DELIVERING RESEARCH RESULTS TO THE DTRA CMR R&D TESTBED

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ABSTRACT

The purpose of the Research and Development Testbed (R&D Testbed) at the Defense Threat Reduction Agency's (DTRA) Center for Monitoring Research (CMR) is to improve nuclear explosion monitoring capability by supporting the R&D community with a wide range of activities and resources and providing environments for testing and evaluating promising research results at a wide range of scales. For certain deliverables, DTRA directs its sponsored researchers to deliver their research results to the R&D Testbed. Results delivered to the R&D Testbed are permanently archived in a manner that facilitates access by other researchers. In addition, the R&D Testbed provides a facility to evaluate such research results and, if desired, integrate them into other software systems and subsystems. For example deliverables are both integrated into software for delivery to the Comprehensive Test Ban Treaty Organization's International Data Centre and also transitioned to the US Air Force Technical Applications Center (AFTAC) at Patrick Air Force Base in Florida for routine worldwide nuclear explosion test monitoring. The purpose of this paper is to formally document the established procedures of the DTRA CMR R&D Testbed.

A key component for success of the R&D Testbed is the delivery, test, and acceptance of results from the R&D community. In general, the R&D Testbed expects four types of deliveries: technical reports, data to receive and store, software components to evaluate and possibly integrate, and parametric results (such as Source Specific Station Corrections) to evaluate and integrate. Separate procedures are required for the different types of deliveries:

- Technical reports only need to be delivered to the R&D Testbed, preferably electronically.
- Data deliveries:
  - Data must be delivered in electronic form, by FTP or tape submission.
  - A description of the data format will aid the delivery; the preferred format is CSS 3.0.
    - Other formats require discussion to ensure the format is properly defined.
- Deliveries that are to be evaluated and/or integrated (software components and parametric results):
  - Optimally, a delivery schedule is defined early in a research contract.
  - The R&D Testbed staff can assist the researcher in defining the software interfaces.
  - A test plan with evaluation criteria is generated by the researcher in collaboration with R&D Testbed staff.
  - The component to be evaluated is delivered.
  - The component is evaluated at the R&D Testbed.
  - The R&D Testbed provides feedback to researcher regarding the testing.
  - A test report is generated by the R&D Testbed with collaboration from the researcher.
  - DTRA will direct the subsequent activity: the component may be developed further or integrated into the operational test and evaluation system at CMR.

The procedure for delivery and evaluation of data and components requires coordination between the R&D Testbed and the sponsored researcher. For data deliveries, the primary issue is ensuring that the R&D Testbed is able to integrate the delivery into its archive database. For deliveries that are to be evaluated and/or integrated, the process is more detailed and requires contact early in the research and development cycle and continuing beyond the component delivery. Historically, the duration of the test and integration cycle has been 3-6 months, and after product delivery has required significant effort by both the R&D Testbed staff and the researcher.

As of June 2000, the R&D Testbed expects deliveries over the next 3 years from: 23 projects that require evaluation, 36 that require only archiving of final reports, and 32 that require integration of data. Given the resources required to properly evaluate deliveries, every effort should be made to define a realistic delivery and testing schedule that works for both the researcher and the R&D Testbed.

Key Words:

Nuclear explosion monitoring, evaluation, testing, delivery, monitoring capability, research and development

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OBJECTIVE

One of the primary objectives of the Research and Development Testbed at the DTRA Center for Monitoring Research is to provide a central delivery point for test, evaluation and storage of the results of DTRA sponsored Nuclear Monitoring research and development. The focus of this paper is to outline the procedures established for interacting with the R&D Testbed for the purposes of accepting, integrating, testing, and evaluating research results.

RESEARCH AND DEVELOPMENT TESTBED PROCEDURES

The R&D Testbed was designed to handle deliveries ranging in complexity from technical reports to software components that are to be evaluated for potential use in an integrated operational environment. Procedures have been developed and refined over time to facilitate delivery and testing of various types of deliverables, where the level of procedure is dependent on the type of delivery. For delivery of reports, all that is required is an electronic copy of the report in a known format. Other types of delivery require a delivery plan, which includes descriptions of what is to be delivered, its format, how it is to be installed, and a schedule. In addition, delivery of items that are to be evaluated must include a test plan that describes suggested test procedures and expected results. Templates for delivery and test plans are being published on the R&D Testbed web site (http://www.cmr.gov/rdtb).

