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SUMMARY SHEET

(DA Memo 340-15)

TO						FOR		FROM	
	DCSLOG		COA		CLL	1 & 2	APPROVAL	AGENCY	TELEPHONE
	DCSOPS		ACSI	1	CHIEF OF STAFF		SIGNATURE	OCE	75375
	DCSPER		ACSRC	2	ASST OF A (R&D)		COORDINATION	GRADE & NAME OF CONTACT OFFICER	
	CRD		TAG		SECRETARY OF THE ARMY			Brig Gen J. D. Cole	

FILE REFERENCE	SUBJECT	DATE
ENGTE-T	Status of Army Mapping Satellite Program	23 August 62

IMPLICATIONS *(The implications checked below are involved in this action, are discussed below or in a seperate inclosure, and have been considered in the final recommendation.)*

☐ CONTROL PROGRAM ☐ MANPOWER ☐ BUDGET ☐ LEGAL
☐ CONGRESSIONAL ☐ PUBLIC RELATIONS ☐ MORALE ☐ SECURITY ☒ NONE

PURPOSE

(TS) To inform the Secretary of the Army of the basis for the current stoppage by DDR&E of the Army mapping satellite program.

DISCUSSION

1. Upon conclusion of a briefing of Secretary Vance on 23 July on several Army topographic programs, Secretary Vance visited Dr. Fubini, DDR&E, and requested a conference to discuss the delay in the start of the Army mapping satellite program. Concurrently, DDR&E issued a memorandum to the Undersecretary of the Air Force and Director, DIA, that states that a mapping satellite as proposed by the Army is no longer required in that a substitute system can be utilized to accomplish the same purpose at lesser accuracies.

2. The memorandum published by DDR&E has been reviewed and determined to be based on a series of beliefs, assumptions and extrapolations developed by the Air Force and are not supported by facts.

3. A review of this DDR&E memorandum is attached which is in a form which can be used by the Assistant Secretary of the Army (R&D) to brief the Secretary of the Army on the basis for the current stoppage of the Army mapping satellite program.

RECOMMENDATION

That the Assistant Secretary of the Army for Research and Development brief the Secretary of the Army on the basis being used for the current stoppage by DDR&E of the Army mapping satellite program based on the inclosed review and analysis report.

