998605

[redacted]

[redacted] 25X1A

DECLASS REVIEW by NIMA/DOD

106-1

AN EVALUATION OF ALTERNATIVE PLANS FOR ACCOMMODATING WIDE FILM

[redacted] 25X1A

August 30, 1965

25X1A

[redacted]

1.0 INTRODUCTION

The possibility exists that future acquisition systems may utilize a film in excess of 9-1/2 inches wide. Many items of equipment necessary to the exploitation process are limited to the acceptance of films no greater than 9-1/2 inches in width. The introduction of a wider film would, therefore, impose serious exploitation problems which should be recognized in advance of the event.

In recognition of this possibility, the present study was undertaken to investigate the problems associated with the introduction of a wider film and to evaluate alternative solutions. The objectives of the investigation were stated in the Request for Proposal R-34-65 as being to provide the following information:

a. A brief description of the alternatives available to this office to accommodate film widths from 9-1/2 to 24 inches, such as adoption of a chip system, splitting film at the processing site to provide film widths no wider than 9-1/2 inches, or modifying all exploitation equipment to accommodate the wide film,

b. Suggestions for film handling component redesign,

c. Cost to provide the suggested modifications,

c. Estimate time to accomplish the suggested modifications.

2.0 STUDY CONSIDERATIONS

Many factors must be considered in determining the impact of a wider film on the exploitation system. The problem goes somewhat deeper than merely the factors of time and cost. The conduct of the study was influenced considerably by the assumptions made and by the somewhat subtle complications resulting from the possible multiplicity of widths. Before embarking upon a discussion of the specific factors investigated it is necessary to establish the framework within which the investigation was made.

The problem of accommodating film widths from 9-1/2 to 24 inches can be viewed in different ways. The solution may be different for each. If the problem were to accommodate a single width between these values one solution may suffice. If, however, more than one wider film is possible, the single width solution no longer holds. In the course of the study it was assumed that more than one wider film is possible and that it is desirable to consider this contingency.

In the current situation several film widths are already in use at the same time. As new acquisition systems are developed it is likely that one or more new widths, lesser or greater than 9-1/2 inches, may be introduced. It is doubtful that a new system would completely replace a current one, at least until sufficient experience has been gained to warrant complete confidence. It seems quite possible, then, that a wider film will be in addition to the present widths rather than as a replacement of, and that the exploitation system should be prepared for this eventuality.

This leads to the question of quantity. A new acquisition system could increase materially the input quantities. In fact, it seems logical that increased coverage would be a prime objective in developing a new system. To investigate all of the ramifications of this aspect in the brief period of this study, however, did not appear justified in view of the other important considerations to be pursued. For this reason, quantity was assumed to remain constant for purposes of evaluating alternatives simply to avoid further complications. While this would affect cost estimates in an absolute sense, it does not alter the relative considerations among alternatives.

Several assumptions were made about the characteristics of a wider film. Scale and quality, for instance, are not expected to be significant factors. While either may be somewhat better than at present, the changes will not influence or restrict the results of the study.

It is also assumed that PI tasks will remain the same and that present methods and procedures will remain in effect. Thus, equipment requirements are considered unchanged except with regard to film width requirements.

Before considering the major factors in the exploitation process it is necessary to examine briefly some basic considerations regarding the processing site. Despite the obvious fact that a wider film would also affect the negative processor, the scope of this study was interpreted to extend only to the second generation prints. Concern about a suitable processor to accommodate a wider negative is assumed to be the responsibility of someone else. Whatever lead-time applies to the negative processor would, presumably, also apply to the exploitation process equipment.

There are several alternative ways in which film might be handled at the processing site which are pertinent to the problem. The impact on the exploitation process must be viewed in terms of the most probable alternative among the following:

1. The original negative and prints are both provided in a width which can be accommodated by present equipment,
2. The original negative and prints are both provided in the original width,
3. The original negative is provided in the original width and prints are provided in a width which can be accommodated by present equipment.

Intuitively, there would seem to be some reluctance to cut or otherwise alter the original negative. Discussions within the building and with knowledgeable contractors substantiate this belief. The probability of the loss of information by slitting the original negative is too great to risk such an approach. The first alternative is, therefore, discarded as an unlikely event except in extreme emergencies. It is most likely that the primary film record would always be handled in its original form.

Which of the remaining alternatives is the better, then becomes the subject of this study. In view of the complexity of the problem and the many variables which could affect it, the study was broadly based. Emphasis was given to considerations of efficiency and permanence of the solution which extend somewhat beyond a strict interpretation of film width requirements. The major factors considered in analyzing the impact of a wider film were:

1. the items of equipment affected,
2. the functions performed in the exploitation process,
3. the alternatives open to examination, and
4. the criteria by which alternatives could be evaluated.