Research Reports

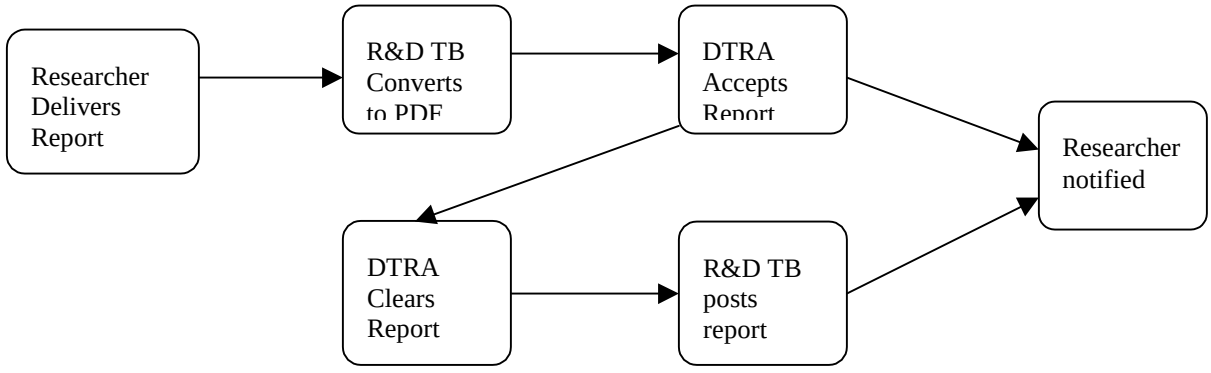
Delivery of final research reports requires minimal procedure. One notifies the R&D Testbed regarding the delivery, specifying a proposed delivery method and product format. The preferred delivery method is electronic distribution, with the format specified (e.g., MS Word, Frame 5.5, PDF.).

Once the report is delivered, the report will (with DTRA approval) be made available via the R&D Testbed web page or ftp site. In addition, a hardcopy of the report will be archived at CMR.

Table 1 Actions for Report Deliveries

Contributor	**R&D TB**	**DTRA**
1. Electronic delivery formatted in: • PDF • Word • FM • Postscript	1. Convert to PDF 2. Post on R&D Testbed web site as PDF 3. Reply to sender	1. Acceptance of deliverable 2. Clearance as needed -- prior to posting 3. Receive copy of report

Figure 1 : The process flow for delivering reports:



Data and Parametric Products

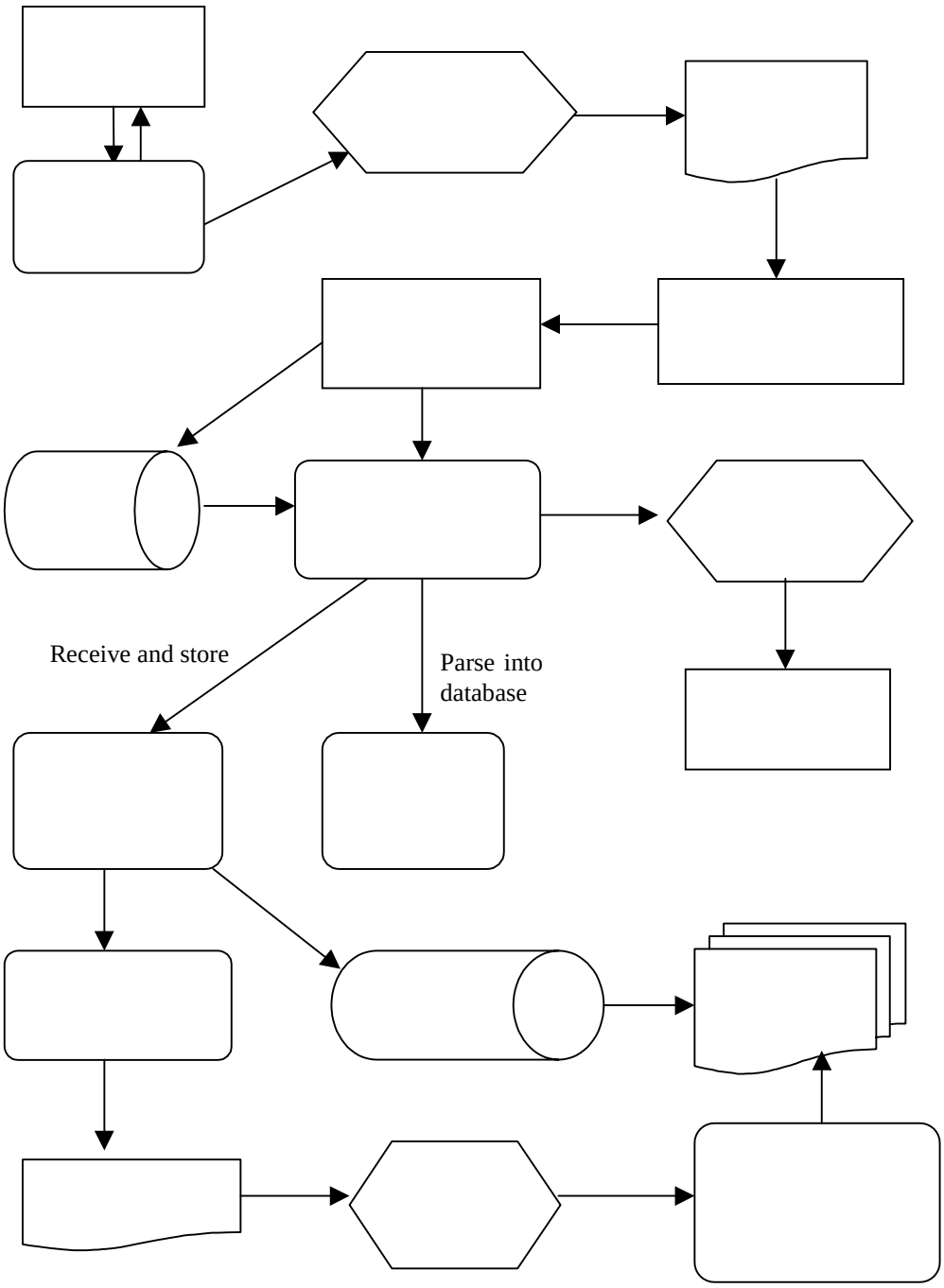
Some deliveries to the R&D Testbed can be described as 'Receive and Store' deliveries. That is, such items are received by the R&D Testbed; they are subjected to basic acceptance tests, and are then stored with the intent of making them available to other researchers. Previous examples of such deliveries would be waveform data sets, earthquake catalogs, velocity models, and so forth.

Receive and Store deliveries to the R&D Testbed require special preparation to ensure that the R&D Testbed will be able to interpret formats, have sufficient metadata to enable the product's use, and be ready to successfully integrate the data set into the R&D Testbed databases and storage system. There are a number of general actions by the contributor, the R&D Testbed, and DTRA, which apply to any product which will be stored on the R&D Testbed and which will subsequently be used by others. Such actions are outlined in Table 2 below, with specific examples provided for waveform and event catalog deliveries. In addition, Figure 2 illustrates the process flow.