Incl
as

W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

COORDINATION
OCRD - Concur
ACSI - Concur

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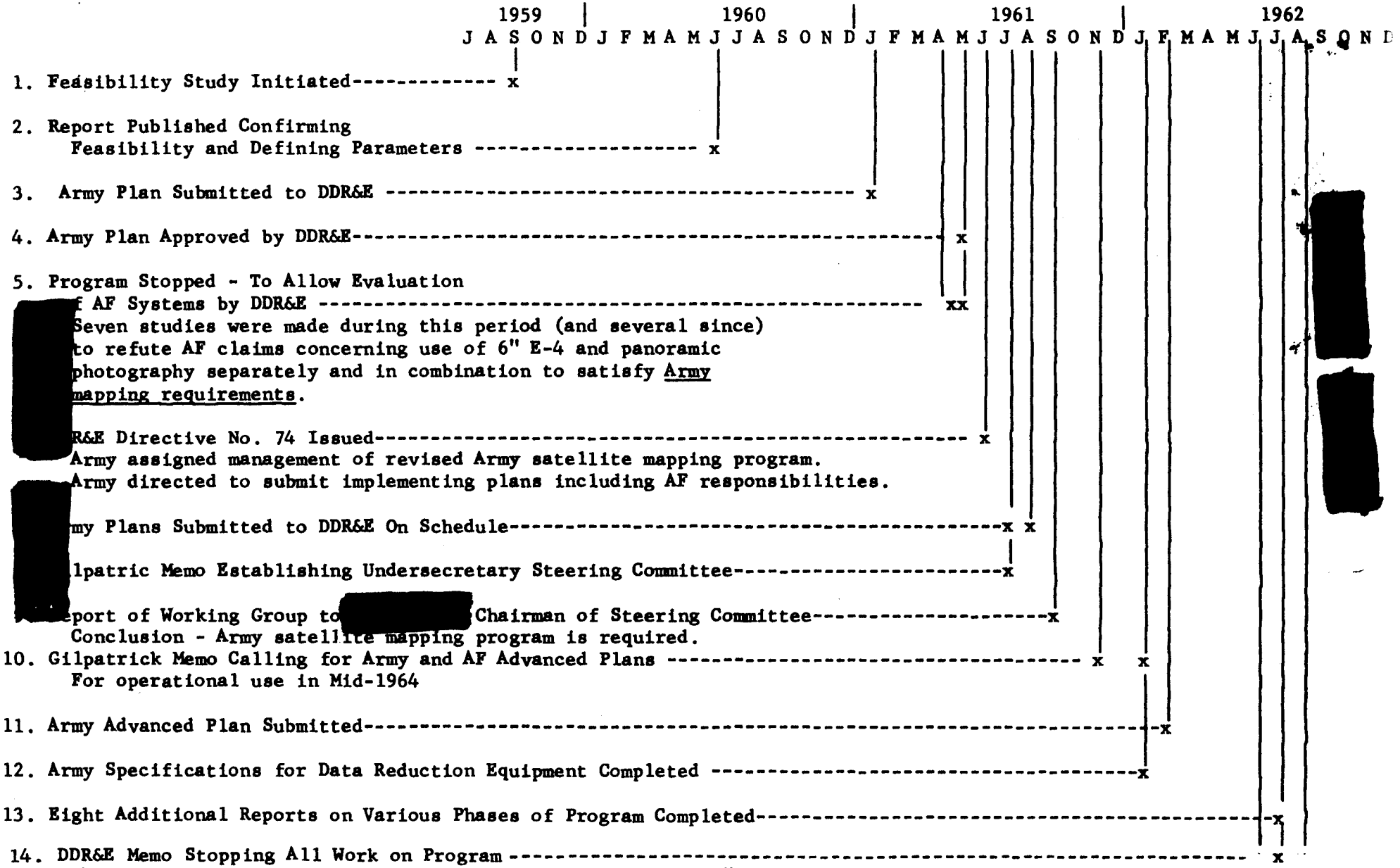
DAS FORM 28 1 JUL 58 REPLACES DA FORM 520, 1 FEB 57, WHICH IS OBSOLETE. U. S. GOVERNMENT PRINTING OFFICE : 1958 O - 474987

CHRONOLOGICAL HISTORY OF ARMY SATELLITE MAPPING SYSTEM



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23 August 1962

Brief and Evaluation of the Memorandum
"Map-Chart Requirements and Techniques"

Brief

The memorandum under consideration is the memorandum, dated 23 July 1962, sent from DDR&E to the Undersecretary of the Air Force and the Director, DIA. It references the two DIA memoranda on Mapping and Charting Accuracies, the Report of the Psuedo Map Committee, the ACIC KC Report, and certain, unspecified "technical developments of ACIC relative to use of framing and panoramic photography for elevation determination to support mapping and charting accuracy requirements".

The significant part of the memorandum is the statement that a new mapping satellite does not appear to be warranted at this time. The memorandum surmises that work at ACIC utilizing a combination of frame and panoramic photography indicates that this is an adequate substitute for good cartographic photography. It further states that DOD mapping accuracy requirements should be formulated unambiguously and that future collection and exploitation systems be analyzed against specific priority requirements (presumably at lower accuracies than presently considered). It infers that these lower accuracies can be met at lower cost.

Further the report stresses the requirement to calibrate panoramic cameras and to superimpose reseau grids.

Evaluation

Fact and surmise have been liberally interspersed in this document to the extent that even when the memorandum tells us that something is just belief, it is made to read like fact. The entire middle section, containing some 11 different items is prefaced with "we further believe ...". Believe, not proved, nor demonstrated, but believe. These statements should be taken as beliefs and not as established fact. For the most part the conclusions are sweeping extrapolations from the KC Report andvague references to unreported results at ACIC.

Initially the memorandum refers to inconsistencies in the 1 December 1961 and 11 April 1962 DIA memoranda relating to military accuracy requirements and later recommends the formulation of an unambiguous list of DOD mapping accuracy requirements world-wide. To obtain a mutually acceptable statement of requirement is indeed the first order of business.

