Composite Communications/Responses During Pre-Solicitation Period
N213-140
Rev. - Date: #1 - 9/20/2021

Note, the original text have been edited for context and clarity to all, as well as to correct past errors; so, **please read full text**. No effort has been made to remove repeat details, as sometimes the context of apparent duplicative information might be important to some. Also, if I had more time, I would say/write less.

General note regarding the size of the BDA defects.

To simplify the discussion herein, it is enough for now to assume that minimum defect size is 0.5 ft^2 for mooring foundations and piles and 1 ft^2 for all other structural members. Some have correctly pointed out that these numbers are rough simplifications, as greater defect size is generally acceptable in many places, or in some situations; however a collection of smaller defects become an issue when in a collection.

General note regarding the level/extent/eloquence of AI/ML and/or non-AI non-ML type solutions:

We have told you the inputs and the outputs. We have been discouraged from specifying how the things get done in the middle. Some have asked if we are open to approaches which are non-AI/ML, hybrid-AI/ML, and a full spectrum of the continuation of what we might accept. It is safe to say that we are open to innovation. We desire a solution which achieves a high TRL, for the intended end user, by the end of Phase-II. We also hope that you are commercially successful. We realize that these two goals might be in competition. At this point, the only thing that I can say regarding clarifying these competing goals is to look at the evaluation criterial; then, separately (not to double-count the topic) look at the potential of commercialization. As I have talked to potential sources, I've found the best generic answer to some of the most precise/eloquent technical questions/issues, is to return the question to the requestor by asking: "What would the commercial sector wish to purchase from you?" … You each know just how much technical short-cutting might be needed to achieve the stated goal. You also each have an idea of how much each technical short-cut might negatively impact the commercial value of your product. You also each know when you would/wouldn't be satisfied to market a certain set of design tradeoffs. So, I will put the subject back to you; I'll encourage you to each use your own best judgment as subject matter experts in you fields and as potential sellers of your solution(s).

General note regarding Desired High TRL at End of Phase-II, Vs and Academic Exercise:

For the eventual Phase-II awardee; we hope for a high TRL at completion of Phase-II, as we have a near-term application for the topic. Therefore, I'd rather address all directly, openly, with candor to provide us All an even and fair chance of an effective and high TRL Phase-II conclusion.

General note regarding Background on *Why* & *Who* for N213-140:

Why: NECC requested that, "3D point cloud data be the input; full repair plans be the output". However, Topic N213-140 covers only the first half of the process; by getting the 3D data (point cloud, SLAM, SfM, photogrammetry, etc.) from its raw input form, into the output of a tabulated inventory of battle damage assessment.

Who: NAVFAC EXWC providing two TPOCs. The project plans to have one USACE ERDC team-member participation regarding the subject tabular outputs, which could become the inputs into the PRAT and/or the Pier Diagram Tool (following the conclusion of the subject work); with long term hope

for satisfying NECC's wish of automating the repair plans for battle damage, or at least increasing the automation of the same.

Collection of Communications During Pre-Release, as of 9/20/2021:

In no particular order.

1. RE: … it appears that PRAT is a new system - but one that is (possibly) too labor intensive.
2. *Yes, it is considered new.*
    a. *The PRAT is intended to statically/quasi-statically and rapidly calculate/approximate pier load capacity, based on a parametric Pier cross-section model (Note: Traditional equation based, Not FEA). Basically the [outputs from N213-140 become the inputs to PRAT] inputs are all of the dimensions needed to roughly model the "controlling" (most damaged) cross-section, as well as a typical (undamaged) cross-section. [Note: The mention of scores here is for understanding the context of PRAT; the handling of conditions scores is outside the scope of N213-140] There are scores assigned to the condition/health of the concrete as well as a score for damage (cracking, spalling, corrosion, etc.). These conditions scores degrade the approximated capacity.*
    b. *Related to, by separate from the PRAT, is the accompanying Pier Diagram Tool (PDT); which is intended to roughly model/express/document the entire pier, all relevant defects, planned repair kit to use, and any accompanying notes, photos, etc.*
    c. *Roughly speaking, the outputs of N213-140 become the inputs of other applications; such as PRAT, Pier Diagram Tool, Finite Element Analysis software, or other similar applications. Due to the broad nature of the possible solution which proposers might submit; it's best for me to keep the description generic to all readers. So, generally, the outputs of N213-140 are generally dimensional, spatial, orientations, zone-delineating (top-deck, under-deck, underwater) inputs, etc. for typical and special industry applications and tools.*
    d. *Together, these two tools (PRAT and PDT) have a fair amount of entries; the requested automation is intended to automate the entire process; although our* ***client specifically requested the future ability to automate the repair plans needed by an onsite repair team.*** *As you can see from the solicitation; we are Not yet targeting the auto generation of repair plans; rather the tabulation of the facility and the defects [as well as the "enabling" of the future capabilities]. [So, ask yourself, is your tabular BDA output detailed enough to send a truck, versus a boat, versus a diver to the correct place, with the correct category of repair material, to make the correct repair type (repair details are Very generic at this point; but, is your output detailed enough to generally direct repair crews)].*
    e. *With such tabular data, one could automate the PRAT, the Pier Diagram [Repair] Tool, as well as remain generic enough to have commercial application.*

3. *Additional Side Note: One of the entries of the Pier Diagram Tool is for the user to select/specify which repair method to employ; note also that the current repair methods might change soon. The requester of the subject project wished for an "easy-button" which would convert 3D structural scan date directly into repair plans/specifications, in one step. However, a tool which specifies military repairs, using a mil-spec-type repair method (again methods which are likely to*

soon change/modify); is Not likely to be commercially marketable. With so much to unpack in the original client request; we authored the subject solicitation; which is intended to get the process to a logical point (tabulation of the real world), which is beneficial to the requester, but stays neutral on whether the future repair method is a mil-spec-type or of a commercial standard.

4. RE: We have been unable to locate any relevant documentation on PRAT; … is any public documentation on PRAT?
5. *There is not much publically available. Having read the available documents, they are thin on any details which would help.*

6. RE: If so, could we have access to it in the proposal period
7. *Likely not. … The overall intent of PRAT, rather than the exact specifics are likely most helpful at this point, as it is an example of your outputs becoming the inputs for other types of applications.*
8. *Also, PRAT and PDT are be rewritten (recoded) by the authoring agency. The programmer for that effort is scheduled as a Government Team Member on N213-140.*

9. RE: … , and/or will it be made available during Phase I work?
10. *I think that would be possible. The PRAT and Pier Diagram Tool can be demonstrated by the agency/office which developed it early in Phase-I*

11. What is the overall process for the current approach, e.g., data collection, processing, etc.?
    a. *Data collection via a Seahorse Marine, NORBIT Portus Pole (multi-beam sonar, puck LiDAR, integrated into HYPACK software)*
    b. *Human onsite and human examining 3D data to find BDA*
    c. *When BDA easily visible by humans, geo-referenced notes and photos are taken*
    d. *Point cloud data and geo-referenced notes and photos all entered into the Pier Diagram Tool (PDT) for depicting/specifying repairs*
    e. *Pier cross-section dim.s and data manually entered into the PRAT; about 12 - 48 parameters/entries; mostly all of the dim.s required to 3D model a basic pier cross-section*
12. How is PRAT incorporated? Does an operator view and manipulate a raw point cloud by hand and enter data into the spreadsheet?
    a. *PRAT is currently separate from the PDT; however, effort currently underway to combine the two*
    b. *For PDT operator views and manipulates a raw point cloud by "hand" and draws/copies/places pre-defined repair kits to the BDA; no current spreadsheet; the tabular format is desired as the future input into an automated BDA repair specification tool*
    c. *For PRAT, an operator makes measurements "manually" inside of PDT and enters the manual measurements into the PRAT's GUI*
13. How is damage detection handled in the current approach?
    a. *Human sensory/judgement*
14. Is there some form of post-processing of the point cloud involved, albeit manually? Is any external software utilized?
    a. *Manual: 1. use HYPACK to merge multiple data collection sensors; 2. use PDT to interact with data and produce repair plans*

