REF ID:A60166

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	INITIALS		
1 NAME OR TITLE Col. Marcy			CIRCULATE
ORGANIZATION AND LOCATION C/S	DATE		COORDINATION
2			FILE
			INFORMATION
3			NECESSARY ACTION
			NOTE AND RETURN
4			SEE ME
			SIGNATURE

Sept
18

REMARKS

Re Report by Inspector on Analytical Machine Employment: I concur in the paper as a whole and urge the adoption of all the recommendations as rapidly as may be practicable. I am particularly partial to the recommendations in Pars. 7a, b, d, and e.

Wenger has copy
& made comments

FROM NAME OR TITLE	DATE
WILLIAM F. FRIEDMAN CONSULTANT	22 August 52
ORGANIZATION AND LOCATION	TELEPHONE

DD FORM 1 FEB 50 95 Replaces DA AGO Form 895, 1 Apr 48, and AFHQ Form 12, 10 Nov 47, which may be used.

16—48487-4 GPO ☆

DEPARTMENT OF DEFENSE
ARMED FORCES SECURITY AGENCY
Washington 25, D. C.

15 August 1952

MEMORANDUM FOR: Consultant
Comptroller
Chief, Office of Operations
Chief, Office of R & D

SUBJECT: Report by the Inspector to the Director on Analytical Machine Employment, dated 15 August 1952.

1. Your attention is directed to the subject report, copies of which have been sent to the addressees of this memorandum.

2. In order that appropriate action can be taken on the recommendations of the report, your comment is desired at the earliest practicable date, and in any event no later than 29 August 1952.

Alfred R. Marcy

ALFRED R. MARCY
Colonel, Signal Corps
Chief of Staff

Copy to:
Admiral Wenger
Inspector

TS 52-446 CR

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~~Security Information~~

AFSA
15 August 1952

Report by the Inspector
to the Director
on
Analytical Machine Employment

THE PROBLEM

1. To determine what policies and practices in our use of analytical machinery are conducive to greatest efficiency and effectiveness.

FACTS

2. The analytical machinery covered in this report is listed and described in the paper "Machines Used in Cryptanalysis", AFSA Inspector/13 June 1952.

3. All usage data cited herein are for the first six months of calendar 52.

4. Definitions:

Programming (machine processes) - Laying out in specific detail the technical and procedural steps that will be taken in the conduct of individual machine processes.

Scheduling (machines and machine processes) - Planning the employment of machines and machine complexes, determining which machines shall perform which processes, and devising new methods and applications of machine processing.

DISCUSSION

5. As inclosure.

CONCLUSIONS

6. Derived throughout the discussion, and translated directly into recommendations below.

RECOMMENDATIONS

7. It is recommended:

a. That the function of analytical machine employment planning and scheduling (under the principles of paragraph 3 of the Discussion) be placed directly under the AFSA-02 Technical Director (02T), with a Machine Methods Group (including AFSA-35 "advisory" membership) to assist him. That spaces for this group be transferred from the Staff (AFSA-00F and AFSA-12 suggested), and bodies from AFSA-22 and AFSA-35.

b. That the principle of having decentralised machine installations adjacent and available to, and directly under the control of, individual analytical sections (including AFSA-41) be recognised and supported, and that additional needs of various sections in this respect be filled as soon as practicable. That the supply and maintenance of these installations (including the initiative therefor) be the responsibility of the Machine Division.

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AFSA
15 August 1952

Report by the Inspector to the Director on Analytical Machine Employment

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e. That the development of comparatively simple, compact, and easily maintained selectors and counters of moderate speed, suitable for individual section use, be prosecuted as a part of our research and development program. (DENHAM results may represent an acceptable start in this direction.)

d. That, with the transfer of the machine methods and scheduling function to O2T, AFSA-22 be reorganized as follows:

(1) Merge the "IBM Branch" and the "RAM Branch" as one, or, if administrative convenience requires, split the processing component by some more valid criterion than the IBM/RAM one.

(2) Transfer the process programming function to the processing branch or branches.

(3) Retain, as a staff group directly under 22, one or two assistants to assist with second-level machine scheduling and job dispatching.

e. That the quality of civilian machine operators be raised through a program of

(1) increasing their analytical responsibilities and background, and

(2) raising their entire grade structure accordingly.

That the administrative decisions and dispensations to give this effect be pursued at whatever level of Government is necessary, staffed within AFSA by AFSA-02 and AFSA-15 in collaboration.

f. That Machine Division strength be augmented as soon as possible by an increase in military personnel, supported by the Military Departments as follows:

(1) Navy. Returning to duty in AFSA all Naval personnel qualified in analytical machine operation and maintenance.

(2) All Services. Undertaking to arrange necessary permanence and non-rotation of qualified analytical machine personnel, with adequate career opportunity.

That the administrative decisions and dispensations involved in this support be pursued as high as necessary in the Department of Defense, staffed within AFSA by AFSA-02 and AFSA-15 in collaboration.

g. That AFSA-02, AFSA-15, and the Comptroller collaborate in exploring every means of facilitating the rapid shifting of personnel strength between the Machine Division and the analytical sections of AFSA-02, as needs vary, with a view to

(1) providing greater flexibility in the management of COMINT operations,

(2) promoting the analytical competence and background of Machine Division personnel as a whole, and

AFSA
15 August 1952

Report by the Inspector to the Director on Analytical Machine Employment

(3) promoting understanding and appreciation of machine processes and potentialities by analytical section personnel as a whole.

b. That our planning for the Fort Meade building be re-examined with an eye to the principles expressed in para. 18 of the Discussion.