2.1 Equipment

Obviously, not all equipment presently in use would be affected by the introduction of film wider than 9-1/2 inches. Only those items which require roll film for efficient operation should be considered in evaluating alternatives. Microscopes, for instance, are not affected by changes in film width. Viewers, on the other hand, are. In general, the types of equipment whose performance would be directly influenced by a wider film are processors, printers, enlargers, light tables, viewers, comparators and some evaluation equipment.

The characteristics of all equipment in use or to be delivered during Fiscal Year 1966 were examined. Table I indicates those items which were, by virtue of physical characteristics, selected for further consideration. It became evident at this stage, however, that other factors must be considered in making a more precise determination of equipment which actually would be affected in the event of a wider film. Results of the analysis are only

Approved For Release 2001/08/13 : CIA-RDP78B04747A002100050006-8

meaningful if the equipment considered is essential to the exploitation process. Certainly not all equipment which might be affected meets this criterion.

One important aspect of essentiality is the use rate or potential use rate of the equipment. It would not be realistic to consider that all equipment, merely because it is on hand, is in regular use or would be used in the event of a wider film. Certain equipment, for one reason or another, has not found application in the exploitation operation and is seldom, if ever, used. Such equipment, naturally, should not be considered in determining the impact of a wider film.

Another factor affecting use rate is the quantity and capacity of the equipment with respect to input rates. When it comes to estimating costs of modification or replacement it is necessary to know how many items are actually required to handle the load. This presents a certain amount of difficulty. The exact usage factor of present equipment isn't readily available and the quantity of future inputs is uncertain. Rather than embark upon a detailed study of this aspect of the problem it was felt adequate to assume that all items of any type of equipment now in regular use would also be similarly needed in the future. Otherwise, the comparison of alternatives becomes unduly complicated by having to consider costs of conversion as a function of various quantities of equipment. This way, comparisons are made on a uniform basis of the present quantity even though exact future quantities are not known.

On the basis of the above considerations the equipment which might require alteration or replacement to maintain exploitation operations in the event of a wider film was selected from among all those of Table I. The items indicated by an asterisk represent the most essential instruments in supporting the exploitation operation. Other items are either not used sufficiently often to warrant further consideration or their future use is sufficiently speculative to make it rather doubtful. By taking this approach the costs of modification and replacement, dealt with later, tend to be conservative.

2.2 Exploitation Functions

In the course of this study it has been assumed that the functions, tasks, methods, and equipment in the exploitation system will remain essentially the same as at the present time. In other words, it is not expected that the introduction of a wider film will change the basic responsibilities within the exploitation system. As indicated in Table I, the equipment which would be affected by wider film falls into three major functional areas: reproduction and processing, interpretation, and measurement. A brief review of these functions is necessary to establish the basis for selection of equipment in Table I.

2.2.1 Reproduction and Processing

It is not anticipated that a wider film would alter the responsibilities and tasks with respect to reproduction and processing. It is expected that a sufficient number of positive transparencies would be provided by the processing site as promptly as possible after each mission. The original negative would usually follow somewhat later when the requirements of the remainder of the community were satisfied.

Thus, the major burden of processing and printing is expected to remain with the processing site. The in-house requirement for reproduction and processing is not really for a production function, but rather for a job shop operation. The major effort is in response to requests for paper prints from partial rolls and single frames and for Vu Graph materials. If, as it appears, the original negative is not essential to the building reproduction and processing tasks, the impact of a wider film on this function is considerably less than were the original negative required.

2.2.2 Interpretation

In the event of an acquisition system using a film wider than 9-1/2 inches it is assumed that viewing and interpretation tasks will remain essentially the same as those currently employed. The objectives of the missions are likely to remain the same even though the equipment and capabilities may be improved. One subtle difference may occur. The current condition of exploitation might be described as steady-state. The same areas of the world have been under surveillance for some time. The targets remain pretty much the same and changes are generally evolutionary. Such a condition could, and probably will, change rather quickly with a shift in locality of cold war emphasis. Such a change would again focus greater attention on location, detection, and identification of significant new targets rather than changes in old familiar ones. Nevertheless, interpreter requirements as well as methods and procedures are expected to remain essentially unchanged.

