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

SUBJECT: A PROPOSAL FOR ACCOMPLISHING THE SAGE SYSTEM COMPUTER PROGRAMMING TASKS OUTLINED IN MEMORANDUM 6M-3416

To: Lincoln Steering Committee

From: Jay W. Forrester, Robert Everett, C. Robert Wieser

Date: 11 March 1955

I. INTRODUCTION

At the last Steering Committee Meeting on March 7, we discussed Memorandum 6M-3416, which outlines the various types of computer programming tasks which we foresee in the SAGE System. If the nature and approximate magnitude of the tasks in that Memorandum are accepted as realistic, the next step is to determine who might properly be responsible for the execution of each task. This memo makes a proposal for responsibilities of various organizations and outlines how Lincoln Laboratory might accomplish the tasks for which it should be responsible.

II. ASSIGNMENT OF RESPONSIBILITY FOR PROGRAMMING ACTIVITIESA. Principles

We suggest that the same principles be followed in carrying out the computer programming work in the SAGE System as have governed the division of effort in electronic equipment phases. The guiding rules might be stated as follows:

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II. A Continued

1. Tasks related to research and development, to system design, and to demonstration of feasibility would be the full responsibility of Lincoln Laboratory.
2. Tasks corresponding to production engineering and final product design, which in electronic areas are normally carried on by other organizations, may, because of the newness of this area, need to be shared by Lincoln Laboratory.
3. Lincoln Laboratory must make available to others having responsibility for later phases of the effort the necessary background information and training support so that those other organizations can accomplish their tasks.
4. Tasks corresponding to production, installation, checkout, and system test would be carried out for the Air Force by an organization other than the Lincoln Laboratory.
5. Tasks relating to the operation of the system after installation would be the responsibility of the Air Force to be accomplished with their uniformed personnel, by civil service, or by contract.

B. Proposal for Lincoln Responsibilities

Referring to Memorandum 6M-3416, we propose that Lincoln be responsible for the following tasks:

Task A - Initial master computer program preparation for SAGE including the:

1. Master program for Direction Centers.
2. Master program for Combat Centers

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II. B. continued

Task B - Initial Computer Program Check-out at:

1. XD-1
2. Kingston Test Cell
3. Maguire for the Direction Center and Stewart for the Combat Center

Task F - Continuation of computer program research

We believe the above tasks fall naturally to the Lincoln Laboratory under the present circumstances even though they include functions which we have not been performing in the electronic counterpart. In the field of electronics, the Laboratory has not customarily done final equipment design without the participation of an outside organization under separate Air Force prime contract. The Laboratory has not, therefore, in the electronic design areas supplied the entire manpower necessary to turn out equipment designs. On the other hand, in the computer program area, the tasks are so interwoven with our responsibilities for systems guidance that no satisfactory dividing line for responsibility seems to exist. Accepting the responsibility for the technical content as well as the doing still leaves open to Lincoln the possibility of enlisting the assistance of others as our agents without our delegating responsibility for the end result.

C. Tasks Proposed for Western Electric

It seems to us that the following tasks of Memorandum 6M-3416 are implicit in the undertaking which Western Electric has already assumed.

Task C - Adaptation of the master programs for all installations after the first. This is a companion task to the design of communications networks, and installation

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II. C Continued

of equipment according to the standard pattern
but unique in detail to the particular subsector.

Task D - System tests for installations in the production
subsectors. This is a part of the routine installa-
tion and system checkout for which Western Electric
has accepted responsibility.

Task J - Computer programs for evaluation tests. This is
part of the system evaluation tests which Western
Electric has agreed to make for the Air Force
before turning over each subsector.

Task K - Preparation of special-purpose maintenance programs.
That part of this task which does not relate to the
FSQ-7 equipment is part of the over-all system test
and integration responsibility.

D. Tasks Proposed for IBM

IBM has already accepted responsibility for the part of Task K
which relates to the FSQ-7 equipment. It seems proper that their
responsibilities be limited to this area since such would be compatible
with our understanding of the present relationship of organizations in
the SAGE System and would also fit the pattern of IBM's relationship
to its commercial customers.

E. Unassigned Tasks for Air Force Action

The following tasks seem not to be commitments of any present
participants in the program so that the Air Force must arrange to have
them done either by uniformed personnel, civil service, or by contract.

Task E - Computer program revision

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II. E. Continued

Task G - Computer program engineers permanently stationed at operating sites

Task H - Preparation of computer programs for data reduction and analysis.

Task I - Preparation of synthetic data for training

III. AVAILABILITY OF STAFF MEMBERS FOR LINCOLN TASKS

In Section II, B, it was recommended that Lincoln carry out Tasks A, B and F in Memorandum 6M-3416. Task F begins in 1957 and phases in with the completion of Tasks A and B so that it will be given no further consideration in this memorandum. Tasks A and B, which are large and immediate, present the important problem.