E. S. L. GOODWIN
Captain, U.S. Navy
Inspector

Copies to: DD(R)
Chief of Staff
Mr. Friedman
Comptroller
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03
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AFSA
15 August 1952

DISCUSSION

1. Purpose of analytical machines. A force of people is the most flexible and versatile of analytical agents. It follows that an analytical machine, in order to be worthy of consideration for our processes, must have some advantage over a force of people that outweighs its disadvantage of inferior flexibility and versatility. This advantage, it happens, is always one simply of speed. Every machine in our list is able to perform one or more processes faster than they could be performed by a force of people equal in size to the force required to operate and maintain the machine. This gain in time benefits operations in two ways:

a. It saves man-hours in certain operations which would be performed anyway (at least in part), with or without machinery, and thus permits machines to replace men, with gains in effectiveness and economy.

b. It permits certain operations to be performed which, without the machines, would never be undertaken at all, even in part, in view of prohibitive or fantastic requirements in man-hours.

Logically, the second is no more than an extension of the first, but practically the split suggests a categorization which has some application to this analysis; that is, categorization by potentiality.

2. Machines according to potentiality. By this criterion the machines fall into two categories:

a. Labor-savers and extenders. Machines which replace men for operations which would be undertaken, at least in part, even without them.

b. Revolutionizers. Machines which make possible attacks which could not be undertaken without them.

According to this break-down our analytical machines line up thus:

Revolutionizers

Now available - - IBM, ABNER, ATLAS I, (GOLDBERG and CONNIE are borderline cases).

Projected - - - - NOMAD, ATLAS II, (AFSAF 1-1 is a borderline case).

Labor-savers and extenders

All others, plus a large part of IBM.

There may be some quarrel with calling the medium and long cycle solution selectors "labor-savers" rather than "revolutionizers" on the ground that operational exploitation of certain systems would not be possible without them. While this is undeniable, it contains qualifications which make its whole truth quantitative rather than qualitative. In any case, as will clearly emerge, counting these solution selectors as mere labor-extenders does no violence to the principles of their sound employment, and they are therefore, perhaps arbitrarily, so counted for the purposes of this analysis.

3. Employment related to potentiality. The categorization by potentiality leads directly to a philosophy of employment. The

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AFSA
15 August 1952

DISCUSSION (continued)

labor-savers and extenders should obviously be employed to perform every operation where they stand to save man-hours and speed up AFSA's results; the revolutionizers should be employed to the limit on operations which could not be attempted without them. At first glance these two requirements look like slightly quibbled versions of the same thought, but actually they are far apart, in emphasis, in the two approaches to the machine employment problem which they generate. The problem of making the labor-savers carry their weight is largely the straight-forward management problem of insuring, day by day and hour by hour, that operations are being performed as effectively and efficiently as possible. If the demand for the talents of a certain labor-saving machine is such that it is active 20 hours per week, and it is determined that there are no residual tasks being performed by hand or by other machinery that could be done better by this machine, and it has no backlog, then its employment leaves nothing to be desired -- it spends 20 hours each week saving labor and speeding results, and there is nothing more for it to do; its idle periods represent no loss and give no basis for reproach.* Thus SKATEs and DEMONs, of whatever vintage, have done their stints and may rest when there is no more of their kind of work to do.# Whether there is, in fact, no more of their kind of work to do is a matter for 02's technical people to determine, as a continuing part of their normal jobs of running the shop. With the revolutionizers, however, there seems to be need for an entirely different approach. If we have a machine that makes it possible to undertake analytical attacks that we could not undertake, even partially, without it, we would seem to be slighting our mission if we allow it to spend any significant time idle or performing labor-saving operations.@ If it has time available for a labor-saving operation, it should be so employed, but the moment this happens it should be a signal for the best brains to go into a huddle and devise some revolutionary employment to take over the time involved.* Maximum employment of the labor savers involves simply good AFSA-02 management in the ordinary sense;

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* I disregard here the argument that the space it stands idle in costs money. While this is true, the proper analysis of all the factors brings in the formula for the equivalence of man-hours and square-feet, involving concepts completely beyond the comprehension of all except those who are at home in the more stratospheric levels of Advanced Management.

\# Of course an expanded force of analysts might make more work for them to do. But the best conceivable reason for expanding the force would be to produce more for the consumers, and the desirability of this, from this angle, is beyond the scope of this study. The question of the desirability of expanding the analysis force solely to keep the DEMON from being idle in valuable floor space involves the formula for the equivalence of man-hours and square-feet, as mentioned in the preceding footnote, q.v.

@ IBM, because of its nature, is an obvious exception to the principle that the revolutionizers should ideally not be employed in labor-saving. IBM is indispensable for labor-saving, and a large part of the IBM installation must always be available for labor-saving and extending operations. What this principle means with regard to IBM is that IBM's capacity for "revolutionary" application should be utilized; whether by extended shift operation or by procurement of additional machines is a point for determination based on logistic considerations.

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Inclosure with AFSA Inspector's report of 15 August 1952

AFSA
15 August 1952

DISCUSSION (continued)

full time employment of the revolutionizers, however, involves something on an altogether different plane, inventiveness and scientific imagination and analytical competence of the highest order. And the two require approaches from two different starting points; in the first case, the approach is "Which of these jobs can be done better by some machine?"; in the second, it should be "What can we get this machine to do?"