The basic photo interpretation tasks considered in determining the impact of a wider film are still considered to be:

1. Immediate Reports,
2. Mission Coverage, and
3. Detailed Reports.

These tasks and the methods in use largely determine the equipment and its importance. No matter how costly or seemingly sophisticated an equipment might appear its essentiality is really determined by the extent to which it is employed in current operations. Thus, many of the items listed in Table I should have little influence on decisions for the future. In the absence of any other measure of utility, there is little choice but to resort to current usage as the best indicator.

A wider film appears to have no intrinsic characteristics which would significantly affect interpretation methods. Examination of the film on light tables, with and without magnification aids, and on projection viewers is expected to continue with the bulk of the work still performed in the former manner. The major considerations, then, from the interpretation standpoint are light tables and projection viewers, and the impact of a wider film on these items.

2.2.2 Measurement and Evaluation

The principal measurement tasks are expected to remain largely as at present. Any new acquisition system using a wider film, it is assumed, would not introduce any new or basically more difficult problems than now exist. It is also assumed that measurements will be initiated mainly as a result of MC and detailed interpretation requirements utilizing the same positive transparencies used for interpretation or similar ones from another roll.

This raises the question of whether or not a roll film capability is really essential to the measurement function. Even though there are a number of equipment items which do accept roll film, only the "Dual Screen Measuring Projector" and the yet to be delivered "Stereo Point Transfer Device" require rolls for manipulation. Unless many measurements per roll are contemplated a roll film capability is open to some question. Since this matter is beyond the scope of the present study, it had to be assumed that whatever exists is, in fact, required and must be reflected in considering a wider film.

With regard to evaluation, the situation is somewhat different. The original negative, and hence a roll of film, is required in making densitometric traces. The question here is the extent to which such readings are currently justified. Whereas, some such evaluation is desirable for quality control purposes, there are practical limitations. The utility of edge traces in image quality evaluation has been cast in considerable doubt by recent work sponsored by your organization*. In view of this, the essentiality

25X1A

* [redacted] "Report on the Image Quality Evaluation Program" July 1965.

25X1A of the [redacted] 1032T Microdensitometer is open to serious doubt. It has not, therefore, been included among the items considered essential to wide film considerations. The 20 [redacted] densitometers 25X1A were given the benefit of the doubt.

2.3 Discussion of Alternatives

Basically there are but two approaches to accommodating a wider film within the center: convert the equipment to fit the film or convert the film to fit the equipment. Within each of these alternatives are several other options to be considered. Table II lists each alternative which was selected for evaluation and indicates the possible application to various film widths between 9-1/2 inches and 24 inches. An X denotes that the alternative offers the possibility for that particular width. It does not mean that it is necessarily a desirable approach. A question mark indicates there is considerable doubt about the practicality of that alternative for that width. A blank indicates the alternative to be, intuitively, impractical.

2.3.1 Equipment Conversion

Two possibilities are evident in considering the conversion of equipment to accommodate a wider film, the equipment may be modified or it may be replaced entirely by a new piece.

The notion of modifying current equipment (alternative 1a Table II) to accept a wider film is straight forward. This alternative considers physical alterations of the film holders, transport

TABLE II

ALTERNATIVES FOR ACCOMMODATING WIDE FILM

METHOD	10"	11"	12"	13"	14"	15"	16"	17"	18"	19"	20"	21"	22"	23"	24"
1-Convert equipment to fit film															
1a-Modify present	X	X	X												
1b-Develop new		X	X	X	X	X									
2-Convert film to fit equipment															
2a-Split film															
2a1-9-1/2" widths ()=#rolls										X(2)					
2a2-8"							X(2)								X(3)
2a3-6.6"				X(2)						X(3)					
2a4-5"	X(2)					X(3)					X(4)				
2a5-70mm widths (2.76")		X(4)			X(5)			X(6)			X(7)		X(8)		
2a6-Other			X(2)						X(2)			X(3)		X(3)	
2b-Contact prints															
2b1-Normal direction(with overlap)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2b2-Right angle to original	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2c-Reduce image size	X	X	X<to 9-1/2">								X	X<to 19"& split>			
2d-Chip system	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

mechanisms, platens, stages, and similar aspects which would permit handling a wider film in the same manner as widths up to 9-1/2 inches are now handled. In other words, modification is considered to include alterations to existing equipment short of a redesign.

Rather than modifying the present equipment, it is also possible to consider replacing it entirely in whole or in part, with equipment which would accommodate a wider film. (Alternative 1b Table II) Were equipment to be built specifically to accommodate wider film formats, it is quite likely that entirely new design concepts would be in order in many cases. It is unlikely that the new equipment would resemble the present except in a very general way. Much of the present equipment provides little or no margin for improvement in input quality and has other shortcomings limiting its usefulness. It therefore, seems rather logical that the necessity to provide for the capability to handle a wider film would also be an opportunity to obtain improved performance in other ways. Replacement would, then, probably be the signal for wholesale changes in equipment design.