15. What is the current data acquisition method and what tools are involved?
    a. *See "NORBIT Portus Pole" response above*
16. Can you further define field execution, e.g., will the solution be deployed on a laptop? Or, is there other hardware in question?
    a. *Com.s degraded/com.s denied environment*
    b. *No off-site cloud computing*
    c. *Currently a laptop is employed to run HYPAC; however, we are only **limiting your computation to a single unit which is two-man-portable***
17. *Note: A high TRL is desired by end of Phase-II; once which produces the tabular BDA with enough detail to "enable" the specification of repair by another/future tool. So, for piles, pile-caps, beams, girders, deck, mooring foundation, and mooring fitting; we need to know the volume of defect, the serialized/specific structural element impacted, and whether the defect is above-deck, under-deck in the dry, or underwater. With such details we can determine what volume/extent of repair; whether to send a truck, a boat, or a diver to execute the repairs. In order to get to this functionality, (while not specifically called out) I would think that one would need to produce a tabular structural "asset inventory"; a serialized list of each/all piles, pile-caps, beams, girders, deck, mooring foundation, and mooring fitting; as well as their serialized location.*
18. *Note: Location under piers in generally referred to by a "bent/row" coordinate; where a bent is the numeric count of pile-cap numbered from shore, and rows are assigned alphabetically from left to right when standing on shore looking seaward.*
19. *Note: While the government will provide technical guidance on general pier construction configuration; there will be No GFI of 3D pier scan data or BDA. Awardees must plan to either gather, sub-contract, purchase, manufacture, or simulate realistic 3D pier data; then modify the undamaged data to approximate BDA. Some battle damage guidance is available as Distribution-A; however, largely photographic and generally underwhelming in quality at the Distro-A level. … So perhaps see commonly available cultural sources of graphical BD representation.*

20. *The solicitation requests the use of AI - is there training data available of damaged and undamaged piers?*
    a. No. We do not have enough real-world data and gathering enough might be cost prohibitive. If you wish to contact product vendors (such as Norbit, CodaOctopus, Konsberger, etc.) for their assistance, that is entirely up to you.
    b. We are open to a wide range of methods to address the lack of GFI training data.
    c. While writing the solicitation, we imagined various approaches to this issue, in order to anticipate future project issues. There are many possible approaches. Some options are technological cheats/shortcuts; which might make the solution easier to achieve, possibly more reliable, but possibly less marketable in the long run. We acknowledge the wide variation in possible solutions, we wish for a reliable and usable solution by end of Phase-II, but also a solution which is marketable. As for how one should balance the demands, see the solicitation evaluation criteria and weighting when planning your strategy.
21. *The solicitation requires field processing of point cloud data. Could you please elaborate on the processes or logistics by which the PC data is collected, processed, and then used to support decision-making? Collection of PC data and processing of the data are likely performed on separate devices. Further, PC post-processing is computationally very expensive and unrealistic to be performed on a hand-held device in a manner that could support decision-making in the*

field. Is it more important to support in-field decision-making (in which case, ML/AI is more appropriate), or utilize PC data and support decision-making in a separate location?

a. *Elaborate on the processes or logistics by which the PC data is collected, processed, and then used to support decision-making?*
    i. Currently Norbit Portus Pole (sonar, LiDAR, GPS, IMU, laptop with HYPAC software) collects 3D point cloud data only and processes, then Pier Diagram Tool and Pier Recon. Assessment Tool (PRAT) receives human manual inputs, where humans decide on the proper repair technique. … In the future we can foresee using things like the CodaOctopus [HD] Ecosounder (or non-GPS relyant) underwater, SLAM under-deck, and diverse methods on top-deck and sides. Therefore, diverse 3D datasets are critical for the near-term and sustained success of your solution.
b. *Collection of PC data and processing of the data are likely performed on separate devices.*
    i. Currently on a single Very large tri-screened "lap" top (it fills up a card table); however, the project does not really restrict the computing. I would suggest to keep the computing unit to two-man portable or smaller (not counting generator or other peripherals); no off-site cloud computing; no off-site communications; i.e. assume coms. denied environment; however, can establish local network(s) or similar, if needed.
c. *Further, PC post-processing is computationally very expensive and unrealistic to be performed on a hand-held device in a manner that could support decision-making in the field.*
    i. Handheld is not required by project AI/ML. – As for source of 3D data; currently all NORBIT Portus Pole sensors (NPP left image below) have been integrated into a remotely controlled survey vessel, a MARV-II (based on a WAM-V USV, middle image below), with live streaming/viewing/integration nearby; also a backpack LiDAR for top-deck; however, currently no "hand-held devices". Note, we do Not limit or require hand-held; however, we do not restrict either. Also note that hand-held or not is NOT a decision factor for Phase-I selection; as the solicitation focuses on converting 3D data into an action-enabling tabular format. Note: the right image below represents future data gathering platforms; not to be thought of as anything specific; however, a generic menu; sharing here for readers overall understanding of the user-space/mission.

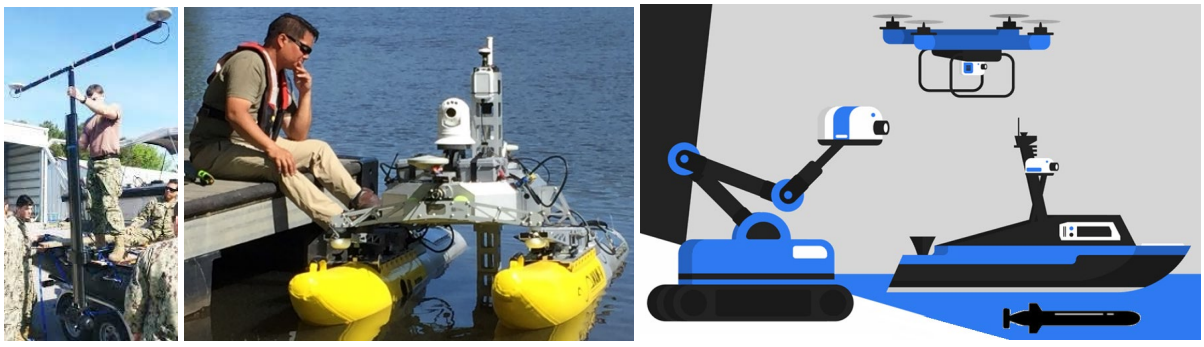

Image N213-140-1: NORBIT Portus Pole sonar & LiDAR (right), MARV-II (center) (based on a COTS WAM-V), running, with LiDAR; 3D data integrated via HYPACK software; general depiction of future input platforms

    d. *Is it more important to support in-field decision-making (in which case, ML/AI is more appropriate), or utilize PC data and support decision-making in a separate location?*
        i. Assume remote tropical island/atoll setting. Onsite/offsite are all within miles of each other. … So; field conditions without reach-back support from off-island locations is key.

22. *… why eliminate the structural engineer from the evaluation? It appears it'd be more efficient to have a SE review imagery (or go into the field) than to go to these lengths, given inherent errors in imagery collection and assessment.*
    a. There are entire processes established for collecting data and sending it all back state-site for analysis by a team of a dozen, or so, general Civil Engineers as well as SEs. However, this project is based on and addresses the assumption that all communications have been degraded/denied. It addresses improving the onsite capabilities to organically get just-enough/fast-enough repairs in order to enable first-shipment into a degraded/under-capacity port/harbor. – These methods ignore things like storm events; seismic standards; factors of safety above one (1); only requiring that the repairs hold for about three months (or less); etc. – Also, for ease of conveying the mission concept, assume that the engineers are unavailable during the associated activities.
        i. Assume the available personnel are not very experienced with rapid battle damage assessment/repair; not allotted time to stay proficient
        ii. This project to aid in equipping the same personnel to do a better job given very, Very short time constraints; while yet possibly producing a commercially viable product

23. Is there an existing database of damage assessment parameters that our analytics could tie into? If so, how do we access this (is it cloud hosted, etc.)?
    a. *No*
24. What accuracy is expected in terms of on pier location, etc.?
    a. *I think that you mean accuracy of identifying the BDA volume per defect: min. defect size 0.5 cubic ft. – 1 cubic ft.*
    b. *I think that you mean accuracy of locating each BDA: Generally, correctly identify if the defect is on top-deck, under-deck, or underwater; then generally +/- a few feet, down to .5 ft. for positional accuracy of the BDA location*
25. What are the current statistics / examples of time between scan data and BDA tabular data entry for each desired data type?
    a. *Statistics?: None*
    b. *A few examples: 2 - 8 hours of clock time, for one person, for just this portion of the effort.* ***<u>However, currently preferring less than 2 hours.</u>***
26. Can you provide other total assessment examples besides the assumptive example in the one to be used in the Phase I proposal description?
    a. *Piers around the world vary greatly from one to another; however, most (90% or so) of them follow typical patters. The Phase-II will have to address the vast majority of piers; however, it is reasonably understood that the subject project cannot address every situation, nor every BDA situation.*
27. What representative training data sets will be provided for Phase I and II activities?
    a. No; however during Phase-I we will discuss ranges of examples; and there is a rather Wide range, with levels of variation stacked atop of variation, then stacked atop more variations.