Table 2 : Actions for Data Deliveries

	Contributor	**R&D TB**	**DTRA**
Generic Receive and Store	1. Abbreviated delivery plan 1.1. Type of information to store 1.2. Expected delivery size 1.3. Limits on redistribution (DTRA may overrule) 1.4. Expected delivery date 2. Electronic delivery in documented format	1. Verify readability 2. Store as delivered 3. Delivery report	1. Acceptance of deliverable 2. Clearance as needed -- prior to posting 3. Assessment of future action on deliverable 4. Resolution of disputes
Example 1: Waveform data	1. Abbreviated delivery plan 1.1. Expected delivery size 1.1.1. Bytes of data 1.1.2. Number of waveform segments 1.2. Delivered format 1.2.1. CSS 3.0 is preferred 1.2.2. GSE, SEED, SAC, or AH acceptable 1.3. Description of supplementary data (origins, arrivals, etc.) 1.4. Limits on redistribution 1.5. Expected delivery date 2. Electronic delivery of waveforms in expected format	1. Review delivery plan 2. Verify readability 3. Load into R&D Testbed database 3.1. Convert to CSS 3.0 format 3.2. Add any new stations to R&D Testbed station listing 3.3. Load waveform onto mass storage device 3.4. Load waveform description and associated data into the R&D Testbed database 4. Prepare delivery report and submit to DTRA 5. Post for export	
Example 2: Event Catalog	1. Abbreviated delivery plan 1.1. Expected delivery size 1.1.1. Bytes of data 1.1.2. Number of events 1.2. Delivered format 1.2.1. CSS 3.0 is preferred 1.2.2. Any format with metadata is acceptable 1.3. Limits on redistribution 1.4. Expected delivery date 2. Catalogs in ASCII (DB ready) and including metadata	1. Review delivery plan 2. Verify readability 3. Load into R&D Testbed database 3.1. Convert to CSS 3.0 format 3.2. Load origin, event, arrival, etc. tables to R&D Testbed database 4. Prepare delivery report and submit to DTRA 5. Post for export	

Figure 2 : The process for delivering data to the R&D Testbed



Software to be evaluated

Procedures for delivering software to the R&D Testbed are similar to that required for data deliveries. The primary differences involve the need for additional information in the delivery plan such as configuration issues (e.g., a list of files required to execute the code), and hardware and software requirements (e.g., the type of computer system required by the component and the expected version of the operating system). Of particular importance to the process are steps ensuring that the delivered component can run on the R&D Testbed, that the R&D Testbed staff understand what is required to install and evaluate the component, and that the delivery timing allows for sufficient evaluation of the component during the performance period of the contributor's contract. To mitigate potential issues, a delivery plan and a stand-alone test plan are to be submitted to the R&D Testbed by the contributor. In addition, the R&D Testbed can supply a compatibility list of software, hardware, and commercial off the shelf (COTS) products.

It is important that a realistic schedule, mutually agreeable to the contributor and the R&D Testbed, be negotiated with R&D Testbed staff as soon as possible in the overall process. The schedule should contain, at minimum, the expected date of submission for the delivery and test plans, the expected delivery date of the component, the evaluation period, and a final report date. The schedule is critical because any deviation in the schedule (by either party) may result in scheduling conflicts with other submissions to the R&D Testbed.

