Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
Lexington 73, Massachusetts

SUBJECT: TEST PLANNING, CONCURRENCE, AND CONDUCT IN THE SAGE SYSTEM

To: C. R. Wieser

From: C. W. Watt, R. Davis, E. C. Proehle

Date: 31 August 1955

Approved: E S Rich
E. S. Rich

Abstract: The logical steps necessary to the planning and execution of SAGE subsystem and system tests are outlined and the various kinds of these tests are defined. This outline results from the work of a small group composed of E. C. Proehle, WE-ADES; R. Davis, Group 23; and C. W. Watt, Group 64. It is intended to provide background for detailed test planning, which must be undertaken at once by Lincoln, with ADES help. The planning necessary for Experimental SAGE Subsector tests is similar in nature, and should be governed by the same logic.

The following memo outlines the steps believed necessary for Test Planning and Test Conduct of subsystem and system equipment acceptance tests, and system operational tests. No attempt is made to define an organization or to assign responsibility for the work outlined. It is hoped that the outline presented here will be useful to ADES when detailed planning for the SAGE subsectors begins, and also to Divisions 2 and 6 in the integration of planning for the Experimental Subsector. The logic of test planning and conduct is suggested on the attached diagram.

I. DEFINITIONS

There is no commonly understood meaning for the term "Test Planning" when applied to the SAGE System. A variety of almost mutually exclusive tests must be designed and conducted before the system can be said to have been "tested" and each responsible group talks about "Test Planning" for its own equipment or specialty. The discussion below seeks to find a common denominator for all test planning, and it should be possible to divide the planning in any field into the logical steps outlined. The following definitions attempt to separate the various types of tests that must be made in the SAGE System, and to establish some terms to be used later in the discussion.

The research reported in this document was supported jointly by the Department of the Army, the Department of the Navy, and the Department of the Air Force under Air Force Contract No. AF 19(122)-458.

A. Equipment Tests

These are tests of individual black boxes in the system, usually done by the manufacturer (or by Lincoln for the ESS, in some cases) to prove that the equipment meets design specifications.

B. Subsystem and System Equipment Tests

These are tests designed to prove that the black boxes, when tied together, will work satisfactorily. An example is a radar plus a data transmission system tested together. This is now the beginning of a subsystem, and must be tested as such before phone line and associated terminal equipment are added. Further tests are run when this occurs, and when the combination is tied to the computer, further tests, implemented by test programs in the computer, must be run. The subsystem cannot be said to have been completely integrated with the SAGE System until it has operated satisfactorily with live input data and with the computer's operational program. The latter test may be considered a system equipment test, for its object is not to test the ability of the system to do air defense but rather to test the ability of one subsystem (a data input channel) to work with another subsystem (the computer).

C. Program Tests

These are tests designed to debug and integrate the various subprograms making up the operational program, and to prove out and debug the final operational program as adapted for a subsector. The sequence of steps involved in the testing of a complete operational program are analagous to those outlined above for the integration of individual black boxes into a subsystem and finally into a system. These tests will normally go on in parallel with subsystem and system equipment tests.

D. System Operational Tests

These are tests that are designed to show whether or not the system will handle aircraft as required by the operational specifications. This is a combined test of the system equipment, people, and the operational program. It logically follows the system equipment tests and program tests outlined above.

E. Technical Planning

This is the actual planning of what tests to do, and how to do them. Specialists in each of the fields defined above will do this technical planning for the various fields.

F. Administrative Planning

This is the scheduling of men, equipment, and time required to do the various tests, and the implementation of these schedules. Much of this planning is of the same type for all of the various kinds of tests listed. That portion of administrative planning that is common should be done by a common agency, in the interests of efficiency and best use of manpower.

G. Administrative Support

This is the day-to-day implementation of the agreements already reached with each organization supporting the tests. It is non-technical assistance to the engineers who are running the tests. It removes from the engineers the responsibility for cutting the red tape that is inevitable when diverse organizations must cooperate for a common task.

II. TEST PLANNING

The goal of Test Planning is to provide all the necessary documentation, procedures, equipment (aircraft and test equipment), and men that are needed for the job. Test planning can be divided into two main areas of responsibility, Technical Planning and Administrative Planning.

A. Technical Planning

This is the actual planning of what tests to do, and how to do them. The Technical Test Planners will provide a Test Plan. This will include:

1. A list of Test Requirements
    a. Detailed definition of the tests to be run
    b. Limits of acceptance for the tests to be run
2. A Test Methods Manual
    a. The methods to be used in running the tests
    b. The manpower support requirements
    c. A full complement of drawings, handbooks, documents, etc.
    d. All necessary computer test programs

3. A list of required Test Equipment

   a. All SAGE System equipment that is needed

   b. Full information on all special test equipment needed

   c. The aircraft support requirements

B. Administrative Planning

This is the preparation ahead of time of all the agreements with procuring agencies, all schedules, and the establishment of standard procedures of all sorts by which the testing group can get the equipment, manpower, and aircraft it needs without any lost time. The testing group will not be called on to do administrative planning of any sort except on a short term basis - namely when schedules already prepared have to be changed on a moment's notice; and even such changes will be covered by detailed procedures already formulated. Examples of things to be fully worked out for each SAGE Sector or Subsector include:

1. The method to be used in filing flight plans with the CAA

2. How to notify AMIS of the flight plans

3. How time sharing of radar sites with the manual Air Defense system is to be implemented, (during the testing and installation period). Fully concurred-on procedures will be spelled out to the testing agency so that day-to-day operations will go off smoothly.