A. Staff Required

Figure 1 shows a replot of Figure A and B in 6M-3416. Figure 1 shows the sum of the two curves in Figures A and B. The curve for the Combat Center master program has been delayed to start October 1, 1955 instead of July 1. Its end point is the same and the curve was made accordingly somewhat higher to include the same number of man months. The shapes of the curves were changed somewhat to give a wide, flat part to the required manpower versus time curve rather than a peak of short duration. The upper curve of Figure 1 shows the resulting manpower required when a training period is allowed for new staff members prior to their start of productive work.

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III. A. Continued:

The lower area under the curve shows the number of experienced staff members required for the preparation of operational and program specifications. Men of this type must have at least a year of experience and must therefore necessarily be drawn from present Lincoln staff. Almost all such persons are now in Group 61. We can assign the required number of experienced persons if we operate under the assumptions which are given in a later section. The center section on the curve shows the number of less-experienced persons, which can be made available from present staff, for the preparation of coding specifications. The upper section on the curve shows the number of new staff needed to assist in the program coding and who are not presently expected to be available in Division 6.

In addition to the computer programming engineers shown on Figure 1, we plan to transfer 7 well-qualified staff members from elsewhere in the Division into Group 61 to assist in coordination, liaison, administration, interviewing new staff, handling visitors, etc.

The following table tabulates the information given above and in Figure 1.

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III. A. Continued:

	Operational and Program Specifications	Coding Speci- fications and Coding	Administrative, Liaison, Coordination
Now available in Group 61	19	10	
Transfer from elsewhere in Division 6	3		7
New additions by September 1		30	
	<u>22</u>	<u>40</u>	7
Total Computer Program Engineers Required for SAGE Master Program		62	

Figure 2 shows the proposed allocation of Operational and Program Specification writers to the several tasks of preparing the master programs for both the Direction Center and the Combat Center. Included are times for initial checkout, modification, and final checkout at McGuire and Syracuse. A total of 22 such people is assumed throughout the period. New staff capable of writing operational specifications should become available by growth from the coding staff. It is expected that such additional staff will be required for peripheral activities such as test programs and that the total available for master programs can at best remain constant. It should be noted that once the operational and program specifications are written, a large number of senior people are still required for close management of the coding

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III. A. Continued

phase.

Figure 3 shows the proposed time allocation for the coding staff. New staff will be brought in and trained during the spring and summer. (These people may be potential but untrained operational specification writers.) Coding staff now available will be used until fall on utility programs and for study of optimum codes for parts of the SAGE programs that are especially time consuming. The major coding load for the direction center will begin in September. During the check-out phase, fewer coders will be required; those released can begin coding for the combat center.

B. Assumptions Made in Assigning Men to Master Program Preparation

In order to assign the above personnel, some strict limitations are necessary on other activities of Division 6, and Group 61 in particular, until still more staff members, beyond those necessary for the preparation of master programs, can be acquired and trained. The most important of these assumptions are:

1. The Cape Cod Test Program will be handled by the personnel presently assigned to it without augmenting their strength. The Test Program is limited by manpower rather than system or equipment test time. This means that the Test Program on the 1954 Cape Cod System in obtaining data on SAGE System performance will proceed at about one half the desired rate. Bell Laboratories and the Air Force are critical of the slowness of the test schedule and probably will apply pressure for accelerating it.
2. Only two top-caliber men have been allocated for the total of any new tasks which may arise with regard to such matters as:

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III. B. 2. Continued

BOMARC

Talos

Antiaircraft

AEW utilization

3. Only one of our better staff members is assigned to counter-countermeasures.
4. The work of Group 61 on equipment specifications in support of Groups 62 and 64 and IEM must be held at the level of two staff members.

C. Sources for New Staff

The preceding sections show a need for 30 new staff between now and September 1 to work on master program preparation. This does not include staff who should be brought in to accelerate the Cape Cod test program, to make preparations for effective testing of XD-1 System, and for other tasks which might be postponed until staff can be made available. These new staff should preferably be capable of becoming operational specifications caliber after they have gained experience.

The 30 needed for master program preparation can be made available in one or a combination of the following ways:

1. Hiring new staff members. We believe it is entirely possible to find this number of new staff members to add to the Lincoln Laboratory by September 1, if we undertake to do this very soon.
2. We believe that between 10 and 20 of the desired number would probably be found amongst the present Lincoln staff if the existence of the openings were publicized and staff members were allowed to transfer.
3. Assignment of staff from other organizations. If the other organizations take on responsibility for tasks as outlined in Section II, they will need, in 1956 and 1957, a number of experienced persons who could receive their training and experience

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III. C Continued

by assisting Lincoln in preparation of the master programs. If the personnel of other organizations do not participate in our work, but come to Lincoln only for training, it will impose an additional unscheduled burden on our staff.