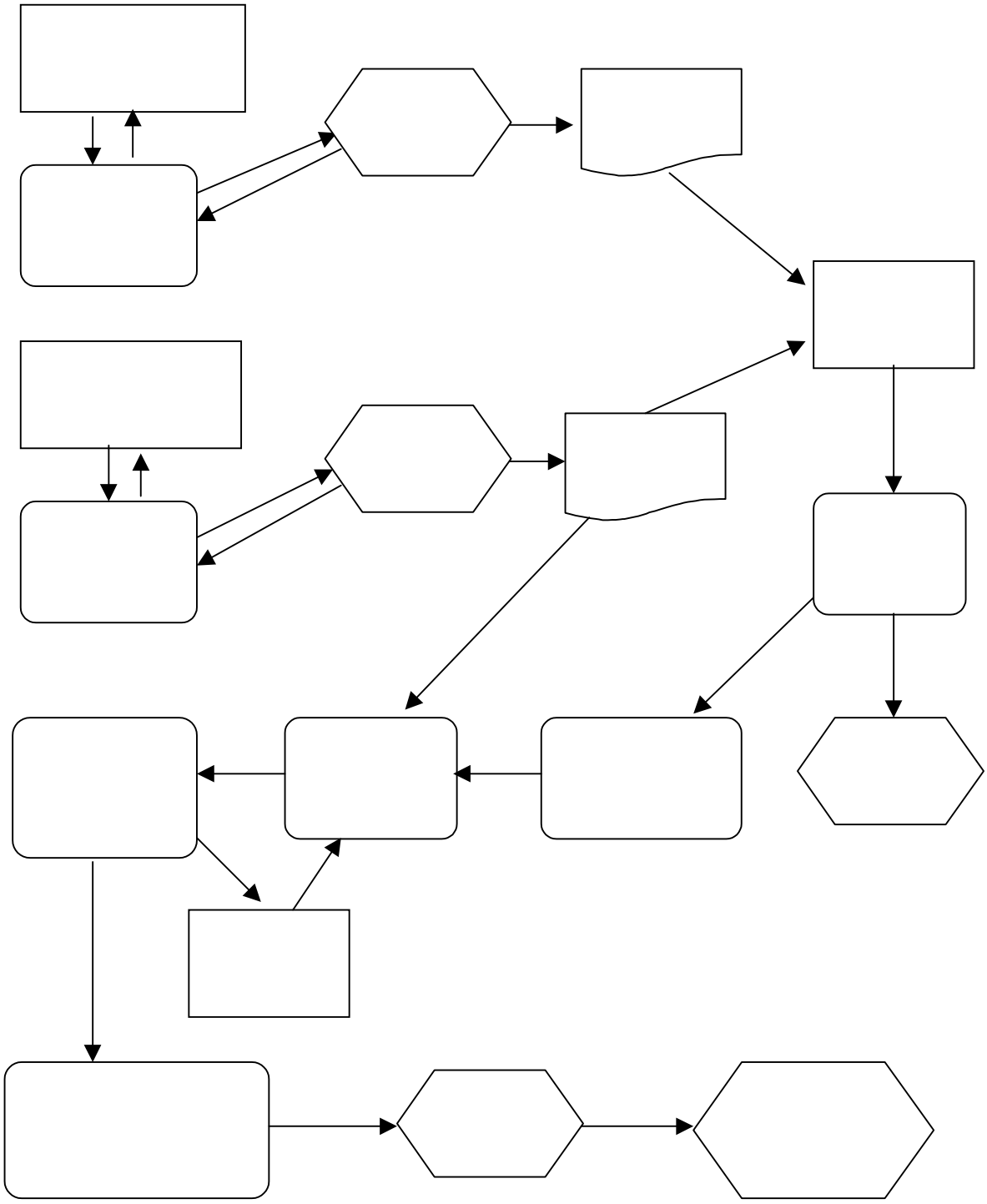
The stand-alone test plan focuses on the procedures for testing, the test criteria, and test cases. Researchers shall submit a test plan that provides comprehensive information on testing the product. This shall include features to be tested, pass/fail criteria, testing approach, resource requirements, and schedules. Test plans should clearly detail all procedures for test cases. Delivery and Test Plan templates are available from the R&D Testbed web site.

Specifications for each party are outlined in Table 3 below. In addition, Figure 3 on the following page illustrates the process for delivery and evaluating software components.

Table 3 : Actions for Software Deliveries to be Evaluated

Contributor	R&D TB	DTRA
1. Prepare delivery plan 1.1. System impact 1.1.1. What does the component do? 1.1.2. What are the inputs and outputs? 1.1.3. How is the software started? 1.2. System requirements 1.2.1. Hardware needed by software 1.2.2. Software requirements (deviations from the COTS list) 1.3. Configuration issues 1.4. Support requirements: what R&D Testbed staff support will be required for delivery 1.5. Delivery schedule 1.6. Installation instructions 2. Prepare stand-alone test plan 2.1. Procedures to execute test 2.2. Test cases 2.3. Evaluation criteria 2.4. Sample results 3. Deliver software 3.1. Complete source code 3.2. Consistent with COTS list 3.3. Documentation	1. Maintain COTS list 2. Supply metadata guidelines 3. Review delivery and test plan 4. Install and test software in stand-alone mode 5. Prepare delivery report and submit to DTRA 6. Evaluate parametric information 7. Prepare evaluation report and submit to DTRA	1. Acceptance of deliverable 2. Clearance as needed -- prior to posting 3. Assessment of future action on deliverable 4. Resolution of disputes

