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ARMY SCIENTIFIC ADVISORY PANEL

Report of the

Ad Hoc Group on Tactical Automatic Data Processing Systems

1. Background. The Ad Hoc Group on ADPS was set up by Secretary Willis Hawkins to assist the Army in assessing its programs for the use of automatic data processing in field operations. The initial charge to the Group was:

"PROBLEM: To assess the planned use of automatic data processing systems to support the Army in the field.

"QUESTIONS: 1. To what extent and in what manner can ADPS most advantageously be employed by the Army in the field?

2. What specific ADPS techniques and technology should the Army seek to adopt for tactical and combat service uses, and in what time frame?"

Briefings were held as follows: At the Army Research Office, 3 September 1964, to receive information on the Army's organizations concerned with ADPS, and a general presentation of the CCIS-70 program. At Fort Huachuca, 26-27 October 1964, to receive further briefings on the CCIS-70 activities at that installation, and to observe test bed operations. At the Pentagon, 7-8 January 1964, to discuss the Group's questions and reactions with Mr. Howard P. Gates, Jr., of Secretary Hawkins' office, General Beach, General Bunker, General Dick, and Mr. Wood of the office of DDRE, and to examine the plans for the Seventh Army ADPS test. In addition, the chairman had several conferences in Washington and Urbana with Army representatives in order to become familiar with the problem.

During the meeting at Fort Huachuca, the Group concluded that they did not feel that there was enough information available to respond adequately to the specific questions of the initial charge. It felt that the Army itself needed to both collect information and develop policies before either it or any other group can provide answers to such questions. It is probably because this information

and set of policy decisions are not available that the Army turned hopefully but perhaps over optimistically to a group such as ours to provide the answers. But the problem is extremely complex and we believe not ready at this time for definitive answers to questions of the specific nature propounded. The Group proposed, therefore, that it be allowed to discuss the more preliminary question "How may the use of ADPS be most effectively implemented for the Army in the field?" In other words, what are the immediate steps in organization, policy decision, and information collection which could be developed, and technical work which should receive emphasis, by the Army to insure more rapid and definitive progress than we are now able to observe?

This question immediately focused attention on the structure of the management of the ADPS program within the Army, and on the need for re-evaluation of objectives and reorganization of personnel, whereby progress could be made more expeditiously. For example, the Group believed that the specific techniques referred to in Question 2, above, could not now be identified, particularly in the areas of intelligence and operations, until much more is known of the essential data and parameters involved in these areas as they are now employed in field operations. While charts are available of Army Field Organization, and experienced officers have extensive qualitative knowledge regarding how such information has been processed by human beings and the current instrumentalities of communication, this type of experience has not been reduced to such quantitative information as essential data rates and vulnerability which is necessary for the planning of an effective, economical and reliable ADPS. It was felt that, in the absence of such knowledge, the present attempts to write requirements might lead to unnecessary or wasteful development and procurement of equipment and software not properly designed for the Army's future needs.

The January meeting at the Pentagon was held to bring these areas of concern to the attention of the responsible commands and management offices of the Department of the Army. In these discussions, it was evident that the Army officials shared the concerns of the Group, and agreed that recommendations from the Group, based on the revised Question, were in order.

2. Comments on the CCIS-70 Program. The difficulties faced by the Army in ADPS planning and implementation are illustrated by the following comments on the CCIS-70 program:

a. The program is too diffuse. This is one result of concentrating on hardware development before requirements are well understood. It attempts to "get going" on a variety of possible applications without setting up clearly defined objectives and priorities. This has resulted, for example, in the premature development of over-ambitious systems (ARTOC) and computers (Basicpac, Mobidic, and RAC) which are now obsolete or obsolescent. The pressure on industry to advance the state of the art of hardware technology will result in achievements as fast as possible; thus, the Army program can expect to profit from these advances and need not emphasize hardware development.