4. Present employment versus reserve capacity. It has been a matter of policy in this Agency that machine operations should be generally confined to one shift, with a view to maintaining in ready reserve the 66% of total capacity represented by the two idle shifts. Lest this policy be regarded as in conflict with the foregoing, let it be clarified here. Surely it is not the real intent of the policy that we actually refrain from necessary or desirable machine employment to create an artificial or illusory reserve! Surely it is its real intent that we should procure and install, possibly not three times as much machinery as we need, but at least more than we need! No other interpretation makes sense, and only insofar as this one does is the policy a valid working doctrine.

5. Employment of the revolutionizers. ATLAS has been manned during six day-shifts, five evening-shifts, and five mid-shifts per week. This 128 hours per week is 76% of total available time (168 hours per week). During the first three months of calendar 1952, because of light usage in the mid-shift, ATLAS [redacted] actual use or under maintenance or alteration only 52% of total available time. This was increased to 72% during the second three months of the year, very nearly full utilization during manned shifts. A further breakdown of ATLAS's employment follows:

	Jan, Feb, March	Apr, May, June
a. Total hours in three month period	2184	2184
b. Total hours manned during three month period	1664	1664
c. Total hours on "revolutionizer" jobs	774.2	1099.7
d. Total hours in maintenance, alteration, testing, or training	215.1	266.9
e. Total hours on labor-saving and extending jobs	144.6	201.6
f. Total productive time (c plus e)	918.8	1301.3
g. Total non-idle time (c plus d plus e)	1133.9	1568.2
h. Total idle time (a minus g)	1050.1	615.8
i. Percent of total productive time as "revolutionizer"	84%	84%

DISCUSSION (continued)

	Jan, Feb, March	Apr, May, June
j. Percent of total productive time as labor-saver and extender	16%	16%
k. Percent of total non-idle time as labor-saver and extender	13%	13%
l. Percent of total available time as labor-saver and extender or idle	55%	38%

The last three items (j, k, and l) are the ones which, under the philosophy of paragraph 3, should be minimized. It will be seen that, while idle time has been appreciably cut down in the second quarter, usage as a labor-saver and extender has remained proportionally constant. Of the other revolutionizers, IBM is used in this role practically not at all (see para. 6, following), ABNER has only recently been installed and put through its initial operational tests, and CORNIX has been used 86% of only one shift exclusively in an essentially labor-extending role in the solution of FRENAN (French hand scrambler) settings. The other borderline case, [illegible], likewise used in only one shift, is discussed in paragraph 6, following.

6. Employment of the labor-savers. In general, and with specific reservations, it may be said that the labor-savers are doing all of the big jobs and most of the small ones that the analysts ask of them. The specific reservations are as follows:

IBM - By far the greater part of IBM employment is for labor-saving and extension. The IBM complex has been working at about full capacity during one shift and half-capacity during a second (punches have been worked at only a little over one-third capacity in the second shift, which indicates that preparation is not the limiting factor). There is widespread complaint, in part, I believe, justified, that IBM results are slow, that much of the work is not sufficiently checked for accuracy, and that too much has had to be redone in whole or in part because of busts which should have been caught on the floor at the machines but which, instead, are allowed to carry through to the end of the process, accumulating error to the fatal vitiation of results.

ROBIN - The ROBIN battery has been giving about 60% usage in one shift and 50% in a second. At the same time, the work it was provided for and is doing is not being pushed to completion with anything like the speed which, in the light of our mission, we should press for. As in the case of IBM, the difficulty here seems to be in operation of the machines themselves, not in preparation.

[illegible] - This operator has been used during one full shift of a 5-day week. Between 25% and 50% of this usage has been on selector jobs which could have been run, with less convenience and more delay (but not necessarily less efficiency), on other machines.

Miscellaneous small operations. There are numbers of small and piece-meal machine jobs, requiring from a few

DISCUSSION (continued)

minutes to five or six hours each, which do not get done and are not even asked for because of the complications inherent in the centralization of machine facilities. The analysts either do these by hand or pass them over and go on to other things or alternative attacks.

These points are discussed in detail in the following paragraphs. It should be mentioned in passing that SKATE II furnishes a fine example of a labor-saver which seems to be well employed. It has been used, in three apparently well packed shifts (but, let it be said, with a rather high maintenance time; recently about 19%), almost solely on jobs which it is well fitted to do.

7. IBM's labor-saving employment. The IBM plant's troubles seem to be due to inadequate qualifications and potentialities of personnel. The intake at the bottom has been largely in the GS-2 (entering punch operator) grade which, as the lowest civil-service grade, is the sump of the personnel pool, containing, along with some people of excellent potential, many of the drifters and part time vagrants, and some people who have no natural potential to achieve higher qualifications. The GS-2s thus provide thin pickings for GS-4, 5, and 6 operator and supervisor material. In addition, not only the intake grade of GS-2 but the entire grade structure of the Machine Division is too low, by at least one or two grades, to provide for the kind of both talent and incentive that AFSA (as distinguished from other Government agencies) needs in its Machine Division. Apparently, too, the outside labor pool of GS-4s, 5s, and 6s is inadequate, perhaps for the same reasons that exist within AFSA. Added to this lack of adequate sources of replenishment of good floor talent is the fact that most of the few employees with this talent are in the Machine Division's front-office Methods Branch (AFSA-221), presumably because they are the only people qualified to man that Branch. The bad effects of this whole situation are two-fold, as follows:

a. The people on the floor are not adequately qualified to know, from the analytical standpoint, what they are doing, and so, being unable to program their own jobs, have to receive detailed instructions which they follow blindly. Errors in both programming and execution tend to go undetected, and this is aggravated by the fact that some of the floor personnel are unreliable in performance of even some of the checks that they are qualified and required to make. The floor personnel tend, thus, to be a group of disinterested automatons, instead of alert members of the analytical team (as they were in both Agencies during WWII).

b. In view of the situation on the floor, the Methods Branch is forced to spend much of its time in the detailed programming of individual IBM jobs, much of which is, to an able machine man, a fairly routine operation. The Methods Branch thus has itself largely tied up in work which belongs at operating-section level, or which, if it must be done at branch level, should be confined to the machine operating branches.