2.3.2 Film Conversion

A number of possibilities exist for converting a wider film to a size which can be accommodated by present equipment. This set of alternatives (2a, 2b, 2c and 2d of Table II) considers the various ways in which film widths might be altered to come within the 9-1/2 inch limit of much of the equipment currently in use.

The most obvious method of converting a wider film into widths which can be readily accommodated would be to split the film into one or more equal widths. Table II indicates the almost infinite variations possible by this alternative. The number of rolls which would be produced in five of the more or less standard widths from various original widths is shown. Quite obviously, any given width can be cut to produce two or more rolls of an acceptable size.

Another possible method of producing compatible widths from a film wider than 9-1/2 inches would be to produce contact prints from only a portion of the original width (2b1). As with splitting above, two or more rolls of 9-1/2 inch or less in width could be produced from an original of any given width. Although this method produces a result similar to alternative 2a, Table II merely indicates that it does in fact apply, in some fashion, to any film width. It is obvious that this method, as the one above, is likely to lead to the introduction of one or more film widths different from those which are now common.

A somewhat novel alternative is indicated as 2b2. In this method contact prints would be produced at 90° to the normal direction of the original material. In concept this is the same as the idea of the "Turn-Around Printer", except for being vastly simpler. Neither magnification nor re-sequencing of scenes is contemplated. A step and repeat type printer, of course, would be required. This alternative provides the opportunity to preselect the most desirable film width for use in the exploitation process and convert any or all original materials to this width. It does, of course, alter the normal relation of flight path and long dimension of the roll and the sequence of frames.

A still different alternative is to resort to optical reduction of the image to produce a width which could be accommodated on present equipment. (Alternative 2c)

The final film conversion alternative, 2d, concerns the possibility of a chip system. In this approach, positive transparencies in the form of chips rather than a roll would be printed from the original negative. This method, however, is not directly comparable to the other forms of film conversion. The objective of the others would be to produce prints in a form compatible with present equipment. The objective of a chip system would be to improve the efficiency of the exploitation system.

Departing from a strictly wide film viewpoint, the use of chips could also be achieved in a hybrid system of exploitation. For example, roll film might be used in the immediate report and mission coverage situations and chips used in detailed analysis. Such a system would, of course, require printers and processors for both types of transparencies. Before embarking on the development of the equipment and facilities for a chip system of any type, a thorough development of the concept of operation is essential.

Intuitively, there would be certain advantages inherent in a chip system, total or hybrid. To the extent that chips are adopted, a uniform format would prevail. In addition to economies in equipment which could result, chips offer opportunities for automated handling, storage, and retrieval. The problem of storage is likely to become more acute with time. Chips afford the possibility of reducing bulk by discarding most of the film which does not contain useful information.

2.4 Evaluation Criteria

To select one or more alternatives as being superior to the others assumes a uniform basis for comparison. The statement of the problem on which the study was based suggests two criteria for evaluation, cost and time. Both of these factors are appealing because they provide a quantitative basis for comparison. In practice, however, there are some shortcomings. Neither cost nor time is subject to estimation with the precision desired within the time frame of the study. More importantly, though, cost and time to modify or develop new equipment accommodating a wider film are not the only considerations which are necessary to evaluation of alternatives.

In the course of the study it became evident that certain alternatives would not be acceptable no matter how appealing they might be from a cost and time standpoint. Quality and information content for example, cannot be compromised. The possible impact on manpower requirements also must be considered either as part of the cost or as a separate item. Equally important in the long range view is the flexibility or permanence the alternative provides. Is it a temporary solution or will it serve for an extended period of time?

Unfortunately these latter criteria are not readily subject to expression in numbers. Manpower, per se, is certainly a matter of numbers. The problem in this regard is estimating the effect on manpower which a particular alternative might have. Would its introduction result in more or fewer personnel?

The only measures which currently exist relate manpower to film quantity. Since none of the alternatives considered in themselves alter the input quantity, it might be too readily concluded that there are no differences among alternatives. Manpower requirements, however, depend on factors other than quantity. The information content and the rate of information extraction must be considered. Assuming that any significant reduction of information content is intolerable, only extraction rate remains to be considered. This is a factor which can't be ignored. The rate is almost certainly affected by the varying degrees of difficulty in film manipulation. For example, heavier rolls might require more time simply by virtue of increased time and effort in the physical aspects of film handling. On the other hand, a chip system might be almost completely automated and, thereby, greatly reduce handling.