b. The information processing needs, on which the valid objectives of CCIS-70 must be based, have not received sufficient attention by the top management of the Army (Secretary and Chief of Staff and their immediate subordinates) to provide needed guidance and coherence to the effort.

c. There are too many separate agencies within the Army at work on the program, with resulting lack of coordination. The Materiel Command, for example, must rely on the Combat Development Command for the writing of Requirements; the CDC, in turn, needs to know "what can be done" before it addresses itself to the requirements. The Group notes with approval the plan to merge the ADPS activities of AMC and CDC in a single office under one officer of high rank. This is a step in the right direction, but we are seriously concerned that it does not go far enough. If the proposed organization is as we understand it, we question whether such an organization involving a general officer in charge of CCIS-70 who reports simultaneously to the commanding generals of both the Materiel Command and and the Combat Developments Command, and in turn has under him individuals who remain identified with these separate commands, is workable. Inevitably there will be differences in attitudes and enthusiasms developing which will continue the present difficulty of defining problems and reaching decisions. The Group firmly believes that the complexities of adapting ADPS to field operations are such that the conventional structure of planning (CDC) and implementation (AMC) is not suitable. The Group suggests, in fact, that consideration be given to establishing a wholly separate organization, (a task-oriented project type of organization, possibly with personnel on detached service) with full

responsibility and authority for analysis, planning, development and implementation for tactical ADPS, and reporting to the highest level of authority within the Department of the Army. (Perhaps as a special group within AIDS.)

d. The approach to CCIS-70 has not been sufficiently critical of the limitations, as well as the potentials of ADPS. Insufficient attention has been given to criteria for deciding whether ADPS is a suitable and appropriate replacement for existing methods of information processing. A computer should be applied to a job only if it can be clearly demonstrated that it can do the job better than human beings. Here, "better" means some combination of "faster", "safer", "more reliably", and "cheaper" appropriate to the problem in hand. An appeal to automation should be made only if data volume or data rate warrants it. An explicit study effort to develop criteria appropriate to the Army situation, including the need for back-up in case of damage, should be a part of an ADPS program.

e. The five major sub-programs of CCIS-70 represent widely different concepts as well as different degrees of difficulty with respect to planning and implementation, but the documents and presentations to the Group did not adequately reflect this. It appears that applications to the fields of (1) Personnel and Administration, and (2) Logistics might readily be satisfied by techniques now well developed and widely used. In this area the decisions appear easier to make, by cost-effectiveness studies based on known, or readily available parameters.

The program for (3) Fire Support is next in difficulty. It is a separable problem in many respects; the objectives are definable. The FADAC development, for example, is viewed by the Group as a moderate success, at least conceptually and in the test evaluation (if not in the hardware sense). The extension of the system from forward batteries to Corps Artillery appears, on the basis of the evidence before the Group, to be feasible and to serve a valid purpose. But there are many questions, particularly in the field of data communications systems, that need systematic analysis before conventional Requirements can be written with assurance that the systems will not be overdesigned in some parts and underdesigned in others. The Group suggests, for example, that the data rates now effective in the manual, non-automated fire support system must be known, and their inter-relations thoroughly understood, before the corresponding data rates

in the Fire Support ADPS System are stated in Requirements. The Group has not investigated the degree to which such data studies have been made, although it has repeatedly asked such questions and been disturbed by the lack of definitive answers. Therefore, it warns that imbalance in design is almost certain unless extrapolation from present to future methods is carried out.