The effect is cumulative. The able people of the Methods Branch are unable to devote proper attention to the primary job of a "Methods Branch", which is to dream up new and better uses for machines; in other words, they are too busy with programming to to be able to devote adequate creative and constructive study to

DISCUSSION (continued)

scheduling. At the same time they are absent from the operating floor, where, among other things, they are needed to develop their own replacements and raise the level of floor talent. The net result is a self perpetuating stasis which requires some deliberate boot-strap lifting. The Machine Division is moving toward the first pull in this direction by a program of temporarily shifting Methods Branch people to the floor, where they are to train and indoctrinate the operating section people in the analytical and programming phases of the work, with a view to eventually shifting the duties involved to the machine sections, where they belong. For this move to be fully effective it will have to be accompanied by a program of raising both the grade levels of machine operating section jobs and the potential qualifications level of Machine Division recruits. A first move in this direction is already underway, an arrangement reached late in June between the Personnel Division and AFSA-02 whereby the standards for new punch operators are raised. Much more needs to be done in this direction. It would appear to be not impossible to convince the Civil Service Commission that our machine operator needs are at least two grades higher than those of FSA and FHA; the ammunition for the attempt is clearly the understanding of the analytical process which we should demand in our operators, not excepting the punchers.

8. The ROBIN job. The ROBIN program was pushed through as an interim measure on the basis that

a. No already available or imminently available solution was satisfactory, even as an interim one.

b. The work could not wait for the ultimate solution (DELLA).

The second premise, imposed by AFSA-02, could not, of course, be challenged by anyone else. The first, however, was challenged by the then Head of AFSA-351 (Mr. Dumey) and appears to me, now reinforced by but not depending solely on some hindsight, to be vulnerable. The ROBINs, having cost close to a million dollars, are now under scrutiny as having produced a totally unexpected lack of results. There is no reason yet to blame the ROBIN concept, and the million is by no means wasted, because the ROBINs will presumably always have uses, but I am convinced that a good deal less money spent improving AMBER would have permitted us (with the help of other existing machines) at least to check out the theory and approach of the ROBINs to find whether we really needed them. There may be nothing wrong with the theory and approach, but the fact that we are even now checking these to see whether there is indicates the possibility that we crashed ahead without knowing too well where we were going. The ROBIN deal, incidentally, is the perfect answer to anyone who says that our approach to our problems is "niggardly and parsimonious". In my opinion this particular deal was extravagant.

9. ROBIN utilization. Putting aside the history of the ROBINs, which cannot be altered and possibly should not if it could, we turn to the day by day uses of these machines. AFSA-02 could not wait for DELLA. Nevertheless, with DELLA now being installed, the ROBINs have been employed at less than 50% capacity! The reason is that there are not enough ROBIN operators to man the machines at full capacity 24 hours a day. The ROBIN problem thus boils down to one of personnel, requiring the same remedies that are needed for IBM; the Machine Division simply does not have enough people of high enough caliber.

10. ROBIN preparation. The preparation of material for ROBIN illustrates a point which has a bearing on the Machine Division's

AFSA
15 August 1952

DISCUSSION (continued)

personnel problems. The hard copy received from the field is first edited and collated by the analysts (AFSA-243) at Arlington Hall, then sent 8 miles to NAVSECSTA to be punched. The punching process includes the making of page proofs, which are checked by the punchers against the edited hard copies; tapes are corrected from this check and second page proofs are run. These are then sent 8 miles to Arlington Hall, where the analysts of 243 check them again. They are then sent 8 miles back to NAVSECSTA where the Machine Division's punchers make final corrections in the tapes, then run them to make hard ("gray") tapes. The gray tapes are then sent 8 miles to Arlington Hall where they are run on the ROBINs. It is not my purpose to emphasize the 32 miles of travel which this material undergoes; it is rather my purpose to point out the following:

a. Two distinct groups of people, 8 miles apart, engage in what is essentially a single routine process.

b. One of these groups has a grade level averaging GS-2/3, the other has a grade level averaging GS-4/5.

c. There is nothing more difficult about the routine operation of the GS-4/5 group than about that of the GS-2/3 group.

Aside from the argument that editing and collation belong, logically and economically, in the punching process (and are, in fact, often done there in other areas of our effort), it would seem to be possible here to give the Machine Division's punchers higher responsibilities and higher grades, thus killing the following three birds:

a. Helping to solve the Machine Division's personnel problems.

b. Ridding what is ostensibly an analysts' group of a routine, mechanical operation.

c. Saving total personnel, thus providing additional hands for, among other things, manning ROBINs.