The kind of a detailed analysis which would be required to develop reliable manpower information is somewhat beyond the scope of the present study. Manpower as a criterion for evaluating alternatives, therefore, is only considered qualitatively in light of the possible influence of the manipulation factor.

Another important consideration in evaluating alternatives is the possible influence on image quality and information content. It is desirable that any method for accommodating a wider film lose as little as possible of the information contained in the original negative. This factor also cannot be assessed quantitatively without considerably more effort than was warranted by the level of the present study. However, it is possible to determine intuitively whether a particular alternative is inherently better than, equal to, or worse than the present situation. It is on this rather gross basis that quality is used as a measure for evaluating alternatives.

The final factor considered in evaluating alternatives is that of the flexibility or permanence of the solution. Certain methods of accommodating wider film are more limited than others. Since it is assumed that relatively little control over the acquisition process may be exerted, the prospect for more than one wider film is always present. A short term solution, even though desirable from other standpoints, may be negated by a subsequent requirement which imposes new demands for even wider film capability.

In summary, the alternative methods for accommodating a wider film were evaluated on the basis of five criteria: cost, time, manpower, information loss, and flexibility. Costs are best estimates obtained in most cases directly from the manufacturers of equipment affected. Time, similarly derived, is the number of months necessary to accomplish the particular alternative. Manpower and information loss are intuitive estimates of whether the method is better or worse than that resulting from present practices. Flexibility is an indication of whether the alternative is a "one-shot" solution for a single width, a limited range, or solves the problem once and for all. Table III summarizes the evaluation criteria.

TABLE III

CRITERIA FOR EVALUATING ALTERNATIVES

	Criterion	Terms
1.	Cost	dollars
2.	Time	months
3.	Manpower	- more personnel than now 0 same + fewer
4.	Information loss	0 same as present - lower than present
5.	Flexibility	- one time solution + permanent solution

3.0 EVALUATION OF ALTERNATIVES

Once the framework for the study was established, as described in the previous sections, the principal remaining task was to compile information concerning the cost, time, and feasibility of various alternatives. A major aspect of this phase was direct inquiry to a number of companies whose equipment would be most affected by a wider film format. From the list of Table I those equipment items which are either in use currently or are likely to be in the event of a wider film were selected for further investigation. The companies which produced these items were then contacted to obtain answers to the following questions:

a. What is the cost and time to modify or replace equipment as a function of film widths from 9-1/2 inches to 24 inches?

b. What are the practical limitations on film width capacity for modifying? Replacing?

c. What are the added costs to produce an item to handle a range of widths rather than a single width?

Those companies capable of producing a printer of the type required by alternative 2b2 were asked the additional questions:

d. Is it feasible to develop a right angle printer?

e. What is the time and cost?

The possible costs of a chip system were not investigated in depth since any meaningful attempt would have to be preceeded by a rigorous analysis of the problem and development of a detailed design concept. The results of the survey of manufacturers is contained in Appendix A.

Concurrently with the survey of equipment manufacturers a review of operating procedures in the areas which would be affected by a wider film were made. Published reports and discussions with center personnel were the major sources of such information. From the information gathered it was possible to evaluate each alternative on the basis of the criteria of Section 2.4. The results summarized in Table IV are discussed in detail in the paragraphs which follow.

TABLE IV

COMPARISON OF ALTERNAITVE METHODS

	25X1A	COST	YEARS	MANPOWER	QUALITY	FLEXIBILITY
1a		[redacted]	ible	-	0	-
1b		[redacted]	1-5	-	0	-
2a		[redacted]	4-5	0	-	-
2b1		[redacted]	4-5	0	0	-
2b2		[redacted]	1-2	0	0	+
2c		[redacted]	ible	0	-	-
2d	Complete Hybrid	[redacted]	1-2	+	0	+

3.1 Convert Equipment to Fit Film

There are several basic disadvantages to converting the equipment to accept a wider film. In general, this approach is limited in range and, therefore, could never seriously be considered for use with 24 inch wide film. There are practical limitations on increasing the film width capabilities of much of the interpretation and measuring equipment. Problems of illumination, magnification, film drive, and strength of materials make it impractical to consider handling films beyond about 12 to 15 inches wide.

In addition, the relation of cost to film width is not a linear function. For the same reasons there are practical limits, the cost per inch increases with width. For example, the 940 MC
25X1A light table which costs about [redacted] per inch of width at 9 inches is estimated to cost about [redacted] per inch at 18 inches. The 25X1A additional cost in this case is largely a matter of the strength of materials. Increasing the size requires a disproportionate increase in the structural members and, hence, in cost.