In addition, the planning agency will arrange for the needed equipment, and requisition aircraft at an early date. A long lead time is necessary for this, especially for aircraft, as the movement of the proper types to designated bases is a massive problem, involving not only the aircraft but the personnel and maintenance facilities as well.

The result of this administrative planning will be:

1. A schedule of the sequence of tests, and a schedule of men and equipment, showing who and what are needed, and when;

2. Requisitions for men and equipment, given to the Air Force early enough for them to do something about it;

3. A series of concurred-on procedures to be used by the testing agency in the day-to-day requisitioning of men and material.

III. TEST PLAN CONCURRENCE

Once a test plan has been prepared that is satisfactory technically and is capable of being implemented, Air Force concurrence must be obtained. This function should be a formality if the planning has been well done, but it is an important step and the time interval to obtain it must be considered in making schedules.

IV. TEST CONDUCT

The conduct of the tests breaks down into the same two categories as the test planning, namely, technical operation of the tests and administrative support of the tests.

A. Technical Operation

Technical operation of the tests must be supervised. While not necessarily defining an actual organization, the conduct of tests will be discussed in terms of hypothetical individuals, the Test Director and the Test Engineer. The Test Director is responsible for running a prescribed set of tests, and conduct of each test is supervised in detail by a Test Engineer who reports to Test Director.

1. Sector or Subsector Test Director's Functions

The task required of the Test Director is to take the test plan received from the Planners and to realize the plan in terms of daily packages of equipment, time, manpower, and test programs. He determines, for example, the type and number of aircraft needed each day, the computer programs required, the operating manpower required, data recording requirements, necessary external equipment, what sort of flight plan is required, and what radio frequencies are to be used. He then passes the daily test plans on to an Administrative Support organization where the detailed scheduling confirmation is done. This will result in all of the required equipment and manpower being available on the designated day for the use of the Test Engineer.

When the test is finished the Test Director's group gathers, reduces, analyses, and interprets the results, to determine if requirements are met, and schedules future work accordingly.

2. Subsystem and/or System Test Engineer's Functions

The Test Engineer runs the tests on a day-to-day basis. Just before the test he checks on the actual availability of the equipment and manpower. During the test the Test Engineer provides technical supervision of the equipment, programs, and manpower being used. He keeps all the records of the test that are required, and will be in position after the test is completed to say whether or not acceptable data have been obtained. He will maintain close contact with the Test Director at all times, and together they will determine from the data obtained whether

or not the test must be repeated, and whether or not additional tests must be scheduled. If schedule changes are necessary the Test Director will see that they are made and that the men, equipment and aircraft involved are rescheduled.

If the test is cut short during its operation or cancelled for any reason, the Test Engineer must have sufficient plans on hand for alternate tests so that he can initiate substitutes on short notice.

B. Administrative Support to Operations

All detailed non-technical support for the operations of the tests is provided by an administrative support organization. Personnel in this organization need not be technically trained, but do need to have a clear understanding of what is being done and a complete grasp of the detail planning that is necessary to make such a large system as SAGE work as a unit.

This group's task will be to take the detailed test plans, which the Test Director has organized into daily packages, and to prepare, with sufficient lead time and with due regard to the constant probability of changes being required, all of the necessary cooperation needed from the other organizations that are affected by the tests.

This work may, for example, be organized on a weekly basis. Each week an administrative support man will take the Test Director's plans for tests and arrange with the Air Force Support organization for aircraft in adequate detailed quantities at specific times on specific days. He will arrange with radar sites a weekly schedule that takes into account scheduled maintenance or changes at the sites and the need for sharing the use of the equipment with the manual air defense system. He will notify the CAA of the expected flight plans for the week, doing this early enough so that if flights at desired times are not approved he will have time to juggle day-to-day schedules. When flight plans are approved he will notify AMIS (Air Movement Information Service) and the Manual Air Defense System so that everyone affected will know that tests are to be run.

It should be emphasized that the methods he uses to make these week-by-week arrangements will have already been determined by Administrative Planning (Section II, above). Administrative support means day-to-day implementation of plans already made through the channels already set up, and with people already designated. The previous planning is essential if this is to proceed easily and if the tests are to run smoothly.