11. GOLDBERG. This borderline revolutionizer's maintenance time runs extremely high; 35% to 50%. Disregarding this factor, which is conceivably capable of correction, its usage is of interest from two standpoints:

a. It is used in only one shift, which suggests the possibility that a properly emancipated group of methods-inventors might be able to devise some uses to fill its spare time.

b. With proper pressure being put on its schedule by the emancipated group of methods-inventors, it is conceivable that its present 25-50% employment as a selector would be shifted to its less versatile cousins, to permit its full-time use in its higher capability as an operator.

Some of GOLDBERG's less versatile cousins are now employed only part time (in one shift) or no time at all. Consideration of these, which are counters and the simpler kinds of selectors, and their possible employment leads directly into the next two paragraphs.

AFSA
15 August 1952

DISCUSSION (continued)

12. Miscellaneous small operations. Every analytical section in 02 has a constant need for small piecemeal jobs in which machines can minimize man-hours. Some of these, of a purely mathematical kind, are performed with the aid of the analysts' desk-top Friden calculators. An analyst wishes to make a mathematical computation. If he has no Friden, he can do one of two things; work it out by hand or follow the S.O.P. to have the job done by the Machine Division on the IBM-604 (or O'MALLEY, if appropriate). If the job is a very large one, he will, of course, write it up and send it to the Machine Division, and will get his answer in not less than two days. If it is anything other than very large, and he wants the answer right away, to fit in with a current train of thought, he will probably make a stab at working it out by hand. Possession of the Friden means that he is assisted and speeded up in this operation; non-possession of it means that the job will not get done or will get done inefficiently. The arithmetical job has been used purely as an example; there are many counting and selecting jobs to which the same arguments apply. Two of the basic chores of cryptanalysis, monographic and digraphic frequency counting, are important cases in point. An analyst may want counts taken on one or two messages rather than a thousand. The thousand, he would write up and send to the Machine Division; the one or two he would toss to a clerk to count manually, unless he has a machine counter handy and informally accessible. Possibly the count of one or two messages convinces him that he wants the count on the entire thousand, in which case he will go through the formality of the work-request to AFSA-22 for the big job. But possibly, instead, the count of one or two convinces him that there's nothing in his hunch, so he abandons the idea of further counting. And this last is important, for if he cannot conveniently check his idea on the small sample he may request the big job of AFSA-22 without a check (and get his negative result two days later after a considerable amount of effort by 22 instead of one hour later after an easy run on his own machine). Exactly similar considerations apply to sliding coincidence and differencing runs. On the whole, the lack of certain machines directly and informally available to the analysts leads to the following inefficiencies:

a. Work which should be done is not done, or

b. It is done by hand methods, or

c. It is unnecessarily inflated to make it big and important enough to be put through the S.O.P. for performance by the central machine pool; or it is ordered in toto even when a first piecemeal result might show the complete job to be unnecessary.

The principles involved here are recognized, and several sections have their small machine rooms, adjacent to their main areas. There is, however, a mild but constant pressure to minimize this dispersion and to prevent its further growth; there seems to be a tendency to accept as axiomatic the theory that if you have something which is a machine, and something called a Machine Division, the machine must obviously belong to the Machine Division. As a result, some sections do not have all the locally controlled machines they need, and some have none at all.

13. Central pooling versus dispersion for operational convenience. I pose the following statement as axiomatic:

> In the absence of overriding reasons to the contrary, the tools needed by a technician to do his job should be (a) under his immediate control, and (b) near and convenient to him.

AFSA
15 August 1952

DISCUSSION (continued)

I believe that there are three possible "overriding reasons to the contrary", two of them compelling and one permissive, as follows:

Compelling

a. There being only one tool of the kind (or a limited number), and that constantly needed by more than one distinct group of technicians, centralized pooling under a system of priorities is unavoidable.

b. Logistics considerations such that decentralized use would be unacceptably expensive or totally impracticable.

Permissive

c. Tools employed in continuing mass operations of fixed types, with large amounts of raw materials, requiring only routine or intermittent participation or surveillance by the requiring technicians.

Along with these principles, there should be noted the essential entailed premise that an increased expense caused by decentralization is not necessarily an unacceptable expense; a small increase in operational convenience may well be worth a large increase in expense, if the operation is an important one (opponents of this view will cite the essential evil per se of the idle machine, bringing in the concept of the equivalence of man-hours and square feet, already mentioned). What these principles point to with regard to AFSA's analytical machinery is the validity in that field of what can be called the Small Model Shops Principle. American industry long ago discovered the reductio ad absurdum of the centralization-for-efficiency principle carried beyond a reasonable point; the Government is a little behind industry in this regard but is, I believe, learning. The philosophies involved have been thoroughly discussed in other connections, and need no further belaboring here.

4. Specific application of decentralization principle to analytical machinery. As this philosophy applies specifically to AFSA, there is obviously both room and necessity for both central pooling and dispersion. ATLAS, NOMAD, GOLDBERG, SKATE II, the DEMONs, DELLA, SLED, and a few others obviously fall under the first compelling reason for central pooling. The ROBINs (at least in their present usage) and a large part of the IBM complex come under the permissive reason for central pooling, and therefore (since the logistics considerations always point to central pooling even when they do not compel it) need not be fought over on the basis of the compelling reasons. CADILLAC, the frequency counters, the desk calculators, the MATHEWs (and their fellow gospellers), PICCOLO, ELKET, and such are obviously tools for individual analysts and analytical sections, but some who need them occasionally do not have them, and there is, in our list, no coincidence selector or digraph counter wholly suitable for decentralized use, although there is need for these. In this connection it is noted that the Machine Division has the two 70-mm general comparators, four specialized selectors (the COPPERHEADs and TESSIEs), and one simple statistical crib placer (STORK) which are not being used at all, but which (with the probable exception of the COPPERHEADs) are applicable to analytical problems that come up from time to time. The reason why these are not used is that GOLDBERG or IBM or ROBIN do the jobs more conveniently or more quickly. But it appears to me that any

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AFSA
15 August 1952

DISCUSSION (continued)

machine which usage figures show is not needed in the central pool is a presumptive candidate for transfer to a section that can use it. By an easy extension of this, any machine that usage figures show is used exclusively or nearly so by one section is a strong candidate for transfer to that section. Under this reasoning SKATE I could very well have been given to AFSA-243 (for COLERIDGE work) during the past six months, and the two BOMBEs could be turned over to AFSA-233. Several groups, including O4's analysis division, have definite need for a small amount of on-the-spot IBM machinery under their immediate operational control.

