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PAR 315S
FINAL REPORT
REPRODUCTION SYSTEM STUDY

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PAR 315S

FINAL REPORT

REPRODUCTION SYSTEM STUDY

Prepared by:

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R. A. Koch

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Date: 18 November 1975

Contract

Task 5

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TABLE OF CONTENTS

	<u>Page</u>
GENERAL MANAGEMENT INFORMATION	
Subject	4
Task/Problem	4
Summary	4
Conclusions and Recommendations	6
DATA COLLECTION AND ANALYSIS	
Background Information	8
Selection of Exploitation Organizations	10
Conducting the Survey	12
Survey Results	14
IMPLEMENTATION PLANS	
9-By-5, Dual Format As Rolls	16
9-By-5, Dual Format As Flats and Scrolls	18
Titling and Auxiliary Data	20
APPENDIX : Questionnaire	A-1

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General Management Information

SUBJECT: PAR 315S, Reproduction System Study

TASK/PROBLEM

Study modifications to the current processing and reproduction system that would improve the utility of product generated from current and future acquisition systems.

SUMMARY

Changes in the existing acquisition systems, the addition of a new system, and a shifting emphasis in intelligence requirements will bring about changing demands for reproductions. The present methods and formats for delivering reproductions must be re-examined to determine whether changes could be made that would enhance their usefulness.

The objective of PAR 315S was to consider changes in the current processing and reproduction system that would meet this goal. PAR 315S was approved by the CCB at the March 1974 meeting. At the same meeting PAR 316S, "Data Appendage Study, Phase I" was deferred by the CCB because it required further review to establish the need for the study. The CCB directed that the scope of PAR 315S be interpreted to include the work needed to determine whether a study like PAR 316S was justified. The stated task for PAR 316S was to "study the feasibility of including alpha-numeric data with the shipment of photographic duplicates to assist exploitation and readout functions." To accomplish the required interface for PAR 315S, the CCB appointed a four-member committee from NPIC (Chairman), OD&E, EXSUBCOM, and BII.

In a questionnaire that was administered through a personal interview, the community's needs and attitudes about changes in reproductions were surveyed. The interview included a briefing and general discussion about the need for the study. Briefing charts that were prepared for this purpose are on file, and the questionnaire is exhibited in the appendix.

A wide spectrum of exploitation organizations was present in the data-collection scheme. The organizations selected for the study had responsibility for the three phases of readout: (1) priority readout, (2) search, and (3) detailed study. The exploitation groups selected were NPIC, IAS, MAA, PFA, TIGER, DIA, NISC, USAHC, MIA, FTD, DMA/AC, DMA/TC, DMA/HC, and SAC. After the questionnaires were collected from an exploitation group, a summary report of the results was prepared, reviewed by management, and occasionally modified to represent an official position. The modified results constituted the data base for the study.

During the study, flats and scrolls were offered to the photointerpreters (PI's) as alternative forms for delivery of reproductions. The main advantage of flats and scrolls over rolls was the flexibility they provided in customized shipping, since the production requirements, packaging, and distribution could be planned for individual frames, rather than for the large groups of frames contained in rolls. Other topics considered during data collection were the quality of present reproductions, frame arrangements in rolls, historical compositing, enlargements, and titling and auxiliary data.

The principal results from the survey about reproductions were as follows:

Gambit

1. Deliver flats and scrolls only to NPIC, IAS, and NISC. Deliver rolls to all other organizations.
2. When the "9-by-5" dual-format reproductions are delivered as rolls, they should be combined in the same roll.
3. When the 9-by-5 reproductions are delivered as flats and scrolls, they should be separated.

Hexagon

Deliver only rolls.

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Gambit and Hexagon

1. Reproductions of different acquisition film types should be combined in the same flats, scrolls, or rolls.
2. Rolls should be geographic-area composited.
3. Multiple reproductions of frames should be in the same flats, scrolls, or rolls.
4. Partial frames are never desirable.
5. Add several additional items to the titling.
6. Supply auxiliary data to remote exploitation organizations.

Since the community preference for flats and scrolls was not unanimous, and since economic and policy decisions might require that reproductions continue to be delivered as rolls, alternative production plans were designed to produce roll reproductions for the 9-by-5 system. The preferred plan depends on the design and construction of two new, improved Geographic-Area-Breakdown units. The new units are intended to have several advantages over the present model: more precise splice alignment, less labor intensive, higher splice reliability, and a higher throughput rate.

Three production plans were developed to produce flats, scrolls, and rolls in two parallel work-flow streams for the Gambit system. The plans met many of the goals indicated by the survey, but not all of them. For example, because of size, image-orientation, and material-mix constraints, no acceptable scheme was developed that would combine the 9.5-inch and 5-inch records into the same rolls. The three production plans were characterized by the principal production areas of work concentration. One plan concentrated the work in a manipulation of the original negative. This plan was not recommended because of the large number of splices involved and because front-end delays at the outset would seriously affect both the timelines of delivery and the production efficiency.

Another plan concentrated the work in the printing operation. Theoretically, this was the most attractive plan because of flexibility. However, the advantages were predicated on a printer that did not exist. Development of such a printer would incur large amounts of time and money and would have a high technical risk. This plan was not recommended.

The recommended plan would produce flats and scrolls from standard roll reproductions, which will be in geographic-area frame arrangements. The operations are mostly manual, but since the initial community demand for flats and scrolls will be limited, the necessary quantities could be produced in this manner. The regular rolls could be chopped, tabbed, labeled, collated, packaged, and shipped as an off-line operation with a small amount of new equipment. The implementation of this plan requires the smallest investment in time and money and has almost no technical risk. The operations could be automated and made more efficient as the demand for flats and scrolls increases.

The survey results indicated that several titling items should be added to those already present on the reproductions. The NPIC control number, Greenwich Meridian Time, and geographic coordinates for the center of the frame were all considered highly desirable. At a committee meeting with EXSUBCOM, it was agreed that the request for additional titling had a low priority, but the titling items should be considered if they can be added at reasonable cost.

The replies about auxiliary data showed that when a computer data base is present, it is the best source for auxiliary data. When a computer data base is not present, then auxiliary data would be useful in the form of a computer printout delivered along with the reproductions. At the same meeting with EXSUBCOM, it was judged that the computer printout would have marginal benefit and should not be provided at this time.

-5-

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CONCLUSIONS AND RECOMMENDATIONS

1. The consensus was that no changes should be made in the form of the reproductions for Hexagon missions.
2. The exploitation community in general does not desire their Gambit reproductions as flats and scrolls, but since the first-priority customer has requested reproductions in that form, development of a flat-and-scroll capability is justified. An austere, primarily manual production plan should be implemented to meet that request (see the figure opposite). The production plan could be expanded and automated in the event larger segments of the community request flats and scrolls in the future.
3. To provide the roll requirements for the 9-by-5 Gambit system, two new, improved Geographic Area Breakdown units should be designed and constructed. No other major changes are required in the present production system that require equipment development or fabrication.
4. Consideration should be given to adding several additional items to the present titling on both Gambit and Hexagon reproductions.
5. Auxiliary data should not be supplied as an integral part of or along with Gambit or Hexagon reproductions.