Figure 3 : Process Flow for the Delivery and Evaluation of Software at the R&D Testbed



Components to be Evaluated in the Context of a Full-Scale Monitoring System

Components that are to be tested and evaluated after integration into a full-scale monitoring system environment, for example the CTBT Monitoring Software System (CMSS), require additional steps than components that are to be evaluated in a stand-alone environment.

The delivered components must be compatible with the applications in the full-scale test environment. For example, while R&D Testbed facilities include Intel-based machines, the full-scale environment uses the SUN SPARC family processors. Special attention must be placed on how the component is to be integrated; that is, what process will initiate the component, where the component retrieves data, and where it writes output. As such, an integration plan is added to the delivery requirements. In addition, developers of these components are encouraged to work with the R&D Testbed software and systems engineers as early as possible in their development process to ensure compatibility with the environment of the R&D Testbed. These additional requirements have significant implications regarding the delivery schedule. The test and evaluation schedule is tighter for full-scale testing, due to competition for access to the integrated environment.

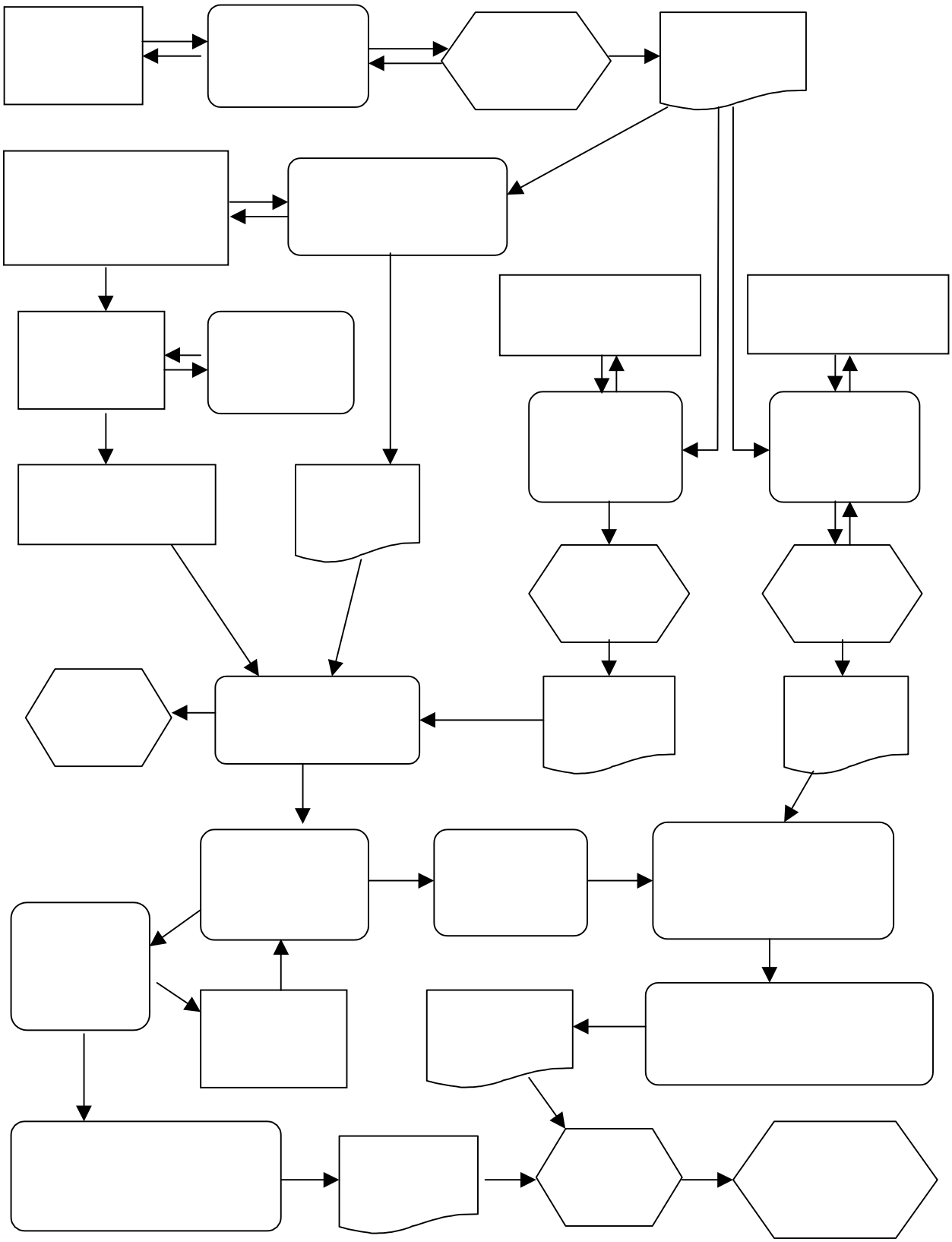
An integration test plan is required for components which will be integrated and evaluated in the context of a larger system. Integration tests differ from the stand-alone tests in that the stand-alone test is primarily focused on the function of the delivered application, whereas integration focuses on the operation of the system as a whole with the delivered component installed. As such, the Integration Test Plan provides the procedures for evaluating the delivered component within the context of the full-scale test environment. The primary issues in the Integration Test Plan are the instructions for determining and assessing correct interaction between the system and the specific application, and the basis for estimating overall system impact. The performance of the application and the integrated system, in terms of monitoring capability criteria, are assessed in the context of the final system output. For example, improvements in event location precision and accuracy would be performance criteria for location algorithms or location calibration parameters. Templates for both the Integration Plan and the Integration Test Plan are available on the R&D Testbed web site.