15. Development needs in connection with decentralization. Despite the foregoing, the facts that AFSA-22 has two idle comparators and that there are at least two sections that need to make occasional sliding coincidence runs on the spot do not necessarily add up to a decision to give these sections those comparators. The 70-m comparators are obsolete and a little complex to operate and maintain. It is quite possible that every section in 02 would refuse the gift of one. The sections would not, however, refuse a simple, modern comparator operating at moderate speed from T/T paper tapes or a small digraph counter operating from a keyboard or from tape. There is a definite need for such simple analytical machines suitable for decentralized use and capable of functioning with minimum maintenance. The DENHAM project might conceivably lead to equipment having just as important uses in AFSA central processing as in the field outfits for which it is being designed.

16. Logistics considerations, rentals. The thought that some decentralized use of conventional IBM machinery is desirable brings up a logistics factor which is peculiar to that machinery; that is, the matter of rental costs and its bearing on utilization. We have been prone to accept as axiomatic the idea that a rented machine wastes money in the approximate proportion of its idle time. This idea I now wish to challenge and refute. Unless the machine is entirely idle, the amount of idle time has very little to do with whether its rental is justified or wasted. The only consideration that significantly affects the justifiability of a rental cost is what use (not how many hours of use) has been got out of the machine. If the machine produces monthly results that are worth more than its monthly rental, the rental is justified, whether the machine produces the results in one hour's operation or 720. If these results can be obtained with central pooling, then the machine should be centrally pooled, so that it can be used to produce other results for other analysts in otherwise idle time; but if they cannot, the machine should not be pooled, and should be left with the analyst who needs it immediately available. The cost of ~~the~~ its idle time is zero; the cost of its results is the cost of rental. The only questions applicable are:

a. Is the employment dependent on the analyst's having the machine immediately available?

b. If so, how many man-hours does he save with the machine, and what results does he get that he would not even attempt without it?

c. Is the total operational value of b. worth the rental cost?

The rental economy realizable from central pooling, where this is possible, should be regarded as highly welcome velvet, not as a necessary condition of machine employment.

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TOP SECRET CANOE

AFSA
15 August 1952

DISCUSSION (continued)

17. Logistics considerations, other. Aside from rental costs, which is a consideration peculiar to IBM alone, the logistics factors involved are as follows:

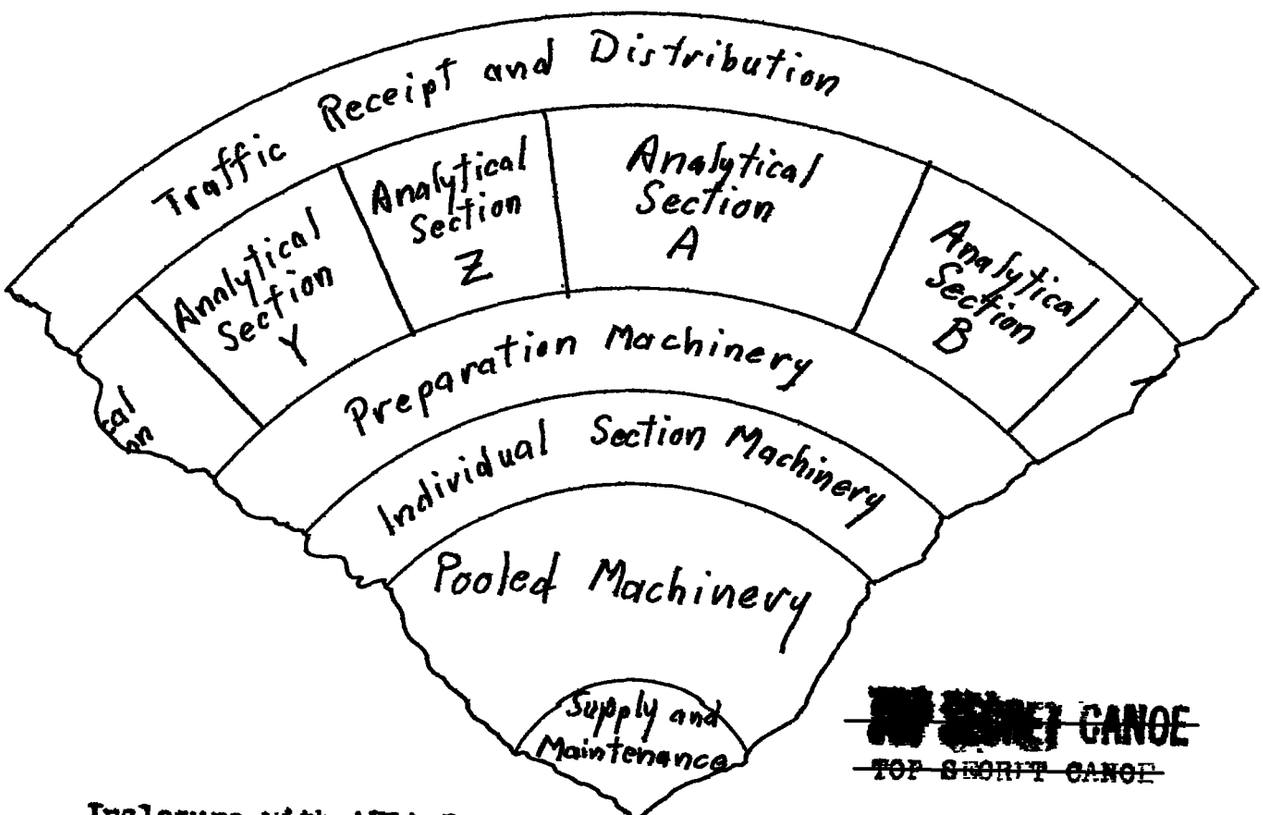
a. Procurement and storing of consumable supplies (paper, cards, tape, etc.)