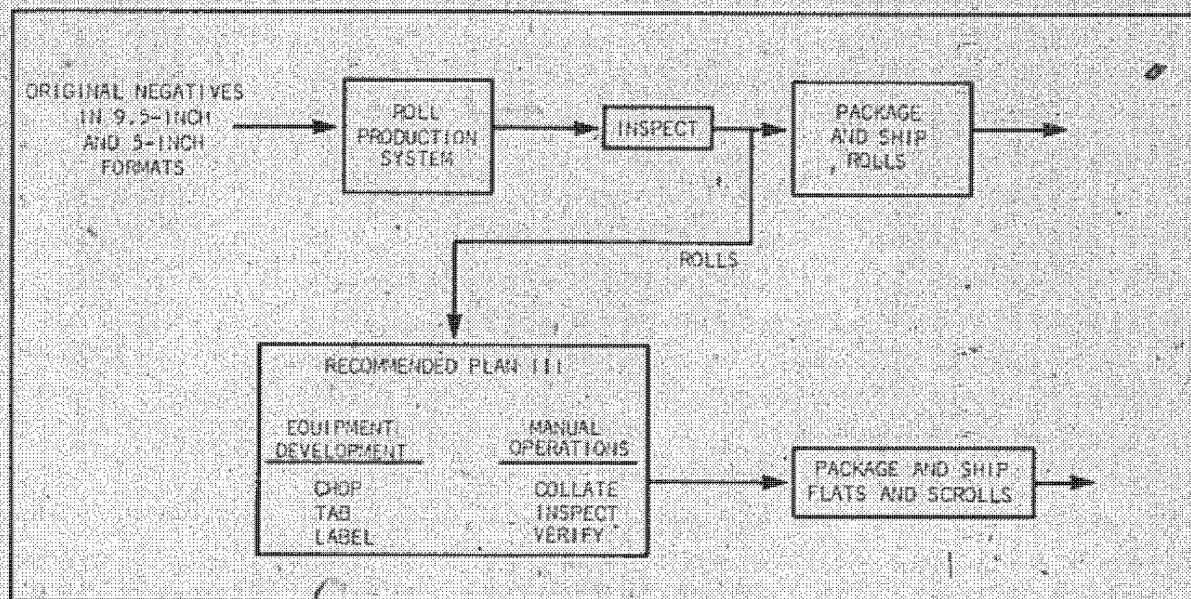
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Recommended Plan for Producing Flats and Scrolls

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Data Collection and Analysis

BACKGROUND INFORMATION

The committee established by the CCB conducted a study to define the changes that should be made in future Hexagon and Gambit mission reproductions and the auxiliary data that should be included either as a part of the reproductions or delivered along with them.

Beginning in 1976, the operating environment and application of the Hexagon and Gambit missions will be changed. A new acquisition system will be on-line to provide a daily output for surveillance. Engineering changes will be made to the Gambit hardware to provide an additional 5-inch-wide record which will allow for more flexible programming with a wide variety of acquisition films. The general application of Hexagon and Gambit missions may change (e.g., a larger percentage of economically oriented subjects than at present). The allowable time between recovery and shipment of reproductions may be longer than at present. All of these factors provide either an opportunity or a need for the reproductions from Hexagon and Gambit missions to be manufactured, packaged, and distributed in a manner that will be optimum for future community needs in both exploitation and mensuration.

Several other factors also played a part in the purposes of PAR 315S. A status report from PAR 199S/R1* stated that a practical design concept had been developed. The printer would be able to handle original negatives safely and efficiently, and produce duplicates with image quality equaling or exceeding existing continuous printers. This capability was considered to be consistent with the anticipated need for more customized reproduction methods in the future. Another factor was described in PAR 316S,** which was submitted but not approved. The stated purpose of this PAR was to "study the feasibility of including alpha-numeric data with the shipment of photographic duplicates to assist exploitation and readout functions." Again, the presence of data (additional titling, mensuration parameters, etc.) would be consistent with the goal of manufacturing reproductions which better meet the needs of the exploitation community. For all of the above reasons, the contractor was directed to study and define changes that should be made in the present reproductions from Hexagon and Gambit missions. In the March 1974 CCB meeting, the contractor was directed to include the objectives of PAR 316S in PAR 315S so the need, amount, and kinds of auxiliary data that should be included with or added to the reproductions would be defined.

One of the principal reasons for considering alternative forms of reproduction delivery was to bring about a better distribution of the reproductions available within an exploitation organization. Geographic-area compositing was a major step in that direction for groups that were structured in subdivisions with geographic responsibilities. Another step was taken in NPIC/IEG for the Gambit reproductions by cutting the rolls into "flats" so that individual frames or stereo pairs could be delivered to work stations. This mode of operation appeared to have considerable potential for flexibility in meeting unique demands of any exploitation organization and was chosen for use in the study as the alternative to delivery of reproductions in rolls. For the purposes of the study, a flat was defined simply as a sheet of film containing a single frame or a stereo pair with a tab attached to bring the overall length to some minimum measurement.

The definition was not detailed any further since an important part of the study was to obtain particulars from the PI's (photointerpreters). The advantages of flats were described to the participants as those associated with customized shipping. With flats, the production requirements, packaging, and distribution could be planned and executed for individual frames. Shipments could be structured as they were specified by the exploitation groups according to targets, geographic areas, etc., and could contain several film types, special printings, and multiple copies (if they existed), so that all items of interest would arrive simultaneously in a work area. Another major reason for selecting flats as the alternative to rolls was because

* Select Target/Area Printer.

** Auxiliary Data Appendage Study.

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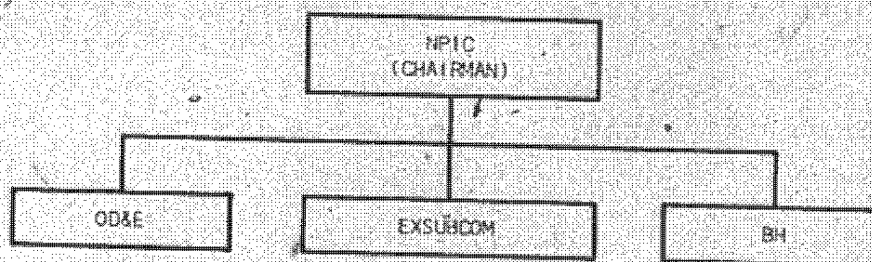
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that was the planned reproduction format for the new system.

It was immediately apparent that reproductions formatted as flats would incur several serious problems. Some individual frames or stereo pairs would be too long to handle as sheets of film. These were defined as "scrolls." Each scroll would be shipped from BH as a roll without a core and wrapped with a rubber band. Again this decision was consistent with plans and decisions already made in the new program. Other problems would be associated with control, shipment verification, and accountability. These would have to be accomplished at the frame level instead of for groups of frames contained in rolls. However, it was judged that the advantages of flats and scrolls to exploitation far outweighed the associated administrative and bookkeeping problems. This judgment seemed particularly sound, since the delivery of Gambit acquisitions to NPIC/IEG as flats and scrolls would be providing that organization with reproductions in the form they currently use and would transfer a production-type task to Bridgehead.

While one of the major objectives of the study was to define the characteristics of reproductions (type, size, quantity, format, etc.) this would have to be done in the context of practical production configurations within the Bridgehead (BH) facility. Work-flow patterns, quality-control procedures, delivery schedules, and new equipment would all have to be considered in detail before recommendations for implementation could be made to the CCB. In the event that changes in the reproductions were identified early in the study, and the changes required the development of long-lead items or major production system changes, those changes would be brought to the immediate attention of the CCB.

The CCB established a committee to supply all of the interface necessary to carry out the study. The members were from the following organizations: NPIC (chairman), OD&E, EXSUBCOM, and BH. The chairman coordinated all activities; the OD&E member was principally concerned with the identification of parallel studies that were similar to PAR 315S and involved equipment and information systems; the EXSUBCOM member provided guidance for data-collection topics and made arrangements to visit facilities; the BH member was responsible for implementation of the study, the details of data collection, and reporting to the sponsor. It was the task of the committee as a whole to design the study, assist in the collection of data, and report routinely to the CCB. The program administrative structure is shown in the figure below.



Organization Chart for the PAR 315S Study Committee

Responsibilities of the Committee Members:

- | | | |
|----------|---|---|
| NPIC | - | Serve as chairman |
| OD&E | - | Identify studies similar to PAR 315S that involve equipment and information systems |
| EXSUBCOM | - | Provide guidance for data collection topics and make facility visitation arrangements |
| BH | - | Implement study, collect data, and report to sponsor |

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Data Collection and Analysis

SELECTION OF EXPLOITATION ORGANIZATIONS

The exploitation organizations chosen for data collection were a valid, statistical representation of the three phases of readout, mensuration, and photo-lab operations.

The readout requirements, readout equipment, storage and retrieval systems, and accountability methods vary among the exploitation organizations. Since these factors could cause considerable variation in the responses of the individuals contacted in the study, it was considered important that all of the disparate organizations be represented in a preference-sampling scheme to make certain that all community points of view were expressed.

The best way to select the groups, if the data were to be amenable to a statistical analysis, would be by two-stage cluster sampling, as follows:

1. Identify all exploitation organizations in the first frame.
2. Identify all photointerpreters within the organization in the second frame.
3. Select a random sample of organizations for the first stage, with probabilities based on size, importance, or some other important factor.
4. Select a random sample of individuals within each of these organizations for the second stage.