There are specific actions for the contributor, the R&D Testbed, and DTRA, as outlined in Table 4 below. In addition, Figure 4 illustrates the process for delivery and evaluating software components.

Table 4 : Actions for Software Deliveries to be Integrated

Contributor	R&D TB	DTRA
1. Delivery plan [See Table 3] 2. Integration plan 2.1. List the application that initializes the component 2.2. Explain all interfaces 2.2.1. Input interfaces 2.2.2. Component output 2.2.3. Controlling the component 2.3. Integration instructions 3. Stand-alone test plan [See Table 3] 4. Integration test plan 4.1. Procedures to execute test 4.2. Evaluation methodology 4.3. Expected system impact 5. Deliver software 5.1. Complete source code 5.2. Consistent with COTS list 5.3. Documentation	1. Maintain COTS list 2. Supply metadata guidelines 3. Review delivery and test plans 4. Install and test software in stand alone mode 5. Integrate component according the integration plan 6. Prepare delivery report and submit to DTRA 7. Prepare evaluation plan and submit to DTRA 8. Evaluate parametric information 9. Prepare evaluation report and submit to DTRA	1. Acceptance of deliverable 2. Clearance as needed -- prior to posting 3. Assessment of future action on deliverable 4. Resolution of disputes

Figure 4: Process for Delivering Integrated Products



SUMMARY

The DTRA CMR Research and Development Testbed is a designated testing and archival delivery point for DTRA sponsored research efforts. The R&D Testbed has the capability to test and evaluate deliveries in stand-alone mode, and in the context of the CTBT Monitoring System Software. Because of the complexity of receiving, storing, distributing, and evaluating a wide range of research products, a basic level of procedure is essential and is proportional to the complexity of the delivery:

1. Research report deliveries require:
    - Using an acceptable electronic format
2. Deliveries of data and parametric information require:
    - Prepare an abbreviated delivery plan
3. Deliveries of stand-alone components require:
    - A delivery plan
    - A stand-alone-test plan
4. Deliveries of components, information, or systems intended for integration require:
    - A delivery plan
    - An integration plan
    - A stand-alone test plan
    - An integration test plan