b. Maintenance, including procurement and storing of maintenance parts.

c. Provision of trained operating personnel.

The provision of trained operating personnel for decentralized machinery is, by the nature of the problem, easily solved. It would not be if the machines were required to be fully manned, but decentralized in-section machinery usually does not have to be fully manned. It is of the essence of this kind of machine employment that it is only intermittent, and that, in general, one or two full time attendants will suffice for a room full of machines; the analysts themselves and their clerical aides will fill in as intermittent machine operators on occasion, and will thereby do themselves and the Government more good than harm. The few permanent full-time attendants needed for such installations should be easily within the capacity of the Machine Division to provide, on a rotating basis. As for supplies and maintenance, it is true that dispersion adds to the cost of these, but this added cost is minimized by keeping the responsibility for supply and maintenance centralized in the Machine Division. With such an arrangement, the only additional cost attributable to dispersion of some machinery is the additional man-hours of maintenance time entailed in the physical separation of the machines. I believe that this would be negligible in the light of the gains to be expected in operational convenience.

18. Reconciliation of operational convenience and central pooling. It is theoretically possible so to locate and organize analytical groups and the machines that serve them that we both meet the requirement of operational convenience and realize the advantages of central pooling. The following topological (to coin a usage of the word) diagram illustrates the possibilities.



Inclosure with AFSA Inspector's report of 15 August 1952

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AFSA
15 August 1952

DISCUSSION (continued)

In the Preparation Machinery ring would be all preparation machinery, both that centrally pooled and that allocated to individual sections for their direct control; the punches allocated to a section would, roughly, be those adjacent to it, but allocations would constantly change with varying needs under centralized priorities control. The same would generally be true of the next two rings. Common supply and maintenance would serve all parts of the installation radially from the center. Besides meeting the direct operational needs involved, an arrangement along these lines would have the following added indirect advantages:

a. Would assist in closing the gap between the two parts of routine preparation now done in the analytical sections on the one hand and in the Machine Division on the other (see para. 10, above), facilitating the minimizing of the personnel engaged in this work.

b. Would promote, through close contact, the analytical competence and background of machine operators.

c. Would promote, through close contact, the analysts' appreciation and understanding of machine processes and potentialities.

It is appreciated that many factors render it impossible to achieve literal conformity with this scheme in our arrangement of actual floor space and physical facilities. This being true, one of the requirements involved will always have to be sacrificed to some extent in favor of the other. I believe that, in accordance with the principles developed in preceding paragraphs, we should lean more to dispersal for operational convenience than we have in the past. Let me make it abundantly clear that this is not an indorsement of the utterly unacceptable dispersal represented by some of the machine installations at Naval Security Station, completely removed from the groups that use them. The concentration for concentration's sake represented by putting unrelated COMINT units together at Arlington Hall while leaving essential parts of their processes at NavSecSta has been an exceedingly dead dog since late 1949, but I cannot resist this one last lash at it.

19. Machine Methods Group. In paragraph 5 there has been discussed the employment of ATLAS and other "revolutionizers" as such. In paragraph 7 there has been discussed the non-employment of AFSA-22's "Methods Branch" as such. The two are intimately related. Certainly if there is any possibility of increasing ATLAS's, and IBM's, and GOLDBERG's employment in their fuller capabilities, it is the function of the Methods Branch to devise the ways to do so. But, as has been shown, they have not enough time for this level of activity under the present arrangement, and they are organizationally separated from the analytical problems involved and organizationally tied to the administrative problems of the central machine pool. No amount of "liaison" or "coordination" can completely make up for the misorientation of view-points which is imposed on the Methods people by these organizational arrangements. I propose the following solution:

a. Abolish the Methods Branch within AFSA-22.

b. Retain a small group (one or two) of staff assistants under AFSA-22 to assist him in second-level scheduling and job dispatching.

c. Transfer the Methods Branch's programming functions to the operating branches or branch of AFSA-22.

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DISCUSSION (continued)

d. Establish a Machine Methods Group directly under the Technical Director of AFSA-02 (02T), with participation ("ex officio" or "advisory" or whatever other words will satisfy our organizational mores) by AFSA-35.