The advantage of data collected in this manner would be that significance tests, test of hypothesis, and other tests would be statistically valid and would take into account the finite population characteristics. Furthermore, statistical procedures would be valid both at the aggregate level (total community) and also at the domain level (individual organizations). For example, statements like "The percentage of photointerpreters in the community who prefer flats and scrolls is significantly greater than 50 percent" could be tested for statistical significance.

While this data collection method was preferred, it was not used for two reasons. First, the time and cost constraints of the study limited the number of organizations that could be contacted. Secondly, while the data would be collected at the photointerpreter level, it was expected that their preferences would be modified by management in the event they were inconsistent with long range planning commitments or policy.

Consequently, it was decided to select as large a cross section of organizations as possible by purposive selection. If their responses indicated that radical or anomalous changes should be made in Gambit and Hexagon reproductions, then the rest of the community would have to be contacted for verification. Conversely, if no changes, (or only changes of marginal benefit) were indicated, then the rest of the community would not have to be contacted since the organizations that would provide the principal driving force for change would be present in the first data set.

Fortunately, a wide variety of organizations was present in the Washington, D. C., area, and within those organizations there were individuals who were knowledgeable about remote-organization requirements from previous assignments. A common feature of Washington, D. C., area organizations, however, was the availability of a central computer data base at NPIC. This would naturally limit the interest in additional titling and auxiliary data as a part of the reproductions. To obtain comments that were not affected by the computerized environment, several other organizations were to be contacted outside of the D. C. area. The ones chosen were FTD, SAC, and DMA/AC.

The final selection of organizations for the study was based on their responsibilities for the three phases of readouts:

1. Priority readout (see Figure A).
2. Search (see Figure B).
3. Detailed study (see Figure C).

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Exploitation, mensuration, and photo-lab operations were all conducted within many of the organizations. All of the organizations contacted within the study are shown in the figures as a function of the study structure. The positions of each organization in the figures must be considered correct in only a general sense since there is considerable overlap in the actual accomplishment of the three readout tasks.

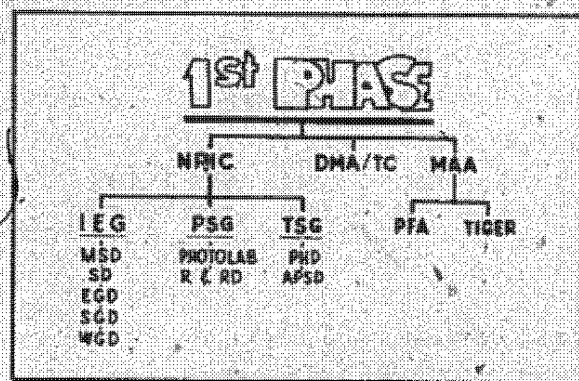


Figure A. Priority Readout Organizations

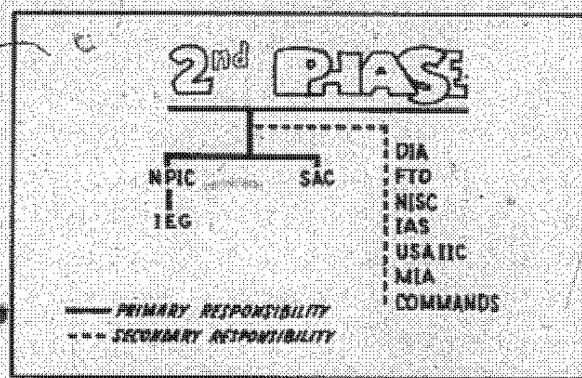


Figure B. Search Organizations

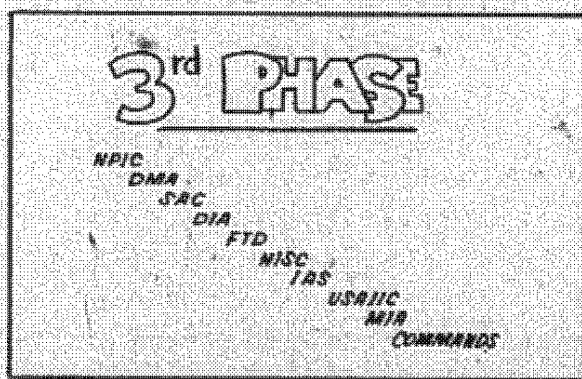


Figure C. Detailed Study Organizations

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Data Collection and Analysis

CONDUCTING THE SURVEY

A briefing, followed by a questionnaire and review by organizational management, constituted a satisfactory procedure for data collection.

A questionnaire was prepared which concentrated on two topics:

1. The format for future delivery of Gambit and Hexagon reproductions.
2. The titling and auxiliary data that should be included with the reproductions.

A brief additional section was included that asked questions about good and bad features of the reproductions being manufactured currently. Although this section was not necessary to the purposes of PAR 315S, it was added to take advantage of the opportunity to compile data on the photointerpreters' evaluation of BH reproductions.

An initial questionnaire was reviewed by NPIC/ESG and the PAR 315S committee for comments about the clarity and suitability of each specific question and the ease with which responses could be made and analyzed. Several revisions were required. A briefing was prepared, covering the reasons for the study, to enable the participants to make meaningful responses to the questions. The briefing covered the new exploitation system in very general terms, since most of the participants were not cleared for the details. The briefing told of the manner in which Hexagon and Gambit will be programmed in the future when the new system is operational and the changes to be made in Gambit (9 by 5). It exhibited a flat, a scroll, and drawings showing how auxiliary data might be an integral part of a flat or scroll. The briefing also laid the groundwork for a general discussion. The briefing and discussion usually took about one-half hour. Almost immediately after the briefing the photointerpreters were asked to respond to the questionnaire. Although many of them heard about the new environment for the first time during the briefing, they were asked to consider the changed environment in recommending radical changes in the format of reproductions produced for their use. A delay of several days between the briefing and data collection would have been preferable. The briefing charts are on file.

While NPIC/ESG was reviewing the questionnaire, a small pilot application of the total procedure was made with several section leaders from IEG (geographic and specialty divisions) and PHD. At the same time, briefings were given by IEG supervision to the survey team about the structure, charter, tasks, and general operations of IEG. A major revision in content and organization of the questionnaire was found to be necessary. Some questions were found to be impossible to answer. For example, "Should frames be arranged according to targets?" was too general because there are several ways to designate targets, and a frame usually contains more than one target. Also, the characteristic of flats, scrolls, and rolls had not been sufficiently well-defined. A major change was also needed in the section for titling and auxiliary data. The original plan had been to have the participants itemize the additional titling and auxiliary data items that should be included with the reproductions, but this was found to be an unreasonable task to perform during a short period. Under the changed plan, checklists were added that included all possible titling and auxiliary data items that might be requested. Each participant was to make a notation of 0, 1, or 2 for responses of "not needed," "desirable," and "mandatory," respectively. The list included, for each system, the titling items that are currently present on the film.

After the questionnaires were completed by representatives of an organization, the data were tabulated immediately. Callbacks were made to clarify any inconsistent or vague responses. There were very few cases where this was required. The principal ambiguous result was that some questions were not answered at all when the participant had no personal interest in the topic addressed by the question. For example, if he was not interested in flats or scrolls, he was inclined not to respond to the question, "What is the maximum, convenient length for a flat?" It had to be pointed out (again, as it was in the briefing) that he might have to receive flats whether he wanted them or not, so he should have his length preference represented in the data.