The most difficult portions of the CCIS-70 program are those dealing with (4) Intelligence and (5) Operations. Here the comments on lack of clear objectives and lack of prior study of what should be attempted apply with particular emphasis. The Group is unaware that any attempt has been made to study systematically the actual functions performed in Intelligence and Operations in the context of the information processes involved (data rates, memory requirements, interfaces, logic processes, and linguistic processes). Such system analysis is well within the available techniques used by other computer users planning for future needs. The Army should make such studies, if not with its own resources then by contract. One possibility is that the work statement of the study proposal TR-NR-CCIS-G-1-65 be revised (from its presently excessively general and ambiguous form) and more precisely defined to include, explicitly, studies of the rules for inclusions and exclusions in the information processes appropriate to the Army in the field.

f. There has been a tendency, in CCIS-70 planning and procurement, to divorce hardware from software. Primary emphasis has been placed on "getting the gear", with program development left to follow procurement of the equipment. The Group feels strongly that these two phases of computer technology must be treated concurrently, by the same organization, with very close ties between the teams specializing in equipment and programs. Experience in the computing field shows that the total cost of the programming effort necessary in connection with an operational system is increasing rapidly, while that of a unit of capability in equipment is decreasing. The impact of this trend on the costs of Army ADPS may be very severe, if the equipment becomes the tail that wags the programming dog. (One example is the fact that the Army Fieldata Language, now obsolete, presents an interface problem at Fort Huachuca of staggering proportions; one of the most powerful computers available, the IBM 7090, is used there as an interface between Basicpac equipment, designed for Fieldata, and other program

sources and equipments.) The technical approach of an ADPS program should place heavy emphasis on the development of generalized programs, not only to reduce the cost of modifying software, but also to permit users to exploit the advantages of ADP, particularly in the Operations and Intelligence fields.

g. There seems to be only a partial realization or quantification of the impending load on, and realibility requirements of, communication links which will result from the introduction of field ADPS systems. To be of maximum use in a mobile and fluid battle situation, ADPS must perform, in many applications, in the "real time" mode, with corresponding spurts of data at high rates and traffic loads. Proper system design might smooth out the flow if operational requirements permit this. The Group was informed that data rates of 2400 bits per second are planned for data links to be used in the ADPS system. The Group was not informed as to the origin of this figure and we are concerned as to whether this may impose requirements on the communication system beyond those needed. It is clear that in the total system of linked computers and input/output units widely different data rates will exist at different parts of the system. Hence, the number of links and their allotment (i.e. the total traffic capability) becomes a question of great importance and needs equal attention.

h. The Group has sensed that, in some quarters at least, there is a tendency to think of the CCIS-70 program as leading to an integrated system which will provide all five of the sub-programs mentioned above. This is a desirable long term development, if warranted after careful study. But at this early stage there is a danger that an excessively complex and expensive system will result. It appears desirable at this time, rather, to treat the sub-programs individually, or possibly in three groups, 1. Personnel and Logistics, 2. Fire Control, 3. Operations and Intelligence, at least until much further progress is made in defining their objectives and inter-relations. Special purpose computers, in the view of the Group, should not be used except in correspondingly specialized, limited, and well defined applications (e.g. for battery fire control). But reliance on general purpose machines does not imply "one big machine". The trend in the computer industry is toward compatible modules of equipment, which allow for expansion without reprogramming. The modular concept seems particularly appropriate to the Army's needs on three counts: (1) It will permit

expansion, both in functions and volume of processing, as the need may dictate, and (2) it will permit replacement of a module damaged in battle, or otherwise rendered inoperative by the exigencies of field operations, (3) it will permit separate deployment of small dispersed units.

i. The CCIS-70 is, of course, an Army Program, and it has been described to the Group in isolation of ADPS efforts by the other Services. The Group is not aware that, even at the Chief of Staff level (AIDS Office), there is any systematic exchange of information with the other agencies of DOD regarding ADPS plans and requirements. Such an exchange, if not now in effect, should be instituted and the information obtained given serious attention in Army planning.