Before declaring the beliefs the memorandum states that the KC Report and "recent experience at ACIC" validate the estimates of the Report of the Psuedo Map Committee. The referenced report necessarily was based on many estimates and it is not possible to determine from the general phraseology

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of the memorandum which estimates were validated and how. The KC Report itself has not validated any of these estimates and the simple reference to recent ACIC experiences is not sufficient basis for a conclusion. The statement is made that "statistical analyses indicated that accuracies sufficient to support 100 meter contour intervals could be achieved". This refers to the use of framing and panoramic photography which is not covered in the KC Report and apparently has not been reported. With the frame photography currently available such a contour interval is not possible, except possibly in those areas in which we possess adequate ground control and generally adequate map coverage.

The first of the beliefs is that "cartographic photography alone from existing systems can produce Class P1 or P2 provisional maps at scales of 1:200,000 or smaller". The systems which are known to have flown have 1½- and 3-inch focal length cameras so it must be assumed that these are the ones to which reference is made. These extremely short focal length frame cameras are suitable and intended only for the establishment of a horizontal network over large land areas. Their use for drawing contours is extremely limited.

The next item states that panoramic photography cannot produce P1 or P2 provisional maps without some form of ground control. We agree if the standard interpretation of ground control is made. However, the accompanying sentence in the memorandum which appears to qualify the term ground control suggests that "a corrected ephemeris, internal camera calibration referenced to a reseau, attitude reference data (stellar or horizon) and/or appropriate ground control" be used to provide the required ground control. This statement covers a wide gamut of internal and external controls more appropriately assembled in a cartographic system.

The next paragraph states that "panoramic photography combinations in conjunction with ground control can provide P1 or P2 provisional maps at 1:50,000 and smaller (sic)." The memorandum further states that tests have been run and ambiguous statements are made about the control which is required to provide P1 and P2 provisional maps. These examples are so vaguely reported that they are not subject to clear interpretation. They cannot form a basis for decision about an appropriate mapping system.

Next there is a statement that relative accuracies obtainable with the panoramic photography of different focal lengths are not significantly different. These are all convergent photographs with approximately the same base-height ratio and this conclusion is warranted because after minimum ground resolution has been attained very little additional vertical accuracy will result with higher ground resolutions.

It is stated that absolute measurements with a 5 micron standard error are possible on a Nistri TA/3 stereocomparator if a reseau is employed, and that this standard error may be reduced to 1-2 microns if improved lens and reseau calibration techniques are employed. Lens calibration and the use of a reseau have become standard photogrammetric practices, but the measuring error hypothesized here is far below the other contributing errors in the panoramic systems such as those introduced by the dynamics of the camera during exposure.

Belief Number "g" of the memorandum states, "Transforming and rectifying oblique panoramic materials using conventional photographic laboratory equipment has been proved and the process utilized operationally (VG-1 enlarger, copy camera, and B&L rectifier, and transforming printer, and the 20X enlarger)". Although it is stated that these procedures have been reduced to practice, no results have been published. Consequently it is not possible to evaluate this statement quantitatively.

It is stated that spot heights can be obtained with accuracies between 3 and 5 feet and 3.5 times enlargements and between 1 and 2 feet on 20 times enlargements. Since no vertical control is carried these measurements refer to elevation differences and not spot heights. With high resolution photography it is possible to measure very small parallax differences (5 microns) with a precision comparator and to determine the heights of defineable ground objects. With panoramic photography this operation relates to a very small and specially oriented section of the photographs and cannot be extended to the remainder of the model as is required in area mapping. Local elevation differences determined by a photogrammetric exercise of this sort should not weigh heavily in the decision for the choice of a mapping satellite system.

The next item is a statement that a "compilation of a 500 foot contour stereo model in an A-7 stereo plotter has recently been completed using stereo panoramic materials which were transformed, rectified, and reduced to ½ scale on glass plates before being placed in the plotter." That this operation can be physically accomplished is unquestioned. What is far more important is the plotting results which were obtained, and, significantly, no mention is made of these data.