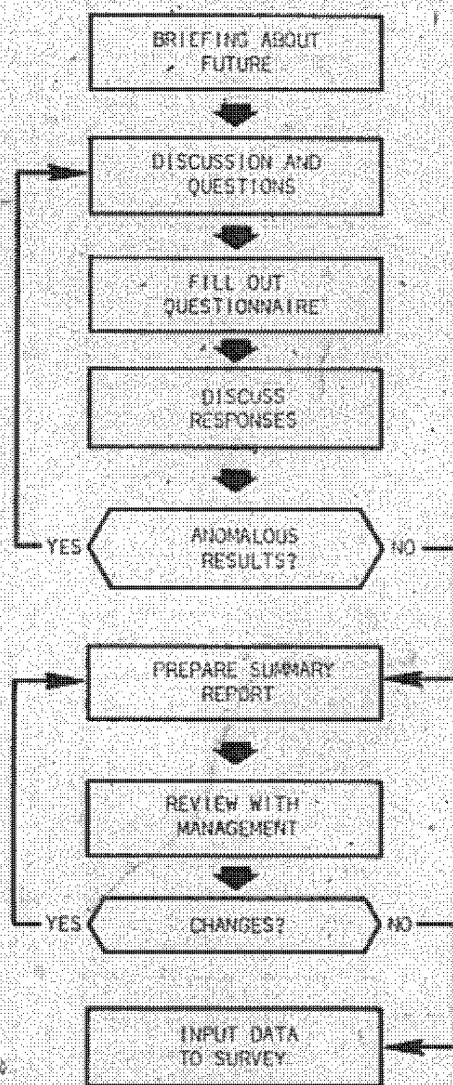
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A summary report of the survey results was prepared for each group. On each question, the report gave the consensus, when one existed. The summary report was reviewed by management in each organization and was modified whenever necessary to correctly represent the total organization's position on each question. Very few modifications were made. The modified results constitute the data base for the study. A flow chart shown in the figure describes the principal steps in data collection.



Data Collection Flow Chart

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Data Collection and Analysis

SURVEY RESULTS

The data collected in the survey provided a sufficient basis for making decisions about reproductions and auxiliary data in the future.

Conclusions drawn from the survey results are presented below in three sections. The first two sections are for topics specific to the Gambit and Hexagon systems respectively. The last section is for topics that relate to both the Gambit and Hexagon systems. Raw data or data summaries from each organization are not presented to support the conclusions, because in a few cases the position taken by management in each organization superseded the comments made by the photointerpreters. In other cases, the entire data input was a summary by management. That is, the only data received for analysis was a completed, consensus questionnaire.

When an organization had responsibility for more than one readout phase, it was asked to complete a separate questionnaire for each phase, as necessary. In no case did this occur. The only conclusion that could be drawn was that their comments apply to all readout phases. This lack of discrimination was probably due to the difficult task they were asked to perform; that is, assimilate new information about the future and then immediately consider radical departures from present methods of reproduction delivery. Although the task of the photointerpreters was difficult, in only one or two instances did they fail to respond in an enthusiastic manner. It appeared that the photointerpreters were delighted to have an opportunity to express their opinions, even though it was explained that their management might temper or modify the results.

Survey findings were as follows:

1. Gambit-Related Conclusions

- a. Deliver flats and scrolls, as well as rolls, to NPIC, IAS, and NISC. The working copy should be as flats and scrolls, and the file copy and duplicate negative as rolls.
- b. Deliver rolls to all other organizations. This was essentially a unanimous position. It appeared that the dominant reason for a preference for rolls was a management concern about storage-retrieval, security and accountability considerations instead of actual exploitation utility.
- c. The maximum acceptable flat length is 42 inches. Apparently, this was based on the illumination area present on standard exploitation viewing tables.
- d. When the Gambit system reproductions are delivered as flats and scrolls, every stereo pair should be contained in the same flat or scroll, if possible. Furthermore, if a choice must be made between separate flats for stereo pairs because of length or the stereo pair within one scroll the latter form is preferred.
- e. When the reproductions from the 9-by-5 system are delivered as rolls, the two records should be combined in the same roll. This would be done by making the 5-inch record reproductions on 9.5-inch-wide film. The frames would then be arranged in rolls as though all of the acquisitions had been originally acquired on one roll of film.
- f. When the reproductions from the 8-by-5 system are delivered as flats and scrolls, the 5-inch and 9.5-inch camera records should be handled separately, but the flats and scrolls should be merged in some logical manner during the packaging-and-shipment phase. This method eliminated problems associated with the mirror-image relationship between the two records, and was one of the principal motivations for considering flats and scrolls as an alternative to rolls.

2. Hexagon-Related Conclusions

- a. Deliver the reproductions only as rolls. The community was adamant in this preference.

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- b. Reproductions of the forward- and aft-camera record should remain as separate rolls. The community was adamant in this preference, too. There was definite concern about the distance between stereo pairs if the reproductions were combined.

3. Gambit- and Hexagon-Related Conclusions

- a. When the camera system contains more than one film type (e.g., black-and-white and color), the resulting reproductions should be combined in the same flats, scrolls, or rolls. That is, the frames should be combined and arranged into the same delivered units and should be sequenced as would have occurred if only one film type had been present in the acquisition system.
- b. When the reproductions are delivered as rolls, the frames should be geographic-area composited. This was not a strong preference, and geographic area was selected as a compromise frame-arrangement format because of a demonstrated ability that it can be done. There was a remarkably large number of requests for leaving the frames in taking sequence for both Gambit and Hexagon. The frame-arrangement preferences seemed to be highly task-oriented. Taking sequence or geographic compositing were about equally preferred for the search task. Specialty task groups almost always asked for the frames to be combined so specific targets and target types are put together.
- c. Multiple reproductions of the same frame should be present in the same flat, scroll, or roll. For example, if both a normal-contrast reproduction and a high-contrast reproduction have been made of a frame they should appear end-to-end in the same delivered unit. This procedure would eliminate the necessity for a photointerpreter to locate two rolls, flats or scrolls. Many times the multiple reproductions are used improperly as independent copies rather than as supplementary copies as intended, and the benefit of the multiple copies is not realized.
- d. Partial frames are never desirable. The community was adamant in this preference. If portions of frames are found to be of no interest, the photointerpreters will discard those sections. They will not depend on anyone else making that decision for them.
- e. There is no interest in BH enlargements in a routinely delivered reproduction form for either exploitation, collateral information or briefing boards. The characteristics of the enlargements (orientation, magnification, etc.) cannot be specified until the reproductions have been examined.
- f. State-of-the-art reproduction technology should be applied to important, historical acquisitions. In many instances the photointerpreters have "chips" of frames in their files that are several years old and are referred to regularly. Considerable advances have been made in reproduction technology, and these chips could be replaced with improved reproductions. Improvements could also be realized because the original reproduction conditions were probably not optimum for the chip area of the frame.
- g. In addition to the standard set of titling items, the following should be added: north indicator (Gambit only), geographic coordinates of the frame center, NPIC control number, and acquisition-film type.
- h. Auxiliary data for mensuration applications should be supplied to remote organizations that do not have a computer data base available. The preferred form of the data is hard copy (computer printout in several copies) and must be delivered with the reproductions for maximum value.
- i. The photo-lab and library-resource participants did not indicate any major differences from the comments made by the photointerpreters. Initially, there was a strong indication that the duplicate negatives should be delivered in rolls, with the frames in taking sequence. Upon further investigation it was seen that this was really related to the number of frames per can rather than frame arrangements, and that no changes are required.

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Implementation Plans

9-BY-5, DUAL FORMAT AS ROLLS

Under the selected plan, two new Geographic Area Breakdown Tables with improved features will support a practical production system in which 9-by-5 reproductions will be delivered as rolls within an acceptable time-span.

While the decision to deliver reproductions as flats and scrolls might be either positive or negative, the reality of the forthcoming "9-by-5" system demanded that a production plan be operational to meet its special characteristics when reproductions are delivered as rolls. Some of the constraints considered in the analysis were as follows:

1. The 5-inch record imagery will be a mirror image of the 9.5-inch record imagery.
2. Acquisitions can be made on the two records either simultaneously or separately.
3. The average frame length will be 6 inches instead of the present 12 inches.
4. Supply loads will be increased because of a reduction in film support thickness.
5. There will be fewer frames that are totally cloud-covered.
6. Shipment time from BH for first-priority reproductions can be lengthened.

The results of the survey indicated that the user community wanted the two records combined in some logical manner so the photointerpreters would receive the rolls with frames from the two records interspersed. A great deal of time and effort were spent in trying to devise a scheme to accomplish this in a practical manner but none could be found. The principal difficulties were as follows:

1. For correct orientation in a roll, the mirror image would require at least third-generation copies from the 5-inch record, which would cause unacceptable image quality losses for the highest-quality acquisitions.
2. While shipment times can be lengthened somewhat, extensive problems with one record could cause unacceptable production delays with the other.
3. The operational programming of the two records was unknown, but in the event the same targets were not acquired on both the 5-inch and the 9.5-inch records, there would be no reason to combine them.

Consequently, while several production plans were prepared and presented to the CCB to perform the collating functions of combining the two records, it was agreed that the plans were not feasible because of the above difficulties. The practical plans are discussed below where the two records are treated separately.