3. Comments on the ADPS Exercise in the Seventh Army. The Group finds merit in the plans to conduct ADPS exercises in the Seventh Army, and recommends that the necessary programming and procurement of equipment be carried forward without delay. There are several comments that should be made:

a. The Seventh Army test will use conventional equipment under peacetime conditions, in connection with maneuvers in which certain battle conditions will be simulated. It is important that the test results be reviewed carefully, in any extrapolation to actual field conditions of war.

b. The Seventh Army test should have great value in indicating the utility of ADPS for the peacetime assignments of a field Army. Such conditions may well prevail, it is to be devoutly hoped, for a long period. Cost-effectiveness studies based on the test results may well show important advantages in such peacetime operations.

c. The principal concern of the Group with respect to the Seventh Army tests relates to the proper evaluation of the results. It was stated that the evaluation would involve system analysts presently under contract from the Bunker-Ramo Co rporation. It appears possible that these individuals are actually programming analysts (i.e. programmers) but not operations analysts (i.e. men trained in the design of test experiments and in the evaluation of the results from a "total systems" point of view). The Group feels that operations analysis is an absolute necessity for these tests, if the results obtained are to be properly evaluated.

A highly qualified team of operations analysts should be brought into the test organization well in advance of the actual test operations, to provide critical

judgment and recommendations in the design of the test experiments. The time schedule of the test requires that immediate attention be given to this matter. The group suggests that the qualifications of the team to be assigned by Bunker-Ramo to the tests be reviewed and that, if suitable operations analysts are not presently planned for, these be obtained.

4. Summary of Recommendations. In summary, the Ad Hoc Group recommends the following:

a. That immediate consideration be given to the establishment of a separate organization for tactical ADPS programs in the Army, to have full responsibility and authority for analysis, planning, development and implementation, reporting to the highest level of authority in the Department of the Army.

b. That the CCIS-70 program be re-evaluated to determine clear-cut objectives and priorities and that these receive the sanction of the top levels of military and civilian management of the Army. A new Master Plan should then be prepared which, when approved, can insure clear objectives which can be pursued.

c. That in connection with this re-evaluation, the following specific points be considered.

i. That criteria be set up for establishing when not to adopt ADPS methods, as well as those favoring adoption.

ii. That systematic studies in depth be conducted to reveal the parameters of the information processes now used in field operations.

iii. That the modular concept of adjusting the capability of a system be explored.

iv. That the development of equipment and software be closely linked, both in time and in the management designated to control these developments.

v. That the procurement of developmental samples of computer equipment be preceded by thorough-going systems studies embracing programming methods and costs, as well as equipment characteristics and costs.

vi. That the present specification of TECHNICAL REQUIREMENTS TR-NR-CCIS-G-1-65 dated 24 August 1964 be modified to provide for the studies recommended in ii above.

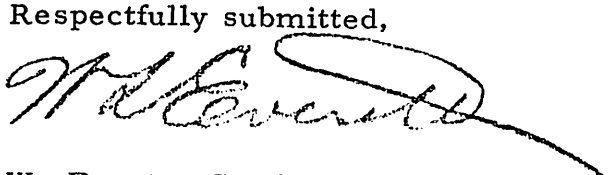
vii. That the role of data links, their rates, reliability, traffic capacity, and forms of degradation, be given greatly increased attention and emphasis.

d. That in the Seventh Army ADPS tests qualified operations analysts be assigned to assist in designing the test procedures and to participate in the evaluation of the results.

e. That the Army should also study the capabilities of means other than computers for electronically recording, transmitting, and receiving information, (for example, facsimile) as a means of reducing computer and associated communications requirements.

5. The Group appreciates the courtesy, assistance, and effort offered by all those who participated in the briefings. In particular, it commends the effectiveness and helpfulness of Lt. Col. Charles W. Spann who acted as Staff Assistant and Secretary. It emphasizes that many of the difficulties experienced by the Army in this field are indigenous to the newness, dynamic character, and complexity of the computer field itself. The difficulties have been brought about, in large measure, by the task of applying ADPS to evermore extensive operations, many of which have not yet been subjected to critical and definitive study by anyone. It is hoped that the recommendations we have given will assist the Army to resolve these issues, undoubtedly among the most difficult now being faced by management in any field of endeavor.

Respectfully submitted,



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