A wider film also poses a question of the roll size or length of the film. A 1000 foot roll 24 inches wide would weigh over 100 pounds. Obviously either the rolls would have to be smaller or additional manpower and machinery used to aid in handling such rolls. Provided these precautions are observed converting equipment to accommodate a wider film could be accomplished but at a certain price in dollars and efficiency.

Equipment conversion is either lacking in flexibility or efficiency. If equipment were modified or replaced to accept some specific width, say 12 inches, the problem would be created anew were a 15 inch film to be introduced subsequently. If all equipment were designed to handle the maximum width possible, a costly capability would have been achieved which might never be needed. Finally, since a 24 inch wide capability is impractical from a technical as well as cost standpoint, this method can never offer any assurance of preparedness for possible future input demands.

Of the two possibilities for converting equipment, modifying present equipment (1a) is the more limited. It simply is not practical to consider modifications, except very minor ones, to the viewing and interpretation equipment. Much the same limitation extends to measuring equipment as well, though the latter problem might be circumvented to some extent by cutting frames or chips from a wider film. This, of course, would be departing from the objectives of the basic alternative and entering the realm of the chip system which is discussed later.

Several schemes for modifying light tables are fairly obvious. For example, reel brackets could be mounted on the sides rather than the ends, as at present, which would provide for film at least up to 18 inches in the case of 918's and 40 inches in the case of 940's. Altering the MC model, however, would offer a bit of a challenge.

As an alternative, reel brackets accommodating a film wider than the tables is possible. The film could overhang a few inches. A rackover device could make it possible to shift the film sufficiently to illuminate all of the image area by sliding the film back and forth. Once again the microscope mount would offer a more severe problem and the danger of film damage is increased by the overhang.

At the very best these modification schemes offer only temporary makeshift solutions.

Neither is it practical to modify the present rear projection viewers. The performance level of the [redacted] equipment discourages any serious thought of alteration to accept wider film. Any investment in viewers would be better made on equipment which provided at least a higher level of quality and illumination. 25X1A

Measuring equipment could accommodate up to 18 inch wide film, although there is some question about the advisability of accommodating rolls so long as a frame or portion of it can be cut out. The added weight, and particularly the imbalance, resulting from roll film adversely affects the accuracy of instruments of the [redacted] type. 25X1A

The situation with reproduction equipment is even worse. Modification of processing, printing, and enlarging equipment is simply not feasible. The changes required to accept a wider film require redesign of the equipment. As an example, the stage transport is the critical problem in an enlarger. The cantilever construction common to most enlargers would probably have to give way to another method.

Developing new equipment to accommodate wider films suffers from many of the same disadvantages as modification. Even though it may be possible to design equipment to handle 24 inch wide film the larger film introduces problems of viewing which alter the basic methods in use today. Such problems can only be treated superficially in this study.

Examination of roll film with a light table and microscope becomes more awkward as the film increases in width. Left to his devices it seems apparent that the PI would alter his technique if it becomes too difficult to lean over a wide film, or too troublesome to reverse sides to cover the entire image with the microscope. A rather obvious alternative would be to turn to a single frame or chip for everything except a quick scan. This takes the problem into an entirely different realm again, a matter discussed in greater detail in considering a chip system.

Light tables, of course, need not be confined to a horizontal position. It is entirely possible to develop one which would operate normally in a vertical position. The efficiency with which a microscope could be used on such a device is another matter. A fairly elaborate instrument would be required to provide the adjustment needed to avoid awkward positions for the PI.

Obvious problems are also encountered in accommodating wider films in rear projection devices. Either the equipment and optical system become larger or a lesser portion of the film is viewed at one time. Perhaps, if the scale were increased with increases in width, less magnification would be necessary. This is not, however, an assumption which can be made with any assurance.

In summary, the development of new equipment to accept wider film does not offer the prospect of substantial rewards. In fact it raises the question as to whether the point of diminishing returns has not already been reached, or passed. Even to the extent that it is technically feasible to consider developing equipment capable of handling film up to 15 inches or so wide, both the cost and inconvenience would be great. It is doubtful whether the estimated development costs would be justified in view of the existence of other alternatives which are less costly, have no adverse effects on manpower requirements, and offer more permanence.

3.2 Converting Film to Fit Present Equipment

The idea of converting a wider film to a width compatible with present equipment is generally more appealing than converting equipment. As indicated in Table IV the costs of each of the several such alternatives is less than either modifying or replacing the exploitation equipment. This is a matter of simple arithmetic. In the latter instance many more items of equipment must be altered or replaced.