One of the pacing tasks in Gambit mission reproduction is in geographic-area compositing. Currently, about 1,250 splices are required. In an extreme case, when each record contains the same number of geographic-area segments, the 9-by-5 format will require about 6,500 splices (about five times as many). Compositing currently takes about 40 hours to complete, so 9-by-5 compositing with the same equipment would require about 200 hours to complete. The impact on first-priority delivery would be the additional 160 hours, an extension from the present 75 hours to about 235 hours; from 3 days to 9.5 days. It was anticipated that future delivery schedules for 9-by-5 missions would be relaxed somewhat, but 9.5 days was judged to be unacceptable. All of the other tasks (printing, processing, inspections, breakdowns, packaging, and shipping) have never exceeded facility capacity for Gambit reproductions and would not impede the 9-by-5 series missions either. So if the geographic-area compositing could be completed in a reasonable period of time, delivery schedules would not change drastically, and the rest of the production system would not require major changes or expansion.

Three production plans were investigated to develop changes that would shorten the time required to geographically composite the 9-by-5 records. The changes are noted as Plans 1-A, 1-B, and 1-C. They differ in the quantity and kind of Geographic Area Breakdown (GAB) tables. Plans 1-A and 1-B have two and four GAB tables, respectively, with the same features as the one GAB table

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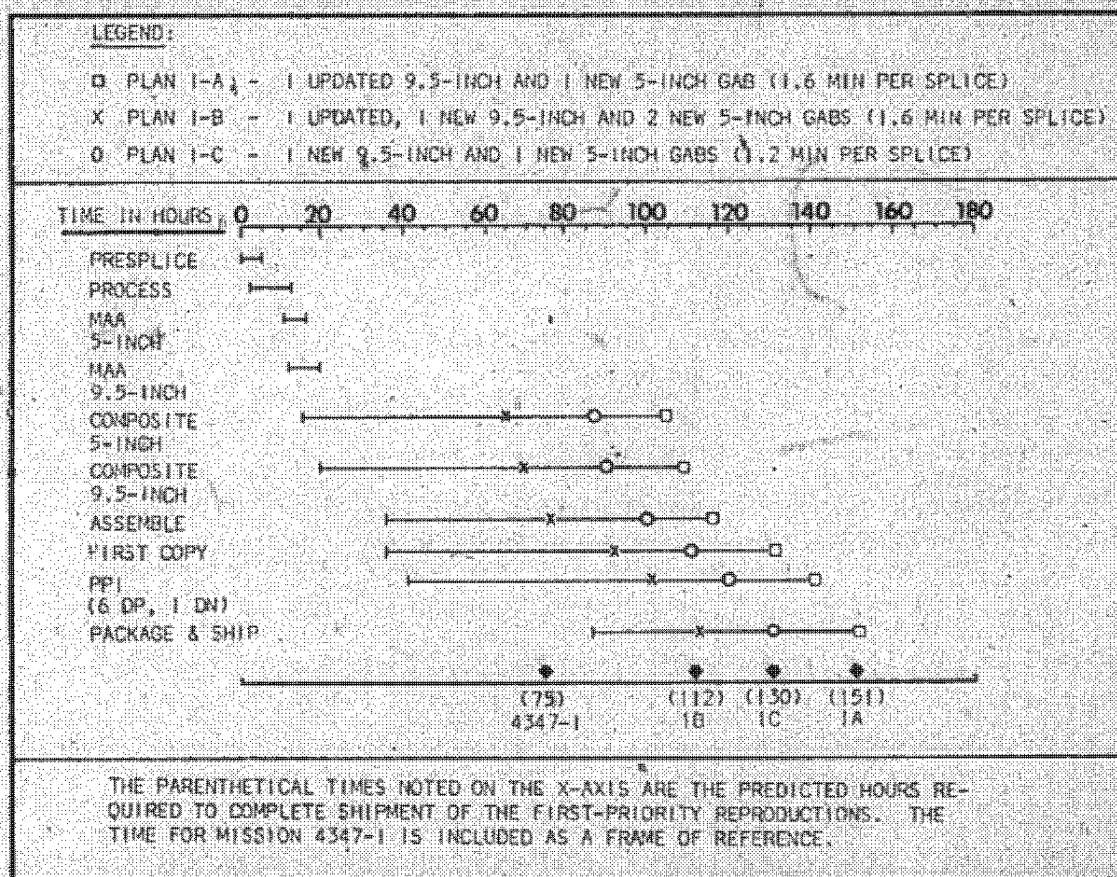
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currently on-line. Plan 1-C depends on two improved GAB tables with superior operating features. Improvements are desirable because the larger number of splices requires exact alignment to prevent tracking problems that would otherwise be encountered during the printing operations. The greater number of splices demands higher splice reliability to minimize damage to original negatives. The shorter interframe spacing hinders splice repair. It was also judged that in a new design the time between splices could be reduced to provide a higher throughput rate. A reduction of splicing time from 1.6 to 1.2 minutes was a realizable goal in a new design.

For these reasons plan 1-C (two new, improved, GAB units) was recommended, and the CCB approved the plan as PAR 321S.* The time-lines of the three plans are shown in the figure below as a function of the principal production steps. It can be seen that the predicted delivery time of the first-priority reproductions for plan 1-C is 130 hours, which was judged to be acceptable.



Production Plans 1-A, 1-B, and 1-C

* Advanced Area Breakdown Equipment, Phase I.

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Implementation Plans

9-BY-5, DUAL FORMAT AS FLATS AND SCROLLS

Production of flats and scrolls under the recommended plan would not interfere with regular roll production, has an acceptable technical risk, and could be automated, or expanded to meet increased demand from the community for flats or scrolls.

One of the major advantages of reproductions as flats and scrolls was that the problems associated with the simultaneous delivery of all materials of interest to an exploitation station would be drastically reduced. While the different acquisition materials and widths would follow different production streams, the flats and scrolls from each could be merged at packaging in almost any customized manner. Because of this flexibility and because NPIC/IEG currently reduces their Gambit work-copy reproductions to flats for exploitation, three alternative production plans were designed to manufacture flats and scrolls at BH. If flats and scrolls were introduced into some other organizations and if the potential advantages were realized, the other organizations would probably find them desirable also.

Some constraints that were accepted for design of the production plan were as follows:

1. Flats must be between 12 and 42 inches long.
2. Lengths over 42 inches will be scrolls.
3. Stereo pairs will be in the same flat whenever possible.
4. Flats and scrolls must contain reflected-light-readable sort information to assist in their distribution within an exploitation group.
5. Cover material will be avoided if possible.
6. Clear tab material will be attached to flats to bring all flats up to at least the minimum length.
7. Auxiliary data and the sort information may be incorporated into the tab material.
8. Flats, scrolls, and rolls must all be produced in parallel, since the file copy and duplicate negatives (rolls) will also have to be shipped with the first priority reproductions.
9. All shipped rolls (dupe positives and dupe negatives) will be in geographic-area-composite form; therefore, the original negatives must be in that form.
10. All flats and scrolls will be in the first-priority shipment.
11. Flats and scrolls will be intermixed in the printing rolls during reproduction.
12. Some stereo pairs will not be adjacent.
13. The frame quantity requirements will vary within a printing roll.
14. The ratio of flats to scrolls will be about 11 to 1.
15. Each complete copy will involve about 1,000 scrolls and 11,000 flats for a total of 12,000 pieces of film.

Three detailed production plans were prepared that operated within these constraints. The differences among the plans were principally characterized by the steps in the production stream during which the majority of work was done to manufacture flats and scrolls. Plan I required considerable manipulation of the processed Gambit acquisition films. Plan II concentrated the work in the printing stage. Plan III produced flats and scrolls from the regular geographic-area-composited reproductions. The principal advantages and disadvantages of the three plans are discussed below, several of which are related to the addition of tab material to the flats. It was decided during the specification of flat characteristics that material would have to be added to bring the overall flat length to at least 12 inches, and to provide space for handling, reflected-light-readable sort information, auxiliary data, and additional titling. The tab material and the method of attachment will be appropriate to the method selected for flat manufacture.

