is expected, can the Government provide the subset of components expected to be assessed by the deliverable?

   Response: RFS lists expected components to be identified in phase 2 and phase 3 deliverables. They are duplicated below, but RFS (and updates) take precedence.
   Integrated circuits, resistors, capacitors, transformers, inductors, potentiometers, diodes, transistors, rectifiers, oscillators, switches, relays, and sensors

8. **Question**: Phase 2 of the RFS is focused on solutions with a single modality. Has the government determined that phase two will rely primarily on optical inspection and imaging tools?

   Response: Yes, the Government would like phase two to focus primarily on optical inspection and imaging tools.

9. **Question**: Does the Government expect the performer to analyze device provenance leveraging external supply chain risk management sources or will the performer be expected to infer attributes such as country of origin from part markings only

   Response: The Government desires PCBAT to be able to infer data based on the physical part markings on the devices. PCBAT is not expected to analyze device provenance by leveraging external supply chain risk management sources. Our hope is that PCBAT will be able to translate detected part markings into a part number based on the manufacturer and determine the date/lot code for each component it identifies.
   The output of the automatically generated bill of materials is will be sent to other supply chain risk management tools—e.g. AMARO (the Navy's Supply Chain Illumination Tool) for the supply chain analysis.

10. **Question**: If a known lighting condition (angle, working distance) is used for 2D optical imaging and the resultant shadows used for component localization, would that be considered a 2D image under phase 2 or will it be a phase 3 item?

    Response: This would be considered a phase two image if it will support mapping device localization for automated bill of material generation.

11. **Question**: Does the Government expect performers to propose sensor innovations designed to increase PCB throughput? Does the government anticipate scan-time standards or metrics that performers should be targeting?

    Response: PCBAT is not targeting PCB inspection throughput improvements. The Government anticipates using current commercial capabilities for image captures. The Government will not reject new approaches to image modality capturing methods that show benefit to PCBAT primary goals (see RFS). While the primary focus of PCBAT is software based, the Government recognizes hardware modification/development—including sensor innovations—can improve data analysis and throughput. The Government recommends collaborating with another performer.

12. **Question**: How is NSWC Crane currently determining the values and manufacturers of components (i.e. resistors, caps, inductors) on a PCBA without any markings. (Are components from the boards removed and tested?)

    Response: The Government seeks unique and novel solutions through the OTA process and not marginal improvements to existing government methods. Non-marked components will not be included in any benchmark testing of proposed solutions.

13. **Question**: Would vendor supply chain vetting to the N\'th degree (supply chain 25+ deep) to be part of the solution? Providing trust in the integrity of the supply chain.

    Response: PCBAT is not expected to analyze device provenance by leveraging external supply chain risk management sources. Our hope is that PCBAT will be able to translate detected part markings into a part number based on the manufacturer and determine the date/lot code for each component it identifies.

14. **Question**: Which supply chain traceability evidence is required by Navy vendors?

    Response: See the answer to the question above.

15. **Question**: Can the Government quantify the elements of high-risk electronics or provide examples of the government's definition of high risk and/or low trust electronics in the supply chain? For example, detection of rework, used components, etc.

    Response: The Government seeks unique and novel solutions and desires industry and academia to partner to provide prototype solutions. The Government also acknowledges there are commercial specifications and efforts that potential performers may benefit from reviewing; such as but not limited to: https://www.sae.org/standards/content/as6171/2/ ; https://calce.umd.edu/ ; https://counterfeit-ic.ece.ufl.edu/ This is a partial list and the government does not endorse any particular entity and acknowledges there are additional entities that can provide information to identify high risk electronics.

16. **Question**: What does the Government mean by "additional inspection techniques" and could the government provide examples?

    Response: The RFS lists the following examples of inspection techniques: thermal imaging, acoustic microscopy, infrared, x-ray, and terahertz imaging. Through the OTA process we are seeking additional inspection techniques as part of the PCBAT OTA RFS.

17. **Question**: What are the minimum and maximum dimensional requirements or desirements for PCBs to be tested as part of this effort? Are there Cost, Size, Weight, or Power (CSWAP) thresholds or objectives for the PCBAT system?

    Response: PCB size range: Minimum: 50 x 120 mm (2 x 4.7 in.); Maximum: 720 x 620 mm (28.3 x 24.4 in.). CSWAP objectives are not listed in RFS since the primary solution is anticipated to be software.

18. **Question**: What is the anticipated age (i.e., 80s- current or recently produced) of the PCBAs that NSWC Crane intends to utilize the PCBAT on?