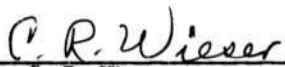
Signed _____


Jay W. Forrester

Signed _____


R. R. Everett

Signed _____


C. R. Wieser

JWF:RRE:CRW:jmm/mb

Attached: Drawing SB-48639G (Figure 1)
Drawing SB-48640G (Figure 2)
Drawing SB-48641G (Figure 3)

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APPENDIX IAllocation of Group 61 Staff Personnel

For the information of the Steering Committee, the following breakdown of present Group 61 staff is given to explain other assignments and obligations of the group which must be carried simultaneously with the master-program preparation.

	<u>Ops. & Program Specs. Writers</u>	<u>Coding Specs. & Coding</u>	<u>Other</u>
Group Supervisor	1		1
SAGE (Air Force) Training			1
Technical Liaison	1		
CCM Study	1		
SAGE Equipment Specifications	2		
Special Studies (ANDB, F-99, AEW, etc.)	1		
Cape Cod Test Program	8	4	2
Theoretical Analysis	<u>3</u>	<u>2</u>	<u> </u>
Obligations other than SAGE Master Programs	17	6	4
SAGE Master Programs	<u>19</u>	<u>10</u>	<u> </u>
Totals, Group 61	36	16	4
Total Staff, Other Obligations	27		
Total Staff, SAGE Master Program	<u>29</u>		
Total Staff, Group 61	56		