-18-

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Plan I, Work Concentrated in Acquisition Films

In Plan I, the tabs would consist of sections of clear film of appropriate length that would be inserted into the original negative. They would be preprinted with all required data. At the same time, some limited rearrangement of frames could be done to bring separated stereo pairs together and to group the sections that would end up as flats and scrolls. The principal advantages of Plan I were that (1) only one production check of tab information would be required, (2) only existing GAB technology was required, (3) the final operations of chopping and collating were simplified, (4) the total plan had a low technical risk, and (5) the lead time for implementation was acceptably short.

The principal disadvantages were that (1) a huge number of precision splices was required, (2) the tab information content would have to be common to all users, (3) if troubles were encountered in building the printing rolls, a significant initial delay would be incurred, and (4) the roll lengths for the users not receiving flats would be significantly expanded by the tabs. The disadvantages were considered unacceptable, and it was recommended to the CCB that Plan I should not be implemented.

Plan II, Work Concentrated in the Printing Stage

Plan II was based on the assumption that a special printer could be designed and built with many new, versatile characteristics. Tabs could be provided by separating the printed imagery with additional duplicate-film stock. At the same time, the tabs could be printed with the additional titling and auxiliary data. If such a printer could be built, the advantages in Plan II would be that (1) the tab information could be customized, (2) no additional precision splices would be required, (3) the footage for roll reproductions would not be expanded, and (4) production requirements could be specified for individual frames.

The principal and overriding disadvantage was the special printer, which would incur a huge technical risk, high cost, and long lead time for implementation. For this reason it was recommended to the CCB that Plan II should not be implemented.

Plan III, Work Concentrated in Regular Reproductions

The third and most conservative production plan dealt only with the standard, geographic-area-composited rolls. Enough rolls would be produced to meet the regular roll requirements as well as the requirements for flats and scrolls. The ones for flats and scrolls would be chopped, tabbed, labeled, and collated. This plan required the least outlay in time and funds to implement. It would allow community evaluation of flats and scrolls. The plan could be expanded, or Plan I or II could be brought into being, if the acceptance of flats and scrolls became universal.

It was recommended in PAR 322S* that a small-scale version of Plan III be implemented. Initially, most of the tasks could be manual and would be arranged as an off-line operation that would not interfere with the regular roll production. If the acceptance of flats and scrolls increased, the tasks could be made less labor-intensive with the introduction of automatic and semi-automatic equipment. The technical risks with equipment to cut, splice, tab, and collate were all acceptable, since technology already exists to perform these functions. The development-engineering requirement would be to merge them into an operational system. The system could be developed in a modular fashion to keep pace with any increased demand for quantities of flats or scrolls. A block diagram of this plan is shown in the summary section of the report. The blocks show which functions would require equipment development and which would remain manual. PAR 322S was deferred by the CCB.

* Film Handling Equipment, Phase I

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81 F-008 H-GH-04694-I-75-

Implementation Plans

TITLING AND AUXILIARY DATA

Auxiliary data should not be provided at this time but titling should be expanded, if possible, to include the NPIC control number, Greenwich Meridian Time, and the geographic coordinates for the center of the frame.

The photointerpreters and mensurationists surveyed were asked to identify items of information that should be included with the reproductions to assist them in their respective tasks. It became evident early in the study that organizations with a readily-accessible computer data base were interested in very few additional items. The mensurationists, in particular, rely almost exclusively on the computer to supply system data to the software programs that perform the calculations. The photointerpreters were more concerned with the legibility and completeness of the present titling items. Some short frames require double-row titling, which results in small characters that are difficult to read. Also, manually titled records ordinarily do not contain all of the titling items that are present on optically titled records. Photointerpreters find both of these conditions objectionable.

New sets of data were collected in NPIC/IEG and DIA, where the participants in the survey were asked to represent remote exploitation groups. They were asked to identify the titling items and the auxiliary data that should be an integral part of reproductions or delivered as hard copy with them. An example of how these items could be included in a tab attached to a flat, a scroll, or a roll is shown in the figure opposite. This example was shown to the survey participants to stimulate their thinking. There is no way of knowing at the present time how successful they were in representing the interests of the remote organizations.

The complete list of items the participants were asked to consider is given in the questionnaire in the appendix. Every item in the list was checked at least once. However, several titling items were checked repeatedly. The NPIC participants were almost unanimous in requesting the NPIC control number as part of the titling. Greenwich Meridian Time and geographic coordinates for the center of the frame were considered highly desirable. Also, a symbol indicating the North direction for Gambit reproductions was requested by a large number of photointerpreters.

At a meeting with the EXSUBCOM chairman on 23 Jan 75, it was agreed that these requests had a low priority but the items should be considered and added to the titling if it could be done inexpensively. The problem was turned over to the BH production subgroup responsible for titling, and the schedules and other details are being arranged with NPIC and other users.*

The auxiliary data results indicated that essentially all or none of it should be available. There was no subject that was requested by a large member of mensurationists. Since it was inconceivable that all of it could be included on the film (or tab), the only alternative was to provide a hard copy (computer printout) along with the reproductions. At the meeting with EXSUBCOM on 23 Jan 75, it was determined that the auxiliary data inclusion would be of marginal benefit since PI's can obtain the data, if needed, from other sources. The advantage would be that the data would be accessible at the same time that the reproductions were received at the remote exploitation sites. It was judged by EXSUBCOM and the committee that this topic should not be implemented in any way at this time. If requests for auxiliary data are received or made known at future EXSUBCOM meetings, then the topic can be reconsidered within the context of regular BH production and support operations. It does not appear that it would be difficult to provide a computer printout of the data for delivery with the reproductions if BH is requested to do so. The listings provided with each shipment could be customized so that only the data pertinent to the included frames will be given.

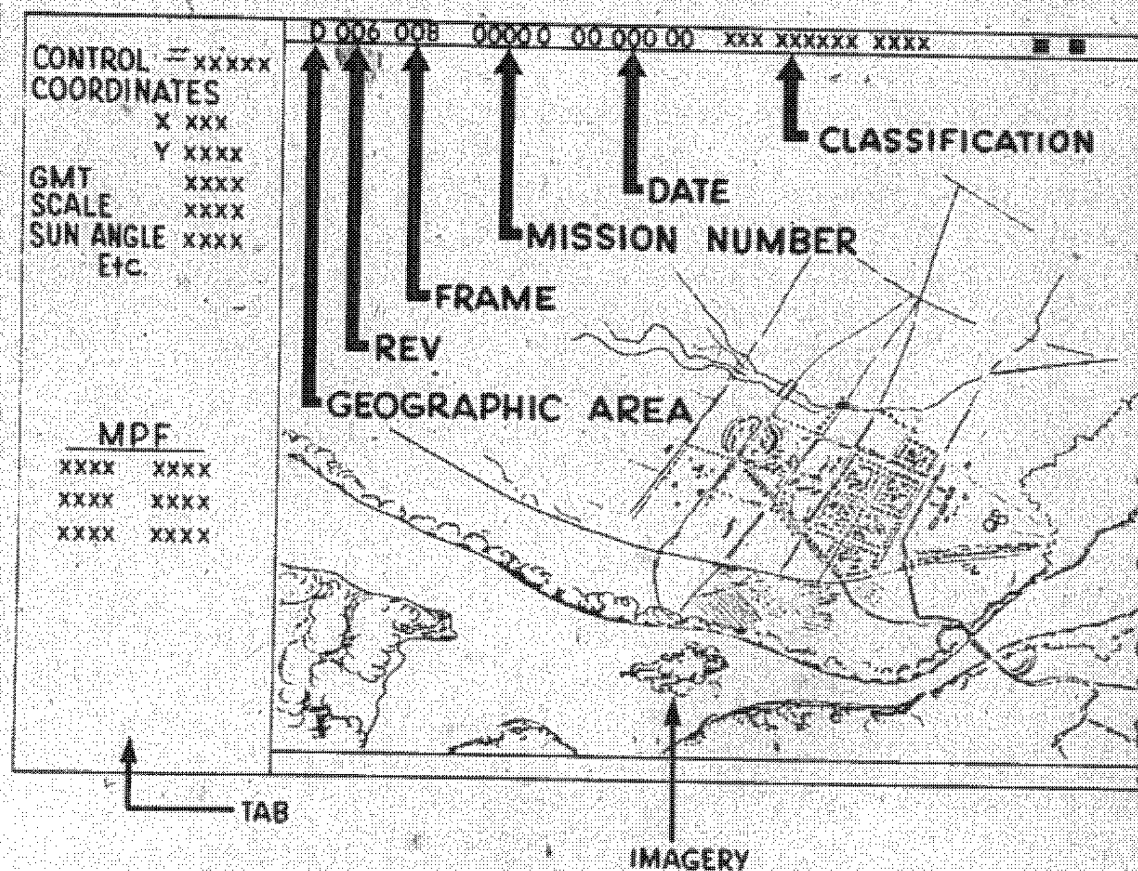
* It is intended to add Greenwich Meridian Time and the NPIC control number to the titling, beginning with Mission 1211.