The Machine Methods Group, under AFSA-02T, would have the responsibility for first-level process and machine scheduling and for insuring best and fullest possible use of the revolutionizers and maximum possible service by the labor-savers. They would not, of course, refrain entirely from programming, since the writing of new and prototype programs would be an inseparable part of their work, but they would be relieved entirely of the responsibility for routine and follow-up programming. (Nor, incidentally, would the development of ideas for new machine applications be discouraged in AFSA-22. It could be expected that making the machine operating branches part of the analytical team would result actually in increased thinking along these lines within the Machine Division.)

20. Machine Division organization, other aspects. AFSA-22's present split between the "IBM Branch" and the "RAM Branch" does not appear to be too valid from a logical functional standpoint. Every machine in the "IBM Branch" is a "rapid analytical machine", the "RAM Branch" is full of IBM machinery, the RAM Branch uses both tape and cards as both inputs and outputs and some IBM Corp. developments have turned to tape, and some processes are done partly by "IBM" machines and partly by "RAM". There would seem to be some logic in splitting 22's Maintenance Branch into two on this basis, but not his processing components. Of course an illogical split of this kind does no great harm per se, but when it is the physical manifestation of a harmful and disruptive split between two rival philosophies of analytical machine development, as in this case, it would seem to be advisable to assist the healing of the breach by removing the symbol. I therefore recommend that the two branches be made into one, or, if one would be too large for easy administration, that the split be based on some more valid consideration (such as, at the moment, the unfortunate circumstances of physical location).

21. Machine Division strength. Better and fuller use of machine aids, according to the principles of this discussion, should follow from the efforts of a properly constituted, properly subordinated Machine Methods Group. This will presumably mean a larger allocation of personnel to the Machine Division at once, and a considerably larger allocation ultimately. I have no specific proposals along these lines, believing that the pressures generated by the Machine Methods Group will result in the right answers as we go along, and that our first preoccupation should be with personnel quality rather than numbers, but I point out the following:

a. Since machines multiply men and minimize man-hours, taking men from analytical sections and giving them to the Machine Division theoretically represents gain, not loss.

b. Military personnel have, in the past, functioned very satisfactorily in the pre-AFSA machine divisions.

These two points are developed in the next two paragraphs.

22. Machine Division personnel - balance with analytical sections' and other strength. The statement that, given too few people, the few available are best employed operating

DISCUSSION (continued)

machines which multiply per-man-hour output is, of course, an oversimplification. In the first place, the machines must be properly employed to make this true; in the second, since there is a considerable amount of non-machine effort in preparing jobs for the machines and in utilizing their results, there has to be a balance, based in each case on specific and unique considerations, between the strength of the groups served and of the machine-operator groups that serve them. Thus, there would be no point in robbing AFSA-243's COLERIDGE section to man SKATE I for fuller operation since, at the moment, the COLERIDGE section is not large enough to feed and utilize an expanded SKATE I operation. There might, however, be some point in increasing ROBIN operation at the expense of AFSA-243's ALBATROSS section, since the latter is now able to produce a steadily increasing backlog of work for the Machine Division. I do not, however, make any specific recommendations in this respect, since AFSA-02 and his assistants and advisers presumably have the matter in hand in the light of all of the factors involved rather than just the few brought out here. I do believe, however, that all administrative, management, and organizational devices which would tend to give them a freer hand and greater flexibility in shifting strength back and forth as needs vary should be explored for adoption, with necessary assistance and support from the Personnel Division and the Comptroller's Management Branch. In addition, I suggest that, since we have no single management and methods problem more important than the proper utilization of our COMINT machine resources, and since plans for the development and employment of these resources are among the most important planning problems involved in our most important major field, it would be no loss to allocate to AFSA-02's Machine Methods Group some of the spaces now devoted to management, methods, and plans in the Staff Divisions of AFSA-00F and AFSA-12. Although some of the bodies for this Group would have to come from the Machine Division's present Methods Branch, this would permit forming the group without robbing the Machine Division of any numerical strength.

23. Machine Division personnel - use of military. Pre-AFSA analytical machine divisions, especially the Navy's, utilized military personnel to excellent advantage. There are no administrative hindrances to moving military personnel from job to job as strength needs vary, and military personnel can be operated in shifts as required. For these two reasons, most of our machine personnel problems would disappear if we had a sufficient force of adequately qualified military personnel. But the Navy's one-time small force of adequately qualified analytical machine personnel has frittered away, what with normal attrition without replacement and the Navy's insistence on rotation (in a skill where rotation is entirely inappropriate), until it has practically disappeared. We could realize a considerable advantage from having a larger proportion of our machine operator strength in military personnel, and every effort should be made to enlist the cooperation and support of the Navy in returning all available machine men to duty here and of all three Services in building up a body of competent uniformed machine operators, with necessary special dispensations regarding permanence and rotation.

24. Summary. The recommendations flowing from this discussion are set forth in detail in the "Recommendations" section of the report. In general, they fall into three groups, which may be expressed as three major and inclusive recommendations, as follows:

a. That the utilization of our analytical machines be increased, as appropriate to the two divergent requirements of their two categories by potentiality.

DISCUSSION (continued)

That the immediate means of doing this be certain reorganizations within AFSA-02, principally the moving of the machine methods and scheduling function out of AFSA-22, and the putting of it directly (with adequate staff) under O2T.

b. That improved machine utilization and performance be promoted by, first, raising the quality of machine personnel by increasing their responsibilities and competence and raising their grade structure, and, second, increasing their numbers, including increasing the proportion of military personnel among them.

c. That the use of small, decentralized machine installations, directly under individual sections but with centralized supply and maintenance, be fostered, and increased as required, and that our development programs take account of the needs involved.