28. Conversational Notes:
    a. Number of planned awards:
        i. 3 phase 1, 1 phase 3
    b. Can we just address one source of data input:
        i. See and address the solicitation; address point clouds adequately; address sources of data types adequately
    c. We wish to pursue only single data source type (i.e. other data type that the solicitation, or we would rather not fully address the data-types of the solicitation):
        i. See the solicitation and the evaluation criterial to self-evaluate the competitiveness of your concepts
    d. Are cracks and issue:
        i. Project is not focused on routine or degradation defects, rather on gross battle damage
        ii. The solicitation includes SfM in order to leave room for future non BDA; however, the current focus is BDA.
        iii. Note: Consult with SMEs regarding possible common convergence points of the data sources listed in the solicitation
    e. Consult with SMEs regarding possible common convergence points of the data sources listed in the solicitation
    f. If a system only worked up to low tide and did an **amazing** job, then there is application; however, see the solicitation and evaluation criteria to self-asses competitiveness
    g. The solicitation is intentionally data collection agnostic and focused on point clouds. However, requires that proposals address SfM, SLAM, etc.
    h. Drones and phones not required in scope
    i. Current Government LIDAR data significant gaps, particularly under deck.
    j. Manufacture, simulation, etc. of input data is acceptable, but must address real-world type of variations and factors
    k. Lots of variability in construction and marine environment
    l. As a benefit of subject SBIR, Gov. would like to also know just how low of point cloud density could/would still work with the solution
    m. Gov. open to hybrid AI/ML or highly functional high reliable alternatives. However, see the solicitation and evaluation criteria to self-asses competitiveness
    n. Emphasis is on reliable, high TLR solution by end, of Phase-II, with solution outputs being the immediate inputs to other prototypes applications
    o. If/when your questions get highly technical, ask yourself; what would a large CAD software vendor wish, for the solution to your question

29. RE: … limitations on non-traditional (to this problem) sensors/data modality and what is in scope or out of scope for this topic?
    a. *We will attempt to Not limit innovation, so propose what you will; however, you are highly encouraged to address as many of the data types/sensors mentioned in the solicitation.*

30. Q: Is this opportunity looking for:
    - A type of technology that can create a repair planning tool with the inputs from remote sensing 3D Technology or,

- … is looking for remote sensing 3D Technology that can create the repair planning tool for the Navy.

a. *A: Objective: Enable a future automated pier repair planning tool. The inputs from 3D point-cloud (or similar); the outputs being Battle Damage Assessment (BDA) Rough Order of Magnitude (ROM) for repair type. For Topic N213-140, this is a tabulated/tabular output only; i.e. not plans and specifications. Although, this tabular data is seen as necessary for the enablement of future fully automated or AI repair plan generation.*

Summary:

i. *Inputs from 3D point-cloud (or similar)*
ii. *Tabular outputs of ROM BDA for enabling a future repair type determination, and future repair planning/repair design*

Conclusion:

iii. *Therefore; this opportunity is looking for, "1. A type of [solution which enables future] repair [plans/] planning tool with the inputs from remote sensing 3D Technology [and the outputs of tabular ROM BDA]".*

31. 1.a. Is there a minimum defect size (volume) that must be detected?
    a. *Generally minimum > 0.5 cubic foot volume*

32. 1.b. If there is a minimum defect size to detect, does it vary with the material type (concrete, steel, timber) and component type (e.g. pile, pile cap, deck, bumper, cleat, etc.)?
    a. *Generally, > 20% pile diameter, regardless of material*
    b. *Generally, > 1 cubic foot volume (concrete), most structure areas*
        i. *Possible exception is mooring foundation ~ > 0.5 cubic foot volume*
        ii. *Possible exception is mooring fitting ~ > 0.25 cubic foot volume (this likely to remain manually inspected)*
    c. *Generally, > 0.5 cubic foot volume (timber), most structure areas*

33. 2. Is there a preferred software language to use for the model and GUI?
    a. *Will rely on you the subject matter experts to decide; however, must keep future use and future commercialization in mind.*

34. 3. Is it preferred to have the software run on a desktop, laptop or hand-held device?
    a. *We prefer to have high TRL at end of Phase-II on a two-man portable computer. After the two-man portable unit is successful, then reducing the computation equipment footprint will come later; eventually targeting laptop, or smaller.*

35. 4. What is the current rough order of magnitude of time needed between obtaining scan data to the completion of the BDA tabular data generation? (The topic description mentions 48 labor hours, but we are not sure if that also includes the scanning time)
    a. *Tabular conversion could range between 2-8 hours of clock time; however, preference strongly given to reducing the time, even below 2 hours eventually.*

36. What is the expected classification level of the data available during Phase I and/or Phase II for model training and inference?
    a. *None provided as GFI*

37. Can the TPOCs provide any further detail on the projected quality of the post-event LIDAR/point cloud data that will be provided for training during Phase I and/or Phase II?
    a. *See tech. specs for NORBIT Portus Pole; can assume that we will fix the non-GPS'GPS-denied under-deck issues*
38. What is the expected classification level of the sensors/systems expected to be used for data collection in the post-event (i.e. degraded or denied) environment?
    a. *COTS; currently NORBIT Portus Pole*
39. Do the TPOCs wish to receive specific recommendations or vignettes describing sensors and data collection in the post-event (i.e. degraded or denied) environment?
    a. *Out of scope; however, always interested in learning/keeping up with the latest*

40. Will a sample 3D point cloud dataset be provided in Phase I work for algorithm verification/evaluation?
    a. *At this time no. However, this might change to enable a Phase-I to Phase-II selection evaluation.*
41. Should inclined [battered] piles be considered, or all piles are vertical in the project?
    a. *Battered pile are included.*
    b. *Assume all pile dimensions, placement, and angle vary to some real-world degree of variation*
42. For a timber constructed pier, the pattern of the crossing brace usually has a large variance, should it be estimated and used for repairing? Or the crossing brace pattern can be adopted from a pier construction code.
    a. *I will openly acknowledge to all readers; Timber is tough, due to vast variations, and fewer large piers globally are constructed of timber. However, the client still wishes for medium sized timber piers to be considered, with eventual success. Therefore, "See the solicitation and the evaluation criterial to self-evaluate the competitiveness of your concepts".*
43. As we understand, the output should include the damaged deck area, bents, piles, and the corresponding required material for repairing.
    a. *First, the minimum BDA load-path components include: **piles, pile-caps, beams, girders, deck, mooring foundation, and mooring fitting**.*
    b. *Clarification for your understanding of the scenario: The subject repairs are via pre-engineered mechanical kits; not conventional concrete, timber, steel, etc. However, focusing on the specifics of those repair methods are outside of this scope; only that your solution enables other to more quickly make repair decisions.*
44. In addition, the pier structure pattern (e.g., the distance between neighboring bents, the distribution of piles in a bent, etc.) should be estimated for construction.
    a. *"Yes", is the short answer.*
        i. The distance between neighboring bents … should be estimated from the 3D input data:
            - *Yes*
                a. *Note: Some "cheating" is acceptable regarding this; however, each proposer must consider all tradeoffs. So, see the solicitation and the evaluation criterial to self-evaluate the competitiveness of your concepts.*
        ii. The distribution of piles in a bent … should be estimated for the 3D input data:
            - *Yes*

a. *Note: Some "cheating" is acceptable regarding this; however, each proposer must consider all tradeoffs. So, see the solicitation and the evaluation criterial to self-evaluate the competitiveness of your concepts.*