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APPENDIX

QUESTIONNAIRE

Date _____

QUESTIONNAIRE #1

Each participant should familiarize himself with the entire questionnaire before answering any of the questions. Many of the questions are interrelated and conflicts should be avoided as much as possible. The areas of inquiry are as follows:

- A. General Information
- B. Characteristics of Present Reproductions
- C. Delivered Units
- D. Flat Characteristics
- E. Frame Arrangements
- F. Enlargements
- G. Historical Compositing
- H. Titling & Auxiliary Data

Comments and suggestions within these or other areas are encouraged and should be helpful in arriving at a family of reproductions that satisfies the majority of the community's exploitation requirements.

When preference statements are required, the following 5-point scale should be utilized.

- 1 = highly desirable
- 2 = desirable
- 3 = neutral
- 4 = undesirable
- 5 = highly undesirable

A. GENERAL INFORMATION

1. Participant Identification

Name _____

Facility _____

Division _____

Branch _____

Group _____

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2. Exploitation Task: _____

B. CHARACTERISTICS OF PRESENT REPRODUCTIONS

1. Indicate the shortcomings and/or good features of the reproductions you currently use for exploitation.

Contrast _____

Density _____

Physical Quality _____

Titling _____

Information on Can _____

Other _____

C. DELIVERED UNITS

1. For the "8" system indicate your preference for receiving the reproductions.

Delivered Unit

Preference Value

Rolls

Flats/Scrolls

Comments _____

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2. For the "9" system indicate your preference for receiving the reproductions.

Delivered UnitPreference Value

Rolls _____

Flats/Scrolls _____

Comments _____

3. If the "9" is delivered in rolls, should the forward and aft record reproductions be in the same roll? Circle one.

Yes

No

Comments _____

4. If the "9X5" is delivered in rolls should the "9" and "5" records be together in the same roll? (5" record on 9-1/2 wide film) Circle one.

Yes

No

Comments _____

D. FLAT CHARACTERISTICS

1. What is the maximum length that is acceptable for a flat? Circle one.

1.5 ft.

2 ft.

2.5 ft.

3 ft.

3.5 ft.

Other _____ ft.

2. If possible, should stereo pairs be in the same flat? Circle one.

Yes

No

3. If a stereo pair is too long for a flat, should the frames be in separate flats or together in a scroll? Circle one.

Separate Flats

Together in Scroll

A-3

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E. FRAME ARRANGEMENTS

1. If the "8" reproductions are delivered in rolls, indicate your preference for the following frame arrangements.

<u>Frame Arrangement</u>	<u>Preference Value</u>
Taking sequence	_____
Area compositing	_____
Subject compositing	_____
BE number compositing	_____
Comirex number compositing	_____
Target complex compositing	_____

Comments _____

2. If the "9" reproductions are delivered in rolls indicate your preference for the following frame arrangements.

<u>Frame Arrangement</u>	<u>Preference Value</u>
Taking sequence	_____
Area compositing	_____
Subject compositing	_____
BE number compositing	_____
Comirex number compositing	_____
Target complex compositing	_____

Comments _____

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3. If the camera record(s) contains more than one film type, should their reproductions be included within the same delivered unit, i.e., roll, scroll or flat? Circle one.

Yes

No

Comments _____

4. If more than one reproduction of a frame has been made (e.g., dual prints) should they be included within the same delivered unit; i.e., roll, scroll or flat? Circle one.

Yes

No

Comments _____

5. Is it ever desirable to receive partial frames? Circle one.

Yes

No

Comments _____

6. Should the file copy and the work copy be the same; i.e., both rolls or flats? Circle one.

8 - Yes

No

9 - Yes

No

Comments _____
_____F. ENLARGEMENTS

1. Do you require enlargements for your exploitation task? Circle one.

8 - Yes

No

9 - Yes

No

NOTE: If answers to 1 were no, skip to next section.

A-5

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2. If the answer to 1 was yes, state preferred magnification factors.

8 - _____

9 - _____

3. What data should be on the enlargements?

8 - _____

9 - _____

4. What are the best dimensions for the enlargements? (Describe)

8 - _____

9 - 7 _____

5. When should you receive the enlargements relative to the receipt of the regular reproductions? Indicate preference.

Delivery

Before

Same Time

Later

Preference Value

8 9

G. HISTORICAL COMPOSITING

1. If the reproductions are delivered in rolls or scrolls, is there any interest in compositing over several missions (may be of different series) for some historical period?

8 - _____

9 - _____

A-6

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2. Do you have important, historical reproductions in your files that should be replaced with reproductions from the original negative with present, improved reproduction methods and films? Circle one.

Yes

No

Comments _____

H. TITLING AND AUXILIARY DATA

During a PAR 315S survey in other installations, several additional items of data were identified which should be added to the basic set of titling information. It is also possible that for some installations outside of B-213, it might be convenient to have parts of the mensuration-parameter file (MPF) listed on the film for those who are involved in mensuration activities. One approach under consideration includes the additional data for each mono-frame or stereo pair on a short piece of film (tab) adjacent to the frame(s) of interest. The attached figure illustrates this approach for the 8-system.

To avoid including unnecessary data or omitting important data, the following lists of items were prepared to confirm or modify the results of the first survey. There are two sections to the questionnaire. All participants should complete Sections 1 and 2, which are concerned with titling data of general interest, regardless of the various exploitation tasks. Sections 3 and 4 should be completed only by those who perform mensuration tasks. Those who complete Sections 3 and 4 should do so in the context of not having a large computer database available; that is, identify the data which should be on the film if that is the only readily available source.

Please indicate your preference for each item contained within the sections. Each item is followed by a preference number. The appropriate number should be circled based on the following definitions.

<u>Number</u>	<u>Definition</u>
0	not required
1	desirable
2	mandatory

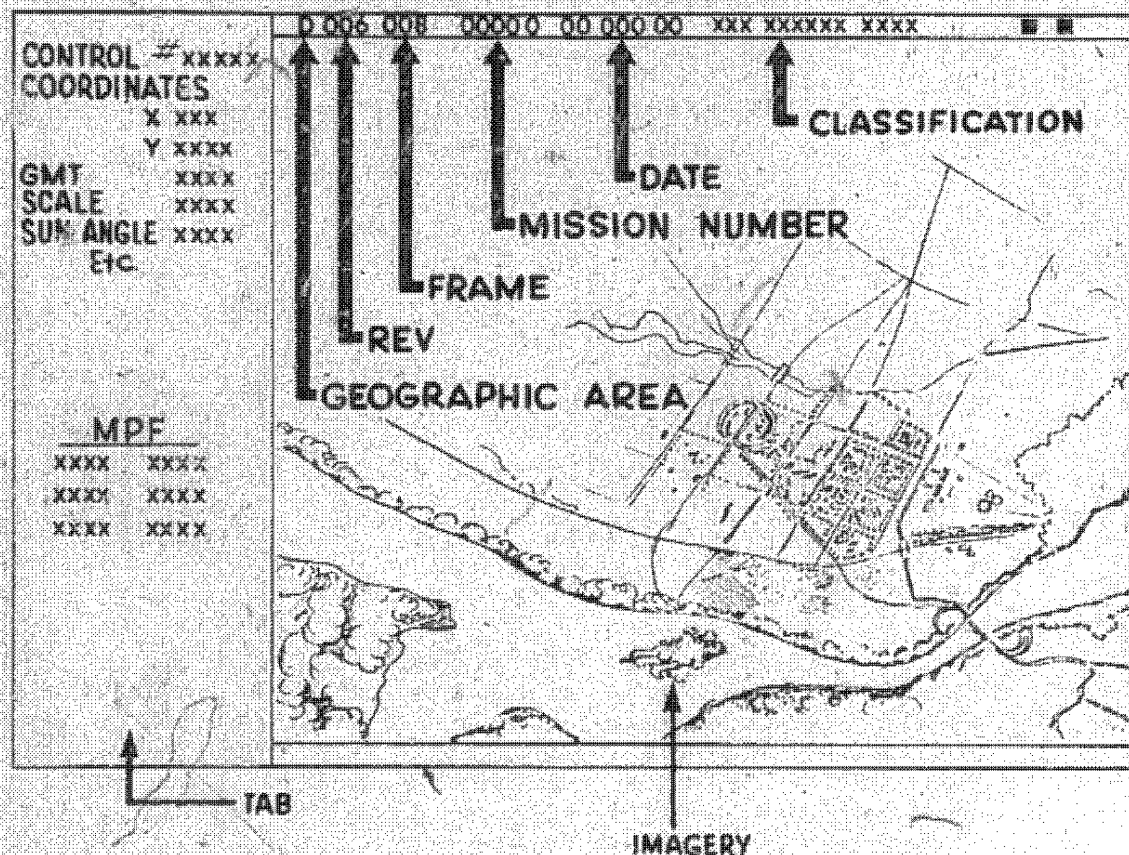
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Possible Method of Including Additional Data