Response: PCBAT ideally will cover both 80s technology and recently produced to reflect PCBs in use on government systems with a focus on COTS assemblies. If this is not technically feasible or cost prohibitive then the effort should be focused on more recent PCB to maximize value to the Government.

19. **Question**: Must our proposal include a budget for all phases of the project?

    Response: Phase 1 proposals shall include a full cost proposal for Phase I and ROMs for Phases 2-4

20. **Question**: At this stage do we need to provide detailed planning included a budget proposal to all phases or just for the planning phase? Are there any financial tables we need to comply with? If the Government is seeking a firm, fixed price cost estimate for all four phases, is there a cost reopener that will allow incorporation of technologies identified in Phase One for incorporation in Phases Three and Four that were not included in the original costing?

    Response: Phase 1 proposals shall include a full cost proposal for Phase I and ROMs for Phases 2-4. Phase 1 awardees shall propose full technical and cost proposals for Phases 2-4.

21. **Question**: How does the Government intend for performers to cost phases 2 through 4 as part of our proposal given the request for a firm fixed price contract? Does the Government intend for interested parties to include ROM costs for each of these additional phases that will be negotiated as part of the technical execution or will the government provide a plug number to include for future phases?

    Response: Phase 1 proposals shall include a full cost proposal for Phase I and ROMs for Phases 2-4. Phase 1 awardees shall propose full technical and cost proposals for Phases 2-4.

22. **Question**: Can the 5-page pricing narrative be submitted in a word or pdf format and in addition to the pricing spreadsheet?

    Response: Yes

23. **Question**: Does the Government have length or formatting expectations or a template for the TDD appendix?

    Response: No template is available and no page limit has been set. The Government anticipates submission of a Gantt type chart that depicts the completion dates of the tasks identified in the TDD, and a milestone payment matrix that lists milestone payment dates that align with project task or subtask completion.

24. **Questions Regarding ITAR:**
    a. Question: Is the expectation of mandating ITAR compliance intended to restrict participation to only US citizens and green card holders for phases 1 and 2, or will it be possible for individuals working or studying in the US on visas to participate in these phases of the effort? Will it be possible to include London-based members of academia? Restricting participation to US citizens and green card holders will potentially limit Crane's ability to tap into exceptionally talented resources, especially those currently studying at interested universities domestically and abroad.

b. Question: One of the potential partners we are looking at is based in London. What Foreign Owned, Controlled, or Influenced (FOCI) Mitigation Documentation would we need to provide if they are the sub or the prime?

Response: The mandate of ITAR compliance is intended to protect PCBAT's unique capabilities from falling into an adversary's hand. It may be possible to partner with a London-based member of academia through The U.S.-U.K. Defense Trade Cooperation Treaty, this treaty recognizes the close ties with the US and the UK and aims to streamline and improve the defense export processes between both countries, it may provide a path forward. It is ultimately up to the Department of State to determine if ITAR needs to be enforced.

25. **Questions Regarding Data Rights:**
    a. Question: Can you clarify what is meant by "full license rights for PCBAT "? Will the government accept SBIR data rights?
    b. Question: In the event that the deployed solution contains previously developed trade secrets and IP, how do you envision the licensing for the solution?

Response: The Government desires access to the unscrambled source code for the purpose of integrating PCBAT into existing workflows of other tools developed through the other Verification and Validation (V&V) labs. Data rights that do not allow for the necessary access to the unscrambled source code will not be sufficient. The Joint Federated Assurance Center is committed to providing the capabilities to other labs across the Government and Government contractor facilities, PCBAT is a highly desired capability.

26. **Question Regarding Classification:**
    a. Question: If it is anticipated that the phases 3 and 4 will be classified at the Secret level, does the government intend to issue a DD254 or SCG as part of the solicitation? Will the test articles being scanned as part of these phases be considered classified?
    b. Question: Does the Government intend to allow proposers include subcontractors on their team who will be working on unclassified portions of the phase 3 and 4 solution and may be non-traditional performers?

Response:

a. Response: The Government will provide guidance to phase 1 awarded performers regarding classification in the form of SCG or other appropriate documentation. Test articles and associated datasets will not be considered classified.
b. Response**:** It is generally acceptable for non-cleared personnel to work on unclassified tasking for a project.

27. **Question**: How many Phase I awards are expected?

Response: The Government anticipates multiple awards for phase one. The total amount of awards for phase 1 is $800K. Additional funds will be designated for phases 2 through 4.

28. **Question**: Since the government intends to multi-award phase 1, does the Government intend to team performers post phase 1 to utilize different solutions for algorithms, software, and/or hardware development?

Response: The Government encourages teaming post phase 1 if performers desire to team. The Government cannot mandate performer's team post phase 1.