45. RE: 1. Will the awardee(s) be provided with or have access to input and output data?
    a. RE: input data:
        i. *No. You will need to either purchase, gather, manufacture, simulate, etc. the 3D battle damage data. The data would need to replicate that which is collected by the sensors/processes/data-types which you chose to support. Example sensors/data include multi-beam sonar, LiDAR, structure from motion, photogrammetry, etc.*

    b. RE: output data:
        i. *We would work with you on example outputs; however, for now the output would need delineations such as:*
            - *Defect located on top-deck?*
            - *Defect located under-deck, but above water?*
            - *Defect located under water?*
            - *Defect is to a:*
                a. *Pile*
                b. *Pile Cap*
                c. *Beam*
                d. *Girder*
                e. *Deck*
                f. *Moring foundation*
                g. *Mooring fitting*
                h. *Etc.*
                i. *Defect location by local coordinate system (such as a bent/row identifier)*
                j. *Defect volume*
                k. *Etc.*

    c. RE: If yes, are all four types of input data (3D point-cloud, SLAM, photogrammetry and SfM) available?
        i. *No; see answers above.*

46. RE: 2. Will the awardee(s) be provided with or have access to sample spreadsheets from the Pier Reconnaissance Assessment Tool (PRAT)?
    a. *The proprietors of the PRAT and other relevant software platforms would present the inputs; however, for now, know that the PRAT inputs are simply the dimensions of all structural components in a single pile-support cross-section of the pier (like the four fingers on your hand, with your palm as the pile-cap), to include scores/ratings of the concrete's health and de-ratings for common wear/tear defects (the latter are out of scope here, as this solicitation is for BDA only). Suffice to say that the outputs of the subject project is intended to further automate other processes; such as rapid load*

capacity calculation, rapid repair assessment, rapid repair planning/specification, etc. – For now though, proposers are reminded to keep in mind that the inputs are 3D data, with the output being tabular inventory of defects. ***Note also that one key potential commercial aspect is the auto-generation of tabular structural component inventories (counting piles, pile caps, …); or such as the conversion of 3D data into the BIM tabular inventory of a structures constituent components.***

47. Question: How crowded is this industry, are there several companies currently working this problem?
    a. *Answer: Thant is a programmatic or market research question that I cannot adequately address here.*
48. Question: We don't have experience … with piers etc… Does that put us at a serious disadvantage for this effort relative to past performance?
    a. *Answer: As discussed; the real challenge with the project is Not the subject matter of Piers, rather the high variability in the constructed structure. So, let's be sober regarding the variability in pile placement and angle; the variation in pile-cap size and shape; the variation in the existence/absence of structural beams or girders; … the type, shape, and thickness of marine growth; three/debris under the pier; sunken small-boats, vehicles, etc. … So; NO; not at a disadvantage; however, anyone unfamiliar with working/construction in the marine environment MIGHT Underestimate the variabilities and/or challenges. It is now up to you to decide if your team has a grasp on the variabilities and whether you can/cannot satisfy the proposal. … We are Not looking simply for a successful Phase-I; rather a good litmus-test for you might be, that we seek a high TRL by the end of Phase-II. … We plan to award three Phase-I; however, only up to one Phase-II, with desire for that Phase-II to conclude with a rather high TRL. … Do you feel that you wish to provide that Phase-II solution?*
49. Question: Are we only looking at point cloud data or are we using other sensors (IR, etc...) to detect structural material?
    a. *Answer: The solicitation lists 3D point cloud, SLAM, Structurer-from-motion, photogrammetry, etc.. Safe to say that for now that the project begins at 3D point cloud inputs. If you wish to add other data types, that's up to you; however, proposals must address the solicited data authoring methods (SLAM, SfM, etc.) and data type(s) at a minimum (note: clouds and surface models can be generated via several different methods).*
50. Question: Are we expected to identify the construction materials from the point cloud data or just the structures?
    a. *Answer: Not in Phase-I or Phase-II. However a Phase-III might utilize the well-documented approach of reflected laser intensity for material typing, or other material typing method. Note though that roughly more than 80% of materials of interest are concrete of some related variation. So, some future value; however, not currently critical.*
51. Question: Will we be provided the point cloud data or a dataset to work with for Phase 1?
    a. *Answer: No; you have the ability and responsibility to simulate/produce the input data (and/or methods) that you propose/utilize.*
52. Question: How complex are these piers expected to be?
    a. *Answer: Typical rectilinear piers/wharves (i.e. no triangular, or curved crane-rail piers, or intersecting main axis piers (curved piers)); however, high variability, even in those "simple" rectilinear piers.*

54. Will any point cloud data of piers be available in Phase I?
    a. *Most likely no, but there are datasets available out in the commercial industry.*
55. Is the underwater structure considered in this project?
    a. *Yes, the underwater portions are within scope.*
56. If so, what type of data does multi-beam sonar produce?
    a. *There could be many different file extensions, but you get a Cartesian coordinate and a "dot".*
57. Are you currently using any software to convert point cloud data to Building Information Modeling (BIM)? If so, do you do any processing like data cleaning and hole filling?
    a. *Most of this conversion / preprocessing is currently manual (via HYPAC). Specific answers to above questions: "no" and "no".*
58. Are you using predetermined libraries to substitute your part data?
    a. *No, while industry is known to use component libraries, we currently don't. Also, consider the variability of the extraneous geometry in our case: utilities, pipes, trees, boxes, ships, etc.*
59. Should this project consider a combination of different types of data such as combining 3D point cloud data with photogrammetry?
    a. *This solicitation seeks to use the specified combination(s) of 3D data types/sources; so, yes.*
60. "This SBIR topic seeks solutions which can be executed in the field" -- What devices do you / can you have in the field? Do you bring a laptop? If so, what are the typical specs?
    a. *Currently have a small vessel with a NORBIT multi-beam sonar, a puck LIDAR by Velodyne. High-resolution video camera. Applanex IMUs. Not currently linked to any structure-from-motion system. Yes, we do have laptops in the field. Hypack software. NORBIT portus pole is being used to gather data. No current need for solution to run on cell phone(s).*
61. You mention defect detection and localization. Is this strictly in response to intentional damage (e.g., an adversary's attack) or are you also interested in normal wear and tear? What about prognostics – prediction of future defects?
    a. *This project is primarily focused on battle damage, motivated by a military application. Prognostics does not fall into the scope of this effort.*
62. Are we expected to estimate ROM for repair quantities / times ourselves, as an output of this effort?
    a. *No, repair quantities are not possible, because you would need to know repair procedures. The output of this project should be a tabular expression of the structure and the defect. Determine if there is a defect / discontinuity, and the volume of the defect / discontinuity. Inventory of what's there, what is not there, and the difference between the two. The solicitation was intended to convey that your outputs must have enough detail to enable other further efforts/applications to use your BDA outputs as their inputs, for enabling the later work to make the proper decisions.*
63. Can you explain a bit more about how you are using SLAM technologies? Is it intended to be used with robotics navigation in future?
    a. *The solicitation is agnostic towards SLAM use/reuse, it does not matter either way; i.e. application is out of scope.*
64. Would Augmented Reality technology such as Hololens bring any benefits? We are currently working on AI assisted infrastructure assessment using Hololens. For this project, would rendering BIM in Hololens facilitate communication/repair?

a. *Yes, there would be value added for AR. However, this project does not require it.*

65. If awarded, would we receive any data during Phase II?
    a. *No.*
        i. *Data is available; however, while the sensors are good, they require GPS, so do not work underneath structures. This dictates scanning the pier/wharf from their perimeters; resulting in sonar and LiDAR shadowing of the interior of the structure (see image below for example). Tough to determine if the shadow is missing structure or battle damage. – We are addressing the GPS-denied operation of some sensors, so in the future will have ~50 dots/square foot underneath the entire structure (or SLAM or SfM would be used under-structure); however, for now we will Not be committing to GFI data. Proposers will need to purchase, sub-contract, simulate, manufacture, etc. the input data types.*