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H. TITLING AND AUXILIARY DATA

1. Titling Data - 8 System

	<u>Not Required</u>	<u>(Circle One)</u>	
		<u>Desirable</u>	<u>Mandatory</u>
1. Rev	0	1	2
2. Frame	0	1	2
3. Date	0	1	2
4. Classification	0	1	2
5. Mission Number	0	1	2
6. Area Code	0	1	2
7. Control Number	0	1	2
8. Comirex Number	0	1	2
9. Geographic Coordinates	0	1	2

Which geographic coordinates are best? Center of frame, lower right corner, comirex target, etc.?

10. Time of Acquisition	0	1	2
11. Acquisition Film Type	0	1	2
12. Duplicate Film Type	0	1	2
13. Component Code	0	1	2
14. North Direction-Arrow	0	1	2
15. North Direction-Degrees	0	1	2
16. Scale	0	1	2

Which scale is best? Center of frame, comirex target, etc.?

A-9

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1. Titling Data - 8 System (Cont'd)

	(Circle One)		
	<u>Not Required</u>	<u>Desirable</u>	<u>Mandatory</u>
17. Sun Angle	0	1	2
18. Cone Angle	0	1	2

ADD ADDITIONAL ITEMS FOR THE 8-SYSTEM

19. _____	0	1	2
20. _____	0	1	2
21. _____	0	1	2
22. _____	0	1	2
23. _____	0	1	2
24. _____	0	1	2
25. _____	0	1	2
26. _____	0	1	2
27. _____	0	1	2

2. Titling Data - 9 System

28. Rev	0	1	2
29. Operation	0	1	2
30. Frame	0	1	2
31. Date	0	1	2
32. Classification	0	1	2
33. Camera (Fwd & Aft)	0	1	2
34. Mission Number	0	1	2
35. Area Code	0	1	2

A-10

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2. Titling Data - 9 System (Cont'd)

		(Circle One)		
		<u>Not Required</u>	<u>Desirable</u>	<u>Mandatory</u>
36.	Scan Angle Mark (5° inc)	0	1	2
37.	Control Number	0	1	2
Describe the control number _____				

38.	Comirex Number	0	1	2
39.	Geographic Coordinates	0	1	2
Which geographic coordinates are best? Center of frame, lower right corner, comirex target, etc.?				

40.	Time of Acquisition (GMT)	0	1	2
41.	Acquisition Film Type	0	1	2
42.	Duplicate Film Type	0	1	2
43.	Component Code	0	1	2
44.	North Direction-Arrow	0	1	2
45.	North Direction-Degrees	0	1	2
46.	Scale	0	1	2
Which scale is best? Center of frame, comirex target, etc.?				

47.	Sun Angle	0	1	2
48.	Cone Angle	0	1	2

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2. Titling Data - 9 System (Cont'd)

(Circle One)

<u>Not Required</u>	<u>Desirable</u>	<u>Mandatory</u>
---------------------	------------------	------------------

ADD ADDITIONAL ITEMS FOR THE 9-SYSTEM

49. _____	0	1	2
50. _____	0	1	2
51. _____	0	1	2
52. _____	0	1	2
53. _____	0	1	2
54. _____	0	1	2
55. _____	0	1	2
56. _____	0	1	2
57. _____	0	1	2

A-12

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TO BE COMPLETED ONLY BY PARTICIPANTS WITH MENSURATION RESPONSIBILITY

3. Auxiliary Data - 8 System

	(Circle One)		
	Not Required	Desirable	Mandatory
58. Focal Length	0	1	2
59. Mirror pitch	0	1	2
60. Mirror crab	0	1	2
61. Vehicle pitch	0	1	2
62. Vehicle roll	0	1	2
63. Vehicle yaw	0	1	2
64. Nadir latitude T1	0	1	2
65. Nadir latitude T2	0	1	2
66. Nadir longitude T1	0	1	2
67. Nadir longitude T2	0	1	2
68. IN velocity T1	0	1	2
69. IN velocity T2	0	1	2
70. Vehicle azimuth T1	0	1	2
71. Vehicle azimuth T2	0	1	2
72. Flight path T1	0	1	2
73. Flight path T2	0	1	2
74. Elevation of sun T1	0	1	2
75. Elevation of sun T2	0	1	2
76. Sun azimuth T1	0	1	2
77. Sun azimuth T2	0	1	2

A-13

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BIF-008 B-GH-04694-I-75-

3. Auxiliary Data - 8 System (Cont'd)

	(Circle One)		
	<u>Not Required</u>	<u>Desirable</u>	<u>Mandatory</u>
78. Height T1	0	1	2
79. Height T2	0	1	2
80. VF	0	1	2
81. PCT T1	0	1	2
82. PCT T2	0	1	2

ADD ADDITIONAL ITEMS FOR THE 8-SYSTEM

83. _____	0	1	2
84. _____	0	1	2
85. _____	0	1	2
86. _____	0	1	2
87. _____	0	1	2
88. _____	0	1	2
89. _____	0	1	2
90. _____	0	1	2

4. Auxiliary Data - 9 System

91. Focal length	0	1	2
92. Camera pitch	0	1	2
93. Camera roll	0	1	2
94. Camera yaw	0	1	2
95. Vehicle pitch	0	1	2
96. Vehicle roll	0	1	2

A-14

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BIF-008 B-GH-04694-I-75-

4. Auxiliary Data - 9 System (Cont'd)

		(Circle One)		
		<u>Not Required</u>	<u>Desirable</u>	<u>Mandatory</u>
97.	Vehicle yaw	0	1	2
98.	Nadir latitude	0	1	2
99.	Nadir longitude	0	1	2
100.	Frame latitude	0	1	2
101.	Frame longitude	0	1	2
102.	IN velocity	0	1	2
103.	GT velocity	0	1	2
104.	IN azimuth	0	1	2
105.	GT azimuth	0	1	2
106.	Flight path	0	1	2
107.	Elevation of sun	0	1	2
108.	Sun azimuth	0	1	2
109.	Altitude	0	1	2

ADD ADDITIONAL ITEMS FOR THE 8-SYSTEM

110.	_____	0	1	2
111.	_____	0	1	2
112.	_____	0	1	2
113.	_____	0	1	2
114.	_____	0	1	2
115.	_____	0	1	2
116.	_____	0	1	2
117.	_____	0	1	2

A-15

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BIF-0089-GH-04694-1-75-

5. If the reproductions are in rolls, indicate preferred location of the titling and auxiliary data.

<u>Location</u>	<u>Preference Value</u>	
	<u>8</u>	<u>9</u>
Computer Listing	_____	_____
On idents at end(s) of roll or scroll	_____	_____
Tab between frames	_____	_____
CRT Display	_____	_____
Microfilm with reader	_____	_____
Other (Describe)	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

6. If the reproductions are in flats and scrolls, indicate preferred location of the titling and auxiliary data.

<u>Location</u>	<u>Preference Value</u>	
	<u>8</u>	<u>9</u>
Computer Listing	_____	_____
Tab at the end of flat	_____	_____
CRT Display	_____	_____
Microfilm with reader	_____	_____
Other (Describe)	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

A-16

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