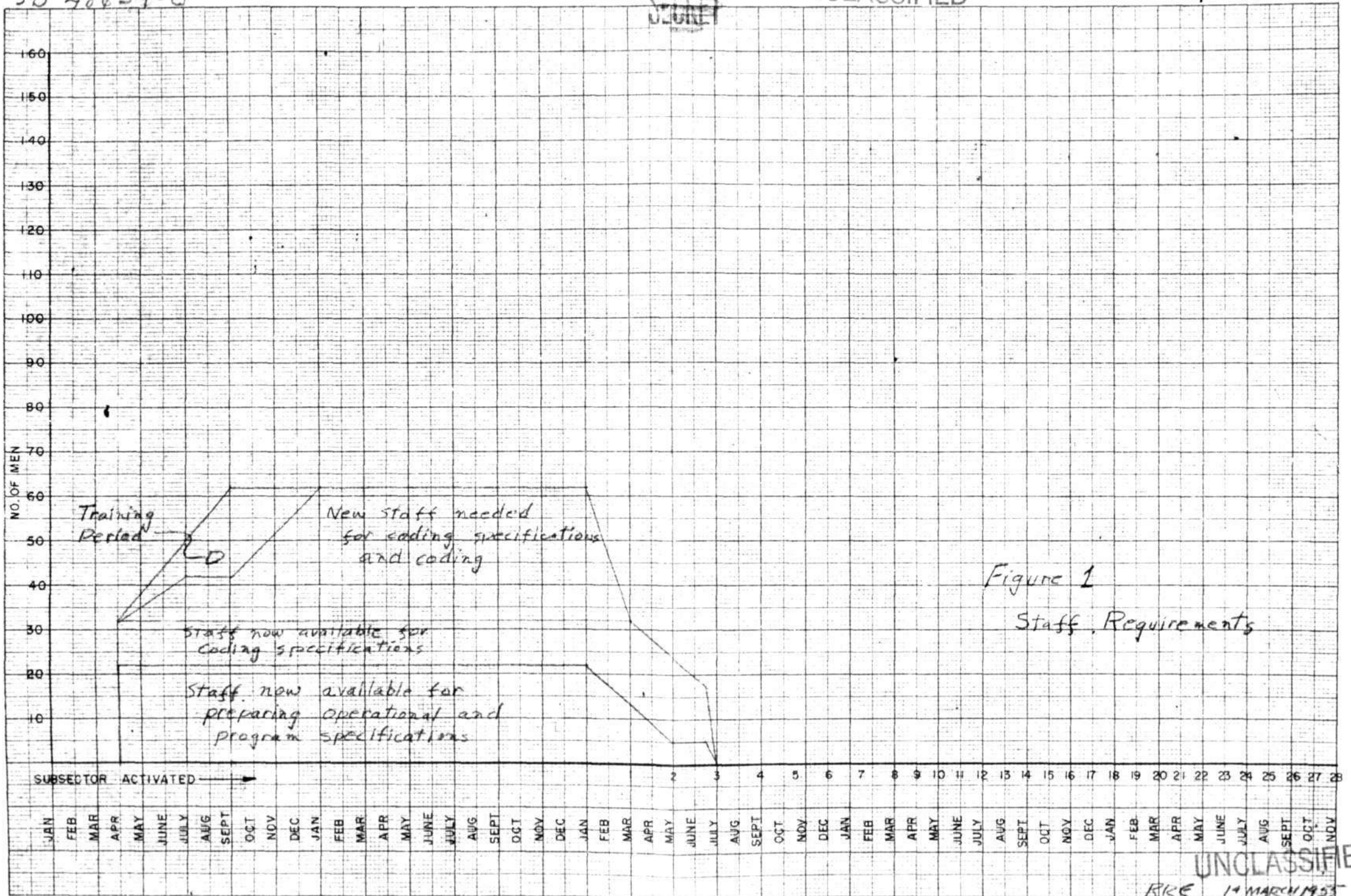
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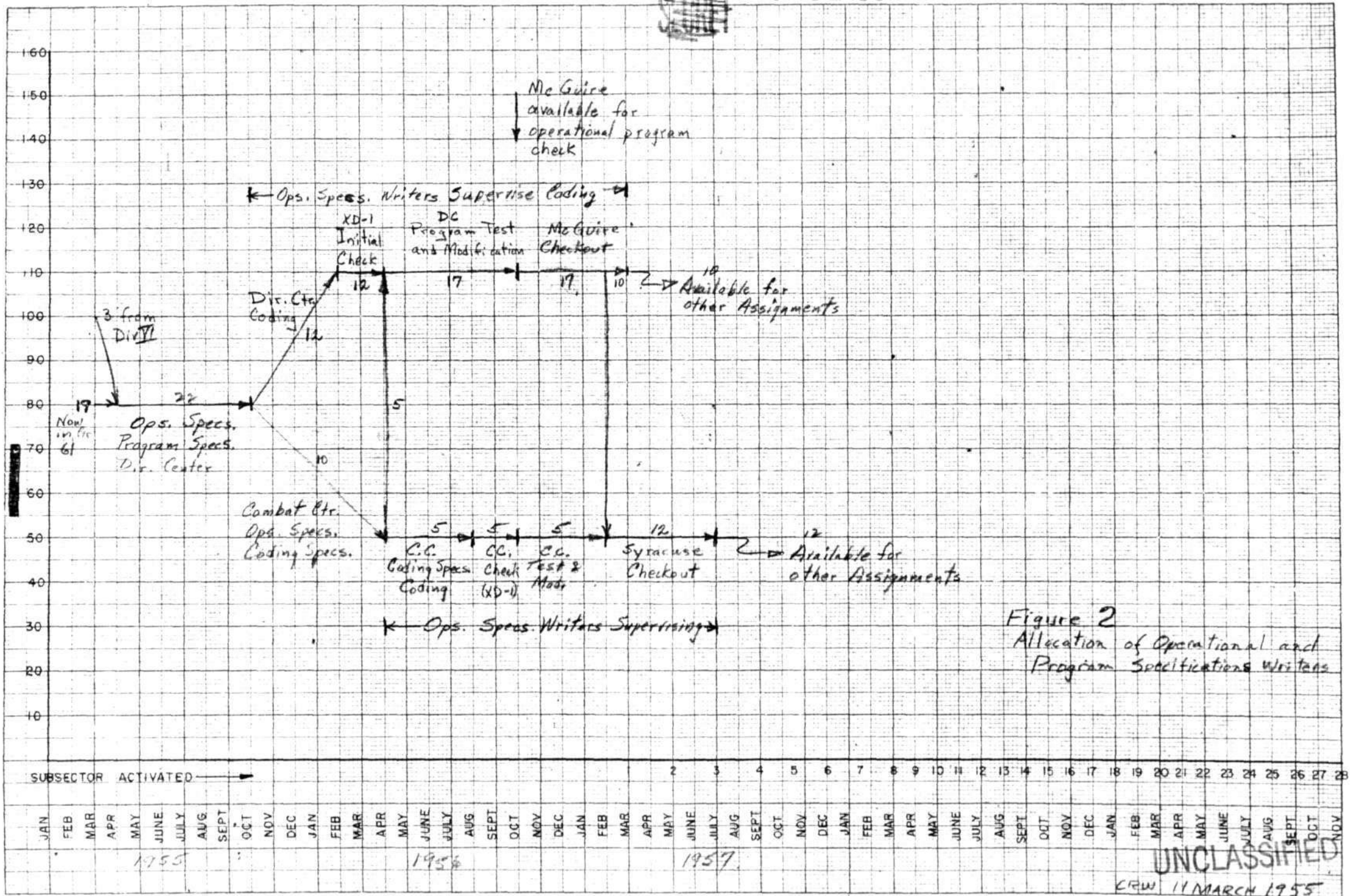
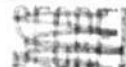


Figure 2
Allocation of Operational and
Program Specifications Writers

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