Next it is stated that the Telereadex has been used in combination with "reseau printed materials" to obtain precise distances between points as well as their relative position on stereo panoramic materials. It is further stated that "accuracy is limited only by the ability of the individual to detect what is measured on a panoramic photograph and assumptions concerning its orientation in space." Most precise photogrammetric measurements are limited by the ability to identify and set on a point, but the "assumptions concerning its (panoramic photographs) position in space" covers many sins. This is one of the cardinal weaknesses in the use of panoramic materials for mapping and it should not be tucked away in a short phrase. Under well controlled conditions, such as described in the KC Report, this uncertainty can be alleviated by an abundance of ground control, but in the general case this amount of control will not be available. Accurate linear measurements will be of only relative value, and of doubtful value at that, if the position and orientation of the photography is only approximated.

The final belief is qualified as a "best educated guess". It estimates the cost per million squate miles of mapping for frame and for frame and panoramic photography at [redacted] for a scale of 1:250,000 and [redacted] and [redacted] for a scale of 1:50,000 and calls the differences for a given scale insignificant when related to the cost of developing and

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operating a new program". The cost of operation is not going to be significantly different as tabulated in the memorandum for these adapted systems, nor will it be significantly different for a real mapping system. The figures themselves indicate that an adequately designed mapping system which will produce the required results will pay for itself over and over again. Such a system is not the existing frame cameras with or without panoramic cameras. For precision map compilation, these systems are weak and their combination does not produce a strong, reliable system.

The essence of this memorandum is to represent the frame and panoramic combination as a mapping system. It was not accomplished in the KC Report, and it is not done here. The facts presented in the KC Report appeared to have been misinterpreted and extrapolated beyond their real meaning. A great deal has been made of the use of a reseau with panoramic photography, but this very memorandum admits that even the feasibility of adding a reseau to such a camera is yet to be determined. It is mentioned that the panoramic cameras should be calibrated, and, if they were our only resort, indeed they should, but fortunately we have a far better alternative. All these alterations are a last-ditch attempt to make a mapping system out of a non-mapping approach. This will cost real money, dollars that were not included in the educated guess. In the final analysis there will be no way to avoid the dynamics of the camera during exposure and all the uncertainties associated with it. It will be less expensive and more productive to produce a mapping system than attempt to rig a substitute.

All real data produced to date does not qualify the frame and panoramic combination as a suitable substitute for a real mapping system. In this memorandum there is assembled some fact and considerable fiction that still does not add up to a mapping system. These beliefs do not support the conclusions that the development of a mapping satellite system does not appear to be warranted.

Based on this conclusion the memorandum makes the following recommendations:

a. Include cartographic and panoramic cameras in the same vehicle.

b. Calibrate panoramic camera systems.

c. Formulate an unambiguous list of DOD mapping accuracy requirements.

d. Determine degree to which existing programs and materials will meet these requirements.

e. Consider the total expenditure by which calibrated panoramic camera system or existing materials may be used to meet specific priority requirements.

f. Investigate the feasibility and desirability of superimposing reseau grids in future panoramic cameras.

Recommendation c is independent of the conclusion and is supported. The remainder imply acceptance of the conclusion, and should be considered only as a secondary to the first priority of developing a mapping system as originally agreed.

Summary

This memorandum was issued immediately after Secretary Vance requested information on why the Army's ADMATOS program was being held up. As can be seen by this review and analysis of this memorandum, the Army's plans for a mapping satellite have now been stopped. This action was based on claims made by the Air Force that the Army's mapping program can be met by using a combination of frame and panoramic photography and by employing new techniques developed recently by the Air Force. These claims are not supported by facts but by a series of beliefs, assumptions, and extrapolations.

Accordingly, it is not believed that anything has been offered which changes the Army's requirement for a satellite mapping system. It is therefore recommended that the unsupportable base on which the conclusion that a satellite mapping system is not warranted be brought to the attention of DOD with a request that the Army be authorized to proceed without further delay with the ADMATOS program.

[redacted]

An excellent paper for use in defending a satellite cartographic system such as A'.

needs rewrite to:

1) eliminate reference to National Map Standards and substitute 30 ft. DIA accuracy requirement

2) Prepare a section on "practical considerations" to specify use of available boosters (not to say TAT)

3) eliminate references to convergent mode cameras

4) Rewrite para 1, p. 7 to acknowledge, but play down difficulties in many combined techniques, but play up reasons for maximum f.l.

5) delete 6" (on basis of booster) substitute 4-5 from DIA proposal + add 12"

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