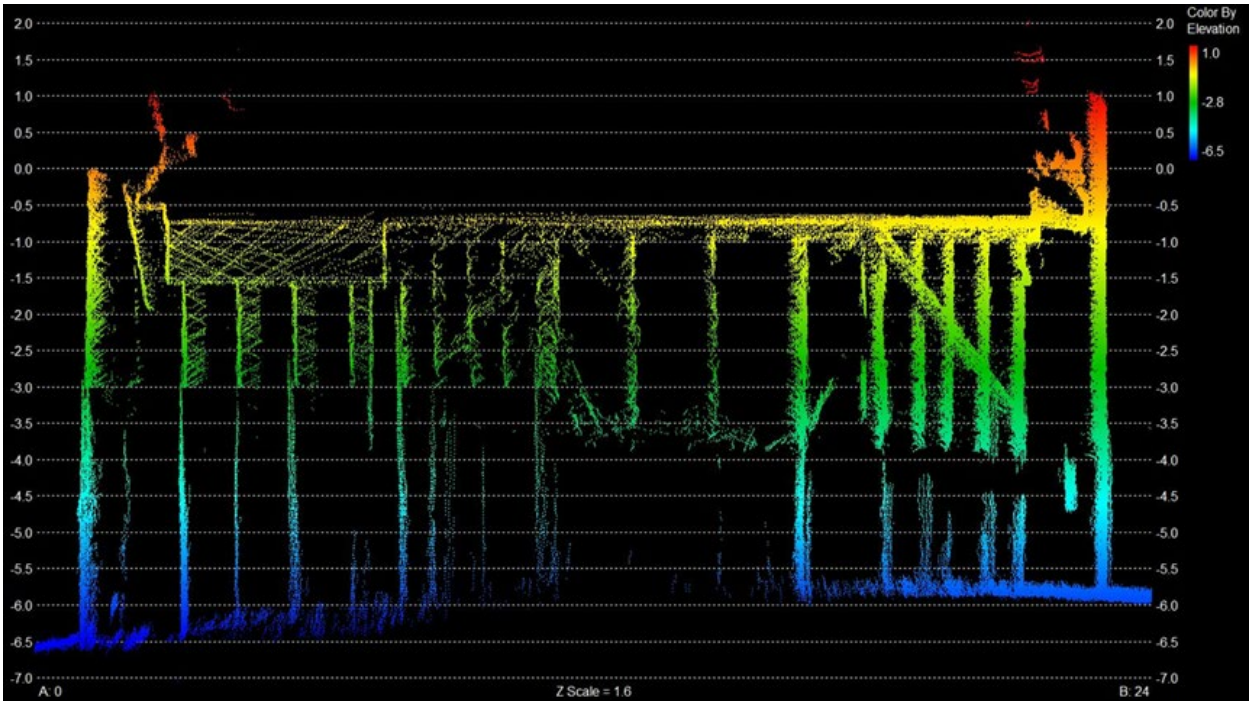

Image N213-140-2: Cross-section of timber pier. This real-world Navy pier has been abandoned in-place due to its poor overall condition. This image illustrates the low surface coverage of many structural components. This image does Not adequately depict just how low the point-cloud density is underneath the deck itself.

66. Can our initial (Phase I) proof of concept be applied to different types of data, such as more readily available 3D building components (e.g. I-beams, posts, bridge components, other structural data, etc)?
    a. *Simply, yes; however, I would encourage verifying that the Phase-I solution could handle substructure grid configuration, although a grid which has notable variability in dimensions and position. – So, in other words, yes, but ensure that your substitute is a fair representation of the challenges which you will face in Phase-II, as well as to convince the client that you really are ready, at the end of Phase-I, for a Phase-II success.*

67. What kind of processing power is available during on-site, real world scenarios?
    a. *The current laptops runs the HYPACK (i.e. hydrographic package) software package. The solicitation does not limit the computing power, only:*
        i. *No offsite cloud computing*
            1. *Due to communications denied coms. degraded environment*
        ii. *The community which this projects seeks to support likes to use the "two-man portable concept" for much of their single-component gear selection. Therefore, the,* ***computing system should be two-man portable, or smaller.***
            1. *This project focusses on allowing for innovation, we can be discriminative of the computational requirements later, so long as attempts are made early on to be within the two-man portable constraint.*

68. (Paraphrasing original question): Are you interested in our sensor products?
    a. *I'm most interested in your approach to the solicitation; namely your mention of, object detection and recognition.*
        i. *Details: Any one pier (most piers) are constructed in a fairly repetitive structural patter (with roughly 1 – 5 different types of structural cross-section types, employed throughout the sub-structure). The pilings and mooring fittings (cleats, bollards, double bits) are dimensionally rather consistent. However, the constructed placement of piles and their installed plumb-ness (from vertical) and x,y coordinate placement are Very sloppy (in order to facilitate low-cost construction in a wave tossed environment). Generally the remainder of the pier is cast-in-place; contracted from plans/specifications, which become construction guidelines (from a precision perspective). Meaning that there is a Lot of dimensional variation in construction; even before battle damage. Also, the natural environment is highly variable, in particular the marine grown on the underwater and splash-zone portions of piles. For these and other reasons; any approach proposed/attempted will need to contend with these highly variable issues. You mentioned key words such as*:

69. RE:
    a. **"Collect"**; *not part of this topic*
    b. **"Manage"**; *within scope, inventorying/tabulating*
    c. **"Visualize";** *not really in scope; rather the filtering/conversion/inventorying/tabulating*
    d. *analyze manufacturing data; our data is Highly Variable, much lower precision compared to manufacture data*
    e. **"3D graphical environment"**; *this is relevant however, N213-140 is a data conversion/filtering/algorithm/potentially AI or potentially change detection topic*
    f. (paraphrasing both the original Question and the Answer) **past experience in a manufactures-product industry AI/ML application**; … *The reality of our project is Highly Variable. This might be a challenge for anyone with past AI/ML experience* ***only*** *in high precision manufacturing settings; where, presumably, variation is much lower. Proposals should address how past experience prepares one for, or how one will overcome no past experience with, such high levels of multiple variabilities.*
    g. **"has expertise in AI/ML"**, *3D … recognition; this could be relevant*

70. Will the Navy be able to share examples of raw point cloud pier data?
    a. *Simple answer is, "No"; however, we have some data to "present" as examples, during early Phase-I*
    b. *During Phase-I we will Not **share** 3D data as government furnished information (GFI) for the purpose of conducting/executing your work. This is mostly a function of not being able to provide good-enough (perfect) data; so for purpose of solicitation, we are absolving ourselves of that responsibility. However, we can present the same data as examples of just how bad our current data is and as examples of the state of real-world data. See the images below for examples of the types of raw data which can be gathered. Our sensors (sonar and LiDAR) are capable of gathering great data; however, the boat is too large to fit under the pier AND the sonar and LiDAR require GPS; … however, under-pier is a GPS denied space. Soon after N230-140 is done, we anticipate having the ability to collect non-GPS reliant sonar and LiDAR 3D point clouds from all sides of the pier (including underneath). So, the subject project assumes that such future idea data is available. However, generally, Do Not assume high point-cloud density than a typical NORBIT Portus Pole (NORBIT sonar and current LiDAR) could obtain.*

Image N213-140-3: 3D sonar and LiDAR point cloud data of typical pier in typical usable condition. This image vaguely illustrates how tough it is to obtain under-pier data via motoring around the perimeter of a structure.