The time factor would be about the same in either case assuming simultaneous development of all items required. The scope of the effort which would, in all likelihood, be created by the advent of a wider film would be something of a major national undertaking. Were this to be the case, a priority effort diverting manpower from other activities could reduce the development time.

Converting film to fit present equipment would not, in general, affect manpower requirements as compared to present operations. The chip system is a possible exception. It is conceivable that automated film handling, storage, and retrieval might reduce the manpower necessary for current production levels. Whether such reduction is significant in the overall depends on how much time is currently consumed by these tasks and the reduction achievable by alternative methods.

Most importantly, film conversion offers two approaches which have distinct advantages of flexibility and permanence. Adoption of either a right angle printer or a chip system provides a solution to the film width problem once and for all. Furthermore, they both provide the advantages of a single uniform film size for center operations.

Film conversion, of course, does not avoid completely the need for equipment changes. It does greatly reduce it, however, Since the conversion would take place at or after the printing stage, a new negative processor and printer are required at the very minimum. To the extent that the original negative is required at the exploitation center for evaluation and second generation copies of any kind, equipment changes there are also required. Nevertheless, the total costs of accommodating a wider format by converting the film are substantially less than converting the equipment.

Alternative 2a is an approach both appealing in its simplicity and its relative economy. Prints from any given width of original negative would be slit into two or more rolls of a width compatible with present equipment. This, of course, still requires that a negative processor and printer-processor capable of the wider original be made available, presumably at the processing site. To take full advantage of this alternative the negative processor and printer-processor should be capable of inputs up to the maximum width which could reasonably be expected. Equipment of lesser capability might solve an immediate problem but would be obsolete were an even wider film to be introduced.

The major disadvantage of this otherwise appealing approach is the very real concern that slitting is likely to divide target areas and even obscure some information. This possibility alone would seem to rule out this alternative on practical grounds. Another disadvantage stems from introducing still additional film widths to a situation which could benefit from greater uniformity. It would be quite a coincidence if a new acquisition system with wider film resulted in a split which would be the same width as one of the present sizes. The possibility of more than one merely adds complexity.

A variation on splitting film in compatible widths is a contact printer which produces compatible widths, alternative 2b1. This of course, still requires a negative processor to handle the original material. And, it requires development of a special printer which would reproduce some portion of the width of the original negative. There are several options available in contemplating such a printer. It might be designed for fixed or variable widths (within some limits) and it may or may not produce some overlap in the prints.

For any one particular negative size, a printer producing a fixed narrower width would be a fairly straight forward development. Some overlap in the prints would be desirable to decrease the chances of bisecting targets. The utility of such a printer would be pretty much limited to the particular width negative for which it was designed. If it were designed to accept a range of negative widths, it would produce prints with greater or lesser overlap depending on the input. Negative widths other than the one for which it was designed would, thus, result in prints which were something less than ideal from an efficiency standpoint. And, except for the fortuitous circumstance of a wider film close to an even multiple of one of the present widths, a printer of this type would produce another non-standard width output. While this printer would be one of the simplest possible designs for handling wide film it lacks flexibility and contributes to the proliferation of film widths to be handled.

A variation of this basic idea which offers somewhat greater flexibility would be an adjustable width printer. Such a device would make it possible to limit overlap to the amount desired for a range of original negative widths. The development of this printer would, of course, be considerably more difficult than a fixed width model. It, too, would very likely result in a print width different from any now common. It is doubtful that the limited advantages of this approach would justify the effort required to develop such a device.

Alternative 2b2, a right angle or "turn-around" printer affords all of the advantages of the adjustable printer above, plus that of uniformity of output. Like 2b1 above, the printer would accept a range of negative widths up to 24 inches. However, instead of producing a print from a portion of the width of the negative, it would print a strip across the width. The strip would be of a uniform width irrespective of the width of the original negative although, of course, the length of the frame would vary with the negative width.

This device may be looked upon unfavorably because of a previously unsuccessful development of a "Turn-Around Printer". The two ideas are not the same. The previous device was to enlarge the image approximately 2-1/2 times and rearrange the sequence of frames on up to 15 different rolls of film! The equipment contemplated for a wider film is a relatively simple contact printer which would reproduce each crosswise slice in regular sequence.

The advantages of this approach are, on the whole, considerable. No other alternative provides the flexibility and permanence of this solution with so little disruptive affect on operations. For the short term any wider film may be accommodated on present exploitation equipment. For the longer term, new equipment development could proceed based on a single uniform film width.