Signed: C. W. Watt, Jr.
C. W. Watt

Signed: Robert R. Davis
R. Davis

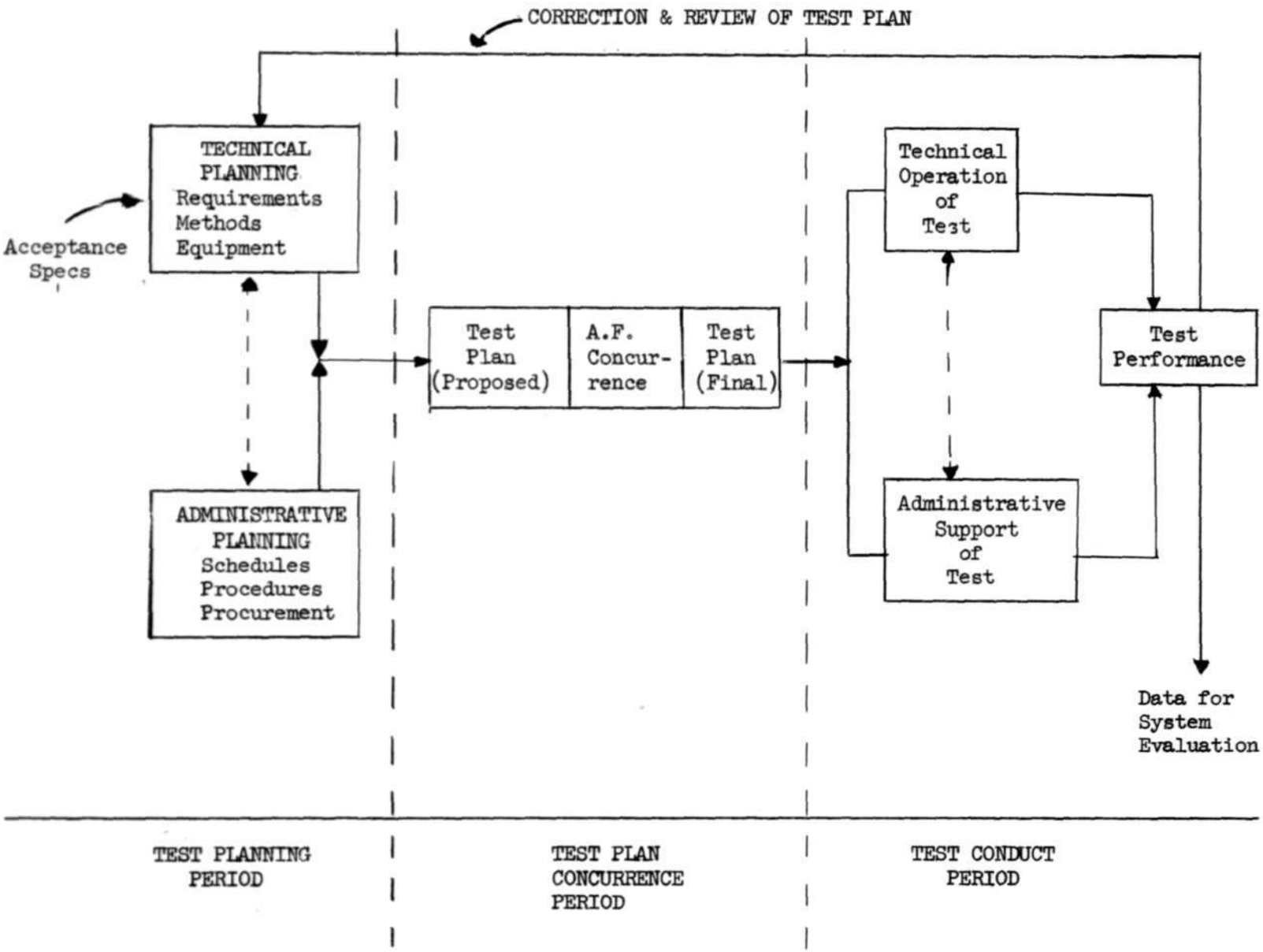
Signed: E. C. Proehle
E. C. Proehle

CWW/RD/ECP:hpm

Attachment: Diagram - Page 1a

DISTRIBUTION LIST

E. S. Rich
N. H. Taylor
S. H. Dodd
K. E. McVicar
F. Simon, ADES, MIT (5 copies)
E. C. Proehle - ADES, MIT
R. Davis
C. W. Watt
J. A. O'Brien
O. V. Fortier
P. Rosen
K. L. Morton - ADES, MIT
P. L. Mueller - ADES, MIT
H. N. Hoefler - ADES, MIT
B. E. Morriss
C. F. Overhage
T. R. Parkins
W. H. Radford
O. G. Selfridge
G. E. Valley
C. R. Whelan
W. J. Canty
H. W. Boyd
R. Mechlin
H. E. Anderson
J. A. Arnow
H. E. Benington
H. W. Boehmer
W. B. Davenport
R. R. Everett
J. W. Forrester
J. V. Harrington
J. F. Jacobs
D. R. Israel
H. J. Kirshner
F. C. Ong - BTL, MIT
B. B. Paine
R. E. Rader
F. A. Rodgers
H. Sherman
S. N. VanVoorhis



THE LOGICAL ORGANIZATION OF TEST PLANNING