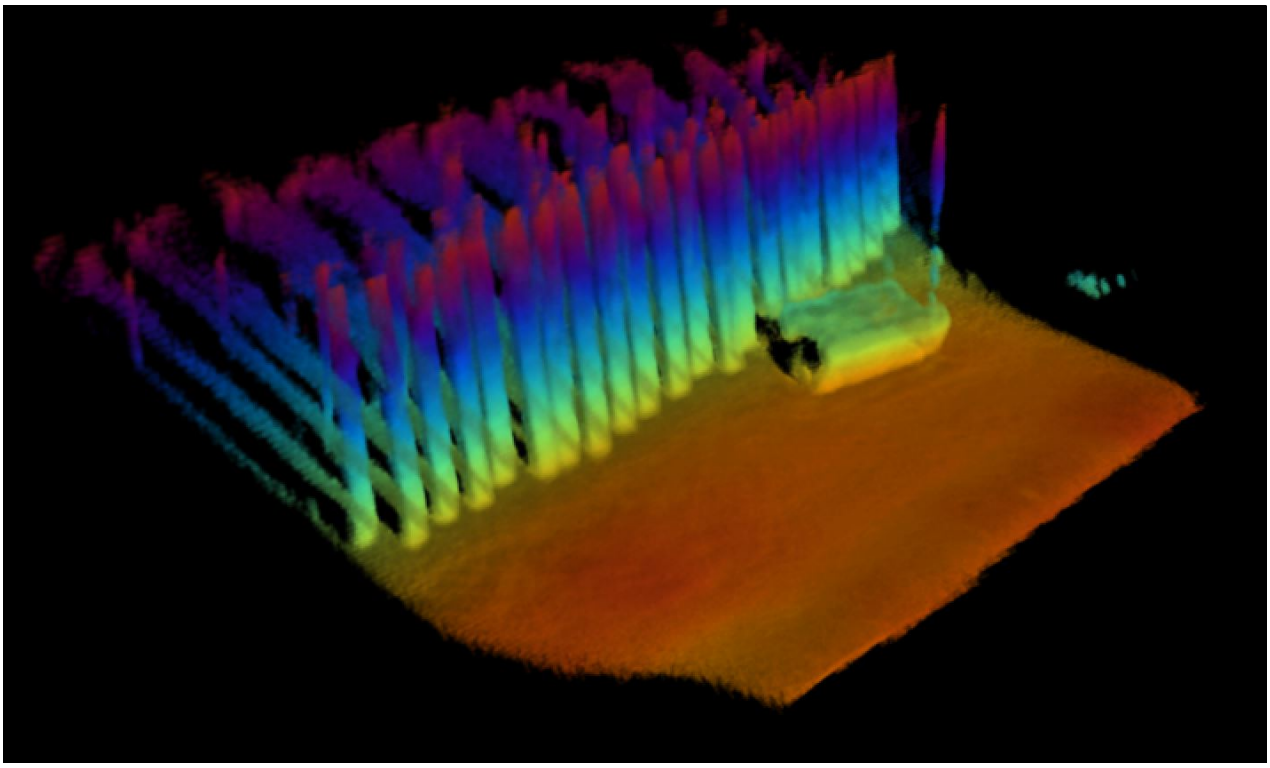

Image N213-140-4: 3D sonar point cloud data of typical wharf in typical usable condition. This image vaguely illustrates how tough it is to obtain under-pier data via motoring past the wharf.

c. *For consistency in our responses to vendors, we are stating that you must either collect/gather, purchase/procure, simulate, manufacture, etc. your 3D input data/training data. The following is NOT a specification; only a discussion point, or a kick-start of your own discussion: When I wrote the solicitation I (based on a Little knowledge and a Lot of optimism) **imagined** that simulated data might be from a parametric modeler/point-cloud generator, with real-world variance added to the data; or other creative solutions. Alternatively, I imagined that the vendor might partner with a major hardware vendor or engineering firm to get/procure ideal 3D point-cloud pier model(s). Alternatively, I imagined that the vendor might manually manufacture a small number of training data piers. (Note: I've listed these ideas as inspirations and must clarify that none of the aforementioned are provided as direction or preference.)*

71. Similarly, will the Navy be able to share expected results of the data processing?
    a. *Yes, in early Phase-I*

72. What is the expected source and resolution of the point cloud data?
    a. *Current source is Seahorse Marine's NORBIT Portus Pole (NORBIT multibeam sonar, Velodyne LiDAR, piped into HYPACK software). Typical density ~50 dots/ft^2; however, see Image-2 (this document) as some under-deck areas have 0 d/ft^2, which is the current problem. Other major sonar equipment vendors include Coda Octopus, with their EchoScope and the Kongsberg Mesotech lineup of products.*

73. Is the documentation and spreadsheet available for the Pier Reconnaissance Assessment Tool "(PRAT)"?
    a. *The relevant PRAT and/or Pier Diagram Tool in/outputs will be available in Phase-I. Note: PRAT/Pair Diagram Tool are being rewritten/re-coded now. The lead programmer will be on the Gov.'s SBIR tech team.*

74. Are buildings and structures part of the assessment? Or initial focus on wharf, pier, piles, pile caps, bumpers, deck, etc?
    a. *The focus is on the load-path elements of the pier; the project will not be required to analyze non-pier load paths/structures/buildings. However, presumably, your solution would need to handle such distractions; either through rudimentary or elephant means. However, how and the level for which these things are addressed are the proposal's responsibility.*

75. Do we address both above and below water in Phase I & II, or just above water?
    a. *Above and below by close of Phase-II; however, your Phase-I proposal will be scrutinized based on what is/is not addressed appropriately. Therefore, see the solicitation and the evaluation criteria/hints.*

76. If above and below water 3-D clouds, are above/below provided in common reference frame?
    a. *Currently, yes; via HYPAC software. However, such data is Not GFI.*

77. Will backscatter intensity be provided with above and below water 3-D clouds?
    a. *Simple answer: No; however, see the tech. specs of our current sensor kit (NORBIT Portus Pole) for setting the expectations of what you should do. Also, the answer to this question is largely up to you and your proposal, since you will need to provide your our project data. So, potentially consult with SMEs to address such in your proposal.*

78. Analysis may be more complicated if the wharf/pier have shipping containers, fork lifts, and other objects on the deck. Do you envision automated object detection/classification/segmentation for these to be addressed in Phase I & II?
    a. *Such is up to the proposer to address adequately; however, it is reasonable to assume that real-world extraneous objects will be present and must be address in some manner.*

79. Is there a need to detect/classify hazards in the water as part of the automated processing?
    a. *The client user will likely eventually wish for the berthing slip to be evaluated. That is currently out of scope; however, proposals may include this if the proposer chooses.*

80. Any chance of providing sample 3-D clouds for Phase I to help with feasibility analysis?
    a. *As stated elsewhere, not provided as GFI; however, similar data might be presented/shows, but not shared as a representative FYI.*

81. Phone call summary notes:
    a. *Pier material: concrete is most important, steel a bit less so, and timber is least important.*
    b. *Defects: missing sections of steel pilings could be a concern. Unfortunately, 3D data is not dense enough to detect smaller cracks.*

c. *Input data: 3D point clouds or surfaces are most relevant now, but hopefully other data sources can be incorporated in the future (e.g., image data to help find those smaller cracks). Solutions that can incorporate more data types (3D point clouds, SfM, SLAM) are generally viewed more positively, although 3D point cloud-type data is the starting point for now.*
d. *Height of piers: Distance between water and pier deck (really bottom of pier cap) is 0' – 20' with the mean being closer to 5'-8' and a tail extending out to 20' (possibly even higher in areas with large tidal swells, like Nova Scotia)*
e. *Pier construction: Pile-based piers are likely the most important, but bulkhead-style piers (a.k.a. wharves) do matter. Make sure you've got a plan for wharves in Phase II, even if you focus on pile-based piers in Phase I.*

82. Can you explain the origin/history of the topic? For example, who wrote it and why now?
    a. Navy Expeditionary Combat Command (parent command of UCT and NMCB, who are the intended users) requested that EXWC pursue the automating (3D date input) -> (repair plans/spec. output). However, I advised on and authored the current solicitation, with edits by A. Viana and others.

83. Who are the intended users of this system? How do those users perform their work today? What are the current limitations or shortcoming that we are attempting to address?
    a. Underwater Construction Team and Navy Mobile Construction Battalion; enlisted personnel lead by a Civil engineer/PE officer. However, this solution intended to increasingly enable expeditionary enlisted personnel, with less engineering oversight required.

84. Can you describe an example scenario for how the user would use the new tool that we develop?
    a. Rapid assessment of pier/wharf structures in a contested environment; coms. denied/coms. disabled; so no access to cloud computing infrastructure.

85. What would you consider a "home run" result from work in this topic?
    a. Phase-I; technical evaluation (maybe basic proof of concept) of your intended Phase-II approach. Note: Three planned Phase I awards; down-selecting to 1 Phase II award. High TRL at end of Phase-II, with intended user supported and a commercially viable solution.

86. What are the key technical challenges that we need to make sure to address? Any non-technical risks that should be addressed?
    a. A lot of real-world variability (marine growth on piles is variable; battle damage rubble is variable; randomness of sunken vehicle, boat, shipping container, etc.; … O! and the variability of originally constructed dimensions and/or pile/component placement); some data sets which are 3D point-cloud while others might be 3D but not points; relatively low human interaction, but some human interaction acceptable; time limits set for success. Must plan to work in a communications degraded/denied environment (so no satellite/global communication), however, could plan on having an onsite communication if required for your solution. Your solution should work a computer which is two-person portable (i.e. no global cloud services, no large servers, but can

have more than a laptop for computation); currently the teams have a laptop with HYPAC software (see vendor site for min computer requ. As a starting place).

87. What types of defects should we be detecting? Missing piles seem reasonable, but how about warped/bent piles, cracks in wood or concrete, or other structural defects? What about external sources of rubble/scrap that don't actually damage the structure but clutter it?
    a. Battle damage which is large enough to have structural significance (things such as {the following are fictitious examples}; losing more than 15% of constructed pile cross-section in a single pile; losing more than 20% cross-section total in any two neighboring piles; on a pile cap, losing more than 6" of concrete on an area larger than 1 square foot; on a concrete beam, losing more than 4" of concrete on an area larger than 1 square foot; etc. NOTE: I just made up these numeric values; we will need to reference the current Battle Damage assessment literature; which I will request a copy of fro the Phase-I. I think that the manual is in PDF and unclassified. Steel warped/bent piles not an issues, to a reasonable extent; however, if out of linear by more than like … ½ the piles diameter, then likely an issue. Minor cracks are Not typically detected by low density of 3D point cloud data (approximately 50 dots per square foot). Wear and tear on the pier is out of scope; if the adversary was using the pier with that wear/tear, then we'll ignore it; it's the … gross BDA defect that is of concern.

88. You mention tabular output encoding the structure and damaged parts of the structure, but would it be a benefit or within scope to have a visualization of the results (e.g., highlighting damage in the 3D view of the data)?
    a. Not required, but … maybe. … Maybe even prompt a human to accept the recommended defects. … However, remember that time is limited, so human interaction(s) should be quick. … If there are 750 possible defects, think about how much/little time required for each human interaction. … Which defects matter most?

89. How is data collected? Do the sensors get in among the piles or just from edges of pier?
    a. Such is currently and issue that is being worked on. Currently, the 3D point clouds, when taken amongst a forest of piles has a considerable amount of acoustic shadowing; also our small data collection boat (a RIB of MARV-II) will not fit under most small pies; and our data collection does Not work in GPS denied (under-pier), so not good date under the pier. … However, we are working to address all of those real issues via other development efforts. That is why this project assumes that good (but realistic point-cloud density) data is already collected/available as an input. Also, you must either manufacture, collect, purchase, simulate, etc. your own 3D scan data. … O!; currently sensors are on boat which travels the pier's perimeter; but working on UAS, small remote controlled boats, etc. to collect amongst the piles; so assume this when collection or simulating your own project data sets.

90. Are there operational considerations driving pier BDA timing (e.g., pier can't open until BDA is complete or pier operates at half capacity during BDA)?
    a. Assume that, "pier can't open until BDA is complete". The total assessment time assumptions are stated in the project solicitation.

91. What types of computational resources are available? Should the software run on one laptop, one phone, or a data center?
    a. See earlier comment; lap top currently runs HYPAC software, but can have addition computation; limited to two-man portable device.

92. Is this topic connected with an existing project or program? Is there a specific follow-on opportunity, DoD or commercial, that you have in mind?
    a. Project/program: Yes, Port Damage Repair concept of operations (can not share this document, however, it will be brief at opening of Phase-I).
    b. Follow-on opportunity/DoD or commercial: Three Phase-I to be awarded; plan on one Phase-II award; Phase-III is always hoped for in SBIR, but you know how this goes, that's mostly based on the Contractor's own project success. Once the subject topic is TRL 8/9; then another SBIR effort to take the tabular data to full repair plans/specs. is logically needed.
    c. Commercial: I've always hoped that the large CAD and 3D data software vendors would be very interested in purchasing/licensing a filter such as the once which this project wishes to achieve.

93. How central is technology transition to the primary goals of this topic?
    a. If what you are asking is, "how academic is this, Vs. how engineering (near term functionality); then I'd say this is a real world need and we really want a real working solution … that's the hope … However, I must respect the nature of the SBIR funding and the programmatic culture of this type of work.

94. Do you know if there will be any CUI (controlled unclassified information) or CDI (covered defense information) associated with the project?
    a. That is a programmatic question; please see the solicitation POCs for that response. If they say, "yes"; then I know that we can share the current BDA documentation; if they say, "no" then I'll have to spoon-feed the awardees a redacted summary of the same. – For now; please redirect that question and please share their response with me.

95. For briefings, would we be visiting you or a different group acting as customer? What should our plan for travel be? Where are you located?
    a. Visits: No (COVID); video conf.
    b. Travel: I'd guess no (COVID).
    c. Location for time zone planning: EST

96. Are there any references that you might recommend in addition to those listed in the topic?
    a. For now, no.

97. The lack of ease and automation in the stitching together of disparate scanning systems or technologies and the difficulty that professionals face in documenting "as-is" conditions, are all major pain points that we have identified that we see are relevant here.
    a. RE: … the stitching together of disparate scanning systems
        i. Stitching already done by HYPACK

98. This SBIR topic seeks solutions which can be executed in the field, without reliable Wi-Fi connectivity; therefore, are not cloud-based or require high computing capability.

    Does it require pretrained Machine Learning (ML) systems in a pier or field? Or, is this speaking to the computing power and speed of data/analysis for the equipment we are considering?

    a. *Your solution, regardless of how you achieve it, must enable field crews to arrive onsite; collect data; input the 3D data into your solution; output tabular BDA, which is then fed as the inputs into other systems for making the pier capacity and/or repair decision(s)*

99. This topic also seeks solutions that utilize open standard data interfaces and enables interoperability between IT systems.

    Can this system use open source construction take-off software systems as part of user interfaces?

    b. *We are open to use of other COTS components and/or solutions. We wish to Not limit the creativity, innovation, or common sense nature of proposals*

100. **Is it a goal of Phase II and beyond to leverage COTS technology? In other words, short-term benefits for COTS, but requirement for optimized technology long term?**
    c. *We are open to use of other COTS components and/or solutions. We wish to Not limit the creativity, innovation, or common sense nature of proposals*

101. **Stitching point clouds to create usable 3D geometry can be complex where many COTS applications already do this fairly well. Is there a strong preference for using COTS in Phase I?**
    d. *Stitching/merging of LiDAR and sonar already done by HYPACK, so not a key issue; unless I'm misunderstanding your questions*

102. **Manually scanning spaces can be time consuming; does an ideal solution incorporate the use of automated scanning processes? If so, is there preference to ground, water or aerial options?**
    e. *This question is out of scope. See full body of this composite communication document for more complete view and context of the situation.*

103. **Is the inability to rely upon historical data because there is no historical data collected or cannot be collected for all targets of interest expected to arise? If so, can we collect information on common, or more common infrastructure, to run future models against as a baselining, or starting point, measure.**
    f. *Best answer: Currently good sensors, but can't cost effectively get GPS-denied, under-pier data, so; "data cannot be collected for all targets of interest"*

g. RE: Can we collect information on common, or more common infrastructure, to run future models against as a baselining, or starting point, measure.
    i. *Several discussions summarized as: You are the SEMs, so consider your own approaches and the pros/cons of the same. You must each assess your overall approach as well as the applicability of any required training of a tool via other piers or structure type(s).*

104. Will data be provided for training the AI? Examples of the hand entered information from the point cloud as a ground truth? Or SfM? Photogrammetry?

a. *No*

105. Do the individuals looking at the data use different modalities to extract different information or is point cloud enough?

a. *Yes; currently:*
    i. *sonar for underwater*
    ii. *LiDAR for above water*
b. *Future: SLAM under-deck, but above water*
c. *Future: several sonar vendors are working to address non-GPS sonar solutions, currently unclear of their solution(s); i.e. do not know if non-GPS sonar will rely on next-gen high precision inertial monitoring units (IMU) of some version of SLAM, or an equivalent to SfM. … Such is one reason that the solicitation lists versions of SLAM and SfM, since we cannot adequately address what to expect for future of non-GPS sonar solutions.*

106. What kind of data can we use to train and test our AI system? How is the dataset annotated? Or, will properly annotated data be something we need to consider when building referenceable databases?

a. *No annotated GFI, proposals will need to address*

107. Is there a Database of specifications/blueprints for the objects/structures to be assessed? Or, at a minimum, a set range of objects/structures within the sphere of operational performance?

a. *Database: no*
b. *Specifications/blueprints for the objects/structures to be assessed:*
    i. *Piers: In Phase-I will share numerous 2D plan-view pier schematic/drawings (inspection type drawings) in order to convey typical ranges of pier configurations. Can also share numerous under-deck photos for the same, but these photos should Not be thought of as AI/ML training photo library for anything, as the photos (among other things) are Not extensive to the point of being training data*
c. *Or, at a minimum, a set range of objects/structures within the sphere of operational performance?*
    i. *A general range: Yes, a general range … However, see any photo of any port/harbor in remote or OCONUS location. We are not going to be prescriptive with this; rather, address extraneous object/geometry adequately and competitively within reasonable context to the solicitation.*

108. Does the manual data entered for LIDAR vs multibeam underwater differ? (is it the same exact information/data fields being entered into the PRAT?

a. *No; see Image N213-140-3; one can see a texture difference in LiDAR and sonar. However, the file format out of HYPCK is the same for the merged file format.*

109. What kind of LIDAR is being used? Is there a typical type or does the solution need to consider multiple types?

a. *This answer is best if generically answered; hwever, if it matters to anyone; currently, our NORBIT Portus Pole uses a Velodyne puck (not sure of exact model); however, the puck is very easily changed out for most any similar functioning unit.*

110. Is there an opportunity to interview/capture input from experts so we train our AI using our "expert capture" system that learns directly from people doing the manual job or do we only get access to the data output of their tasks?

a. *No GFI; proposers must address or obtain their own data, so direct this questions to subject matter equipment vendors, sub-contractors, or users, etc.*

111. Notes from a conversation:
112. This topic is the first step in a longer term goal to convert sensor data into construction plans.
113. One of the goals is to create a toolset for less experienced personnel to use in a time critical situation.
114. Discussed that the present data set is 3D point cloud, but the future is SLAM, photogrammetry, and SfM. Need to address the present and future.
115. The need to work in a GPS denied environment. Current arrangements with a local coordinate system.
116. Asked if repairs would be with poured concrete.
    i. TPOC explains that with the required turn around times, repairs would be with pre-fabricated mechanical kits (ala Erector Set).
117. Asked if we should be concerned with mapping rubble to assist with repair analysis.
    ii. The answer was that this phase is only concerned with tabulating defects, repair material quantities, and repair volume.
118. Asked if bridges or piers we could use for the Phase II demo
    iii. TPOC revised response: a demonstration, could do such (preference for pier)
119. Asked if other types of sonars, such as SAS, had been considered.
    iv. So far, only sonars identified by ERDC have been considered. Cost, portability, and duration of survey have to be considered if another sonar is recommended. Also, for this phase, the focus should be on converting survey data to tabular defect analysis.
120. Desired for the project solution(s) to have commercial value, so that DOD does not have to bear the sustainment cost, in the long term.
121. Desired high TRL, about TRL 7, by the end of Phase II.
122. One of the primary goals is to identify where the load path is still intact and where it needs to be repaired. This is to support immediate re-opening of the pier.

123. Site survey crew typically requires ~ 4 hours to collect; solution processing of data in < 2 hours.
124. Notional pier size is 110ft wide and 1,000 ft long.
125. Will award three phase I and one Phase II.

126. Is there preliminary data regarding the pier before the post damage scans are completed?
    a. The subject is the adversary's facility. Therefore, we will not be invited to gather data prior to the event, so assume no before/after equivalent comparison.
127. The topic mentions estimated material quantities and time needed for repair. Are there any others?
    a. This was intended to convey the level of logic able to be controlled by your BDA tabular output. See elsewhere in this combined document for discussions of directing truck, boat, diver; top/under-deck Vs. underwater, ad related discussions of levels of output detail and "enabling" of future actions.
128. For repair time, is the tool expected to consider location/site and availability/access to different types of materials, specialized labor, and equipment?
    a. Not specifically; only that your output have the hooks and details needed for directing repairs to top/under-deck Vs underwater; and to which exact component and grid coordinate
129. Is the requested tool an automated version of the PRAT spreadsheet and the associated data entry?
    a. No; your outputs become the inputs for other tools; such as PRAT, PDT, FEA, etc.
130. Will the pier construction type be a known input to the tool?
    a. You must decide whether to handle this question with AI/ML or as a parametric/user input.
131. What is the average precision of the 3D scans currently used?
    a. This is basic to the industry, suggest consulting your team or your partners, as not addressing this is a potential indicator.
132. How much noise is typically seen within the 3D scans?
    a. This is basic to the industry, suggest consulting your team or your partners, as not addressing this is a potential indicator.
133. What format do the scans of the Pier use?
    a. This is basic to the industry, suggest consulting your team or your partners, as not addressing this is a potential indicator.
134. What is the intended hardware that this application will run on?
    a. Consider what follow-on software vendors/SMEs/industry would wish to purchase from you.
135. The software must work equally well for all four types of data sets listed?
    a. This is basic to the industry, suggest consulting your team or your partners, as not addressing this is a potential indicator.
136. What is the desired run time? Seconds, minutes, hours?

a. ~2hr

137. Can typical construction patterns be provided by the Navy?

a. It is the TPOC's intention to be reasonably supportive of the proposing contractors; however, there is a practical limit to how much support the Government can provide. **If a proposer is not familiar with pier construction, then it is suggested that they see the ASCE Ports and Harbors Committee list and address their familiarity/unfamiliarity adequately in the proposal.**

138. Does the Navy have an existing database of data/images that can be used to train the AI/ML models?

a. None that will be made available as Distribution-A

139. Are there parallel efforts (RFP, BAA, PRDA) in progress or planned?

a. No

140. Are there any universities your group has worked with in this area in the past? And if so, could you give me any points of contact (POC) for them?

a. Will not share this.

141. Can you tell me the Program(s) of Record (POR) this topic is directed toward?

a. Generally a programmatic question; not addressed here.

142. Is there a primary Program Executive Office (PEO) responsible for funding this topic?

a. Generally a programmatic question; not addressed here.

143. The types of user or graphical user interface/inputs which might be acceptable, with limits

a. Solicitation mention of GUI was intended to indicate an openness to manual user inputs/interaction; however, limited interaction(s). If you need to know specifics of GUI; consider what other software SMEs will need to interact with in the future. While we will need to use your output, you will need to try to market its commercial value; so, do things that you are willing to live with as well.

144. RE: What is the main modality of data? Pointclouds?

a) Yes, 3D point-cloud; gathered via multi beamsonar and above-water LiDAR

143. RE: To what extent does SLAM matter, as we are looking at static data?

b) Proposal's should providing the answer to this question as part of demonstrating your familiarity with both the solicitation, as well as the accociated technolofgeis.

c) Yes; you are looking at static data.

d) All of the specified input source types have been weighted as stated in the solicitation.

144. RE: What level of detail are you looking for in the tabular details? High level e.g. structural damage occurred, or more fine e.g. deep scratches on legs.

e) Which repair vevicle to dispatch:

- *Truck*

- *Boat*
- *Diver*

f) *Generally, what type of component is to be repaired:*
   - *Pile*
   - *Pile-cap*
   - *Beam*
   - *Girder*
   - *Under-deck*
   - *Top-deck*
   - *Mooring oundation*
   - *Mooring Fitting*

g) *Exactly which/where is the component*

h) *What is the volume of repair*

i) *i.e. enable the future direction for repair(s)*