The present generation of exploitation equipment already has a considerable flexibility built in. Much of it is capable of accepting film from 70mm to 9-1/2 inches wide. This has been achieved at a price in dollars and efficiency. There is no question that a piece of equipment designed to accept only 70mm film is less costly than one built for 9-1/2 inch film and they are both less expensive than one accommodating the range from 70mm to 9-1/2 inches. For example, rear projection viewers accepting 9-1/2 inch film are some 4 to 5 times more costly than similar equipment accepting only 70mm film. The situation is similar with other equipment. One wonders whether the extra cost of equipment to accept wider film is money well spent.

It is assumed that most of the present generation of exploitation equipment, particularly that pertaining to interpretation and measurement, is nearing the end of its useful life. This is not necessarily a result of wearout but of technological obsolescence. The next generation is in, or soon to be in, the development stage. The opportunity is present in the concept of a uniform film size to develop more efficient and less costly equipment for those future generations five and ten years hence.

It is not meant to imply that this alternative is without its shortcomings. The order or sequence of the frames produced by a right angle printer is going to be different from that of the original. Whether or not this will impose any serious problems depends largely on the sequence of frames on the original. Judging from at least one current acquisition system which produces an unorthodox sequence, the problem is trivial. The PI's appear to adjust quite readily.

Possibly more of a problem, but no worse than with a chip system, is the affect on measurement. A right angle printer would very likely not include a fiducial mark on each printed frame unless the acquisition system made provision for it. If this were not possible some means of accurate position location would have to be provided as is being done in the chip printer currently being developed by [redacted] 25X1A

A right angle printer would also have to be of the step and repeat type. Whereas this approach holds promise of high quality results, it lacks the speed of a continuous printer. Obtaining the rate of throughput required to expeditiously print the original negative may be difficult to attain. Separating rolls into shorter lengths and increasing the number of printers is, of course, a possibility for achieving the necessary processing rate.

Possibly the least desirable alternative, and one that is only mentioned in passing, considers optical reduction of the original negative, alternative 2c. Positive transparencies could be produced by an optical printer of some flexibility. The limitation, of course, would be the point at which information loss due to the reduction becomes significant. In view of the other simpler and more promising alternatives this one was not given serious consideration.

The chip system, alternative 2d, offers all of the advantages of the right angle printer plus the possibility of the benefits of automation. The latter is only possible, though, by a redesign of much of the present system and development of the concepts of operation to take full advantage of it. As was indicated in the earlier discussion of this alternative two different options are available, either a partial or complete chip system. The equipment requirements would be different depending on which approach was chosen.

This alternative represents the most radical departure from present operations. And, it is not an alternative so completely confined to converting film to fit present equipment. Much new equipment would have to be developed to accommodate chips, the exact amount depending on the extent to which chips would replace rolls in center operations. Thus, the concept of chips requires a greater preparational effort than most other alternatives, not merely from an equipment but also from a methods and procedures standpoint. The benefits of automated film handling, manipulation, storage, and retrieval are not likely to be fully achieved without a thorough analysis of system requirements. Embarking on a chip approach piecemeal will only provide an efficient system by accident rather than by design.

4.0 CONCLUSIONS AND RECOMMENDATIONS

To review the situation, some form of film conversion emerges as superior to the idea of converting equipment to accept a wider film. There is already some question as to whether the point of diminishing returns has not already been reached, or passed, at the 9-1/2 inch width. To resolve the issue among the several possibilities for film conversion it is necessary to refer to an earlier assumption that alteration of the original negative is unacceptable. This means that the negative is processed in its original form and conversion takes place at or after the printing stage. All of the film conversion alternatives, therefore, require the development of a new negative processor and printer. The cost differences among these alternatives is not sufficiently great and the estimation error too large to base a decision on this factor alone. The choice of approach to what to do about a wider film must depend on other considerations.

It must be assumed that any move to a wider film format will be accompanied by sufficient advance notice to allow the center a certain amount of preparation time. The processing site would also have to prepare for any wider film. The development time for equipment to accommodate film widths up to 24 inches has been estimated to be 4 to 5 years. A high priority program could possibly cut this in half. The point is, however, that a reasonable time would probably be available to develop the necessary equipment to satisfy exploitation requirements, <u>provided objectives and requirements were prepared in advance</u>. It is the objective here to define the steps which should be taken in this direction.

Approved For Release 2001/08/13 : CIA-RDP78B04747A002100050006-8

If it can be assumed that only one wide format film is likely to occur in the next five to ten years and that a variety of film widths results in no loss of exploitation system effectiveness, alternative 2b1, the development of a continuous partial width printer offers the simplest solution. Both of these assumptions, however, are open to question. Nevertheless, if the introduction of a wider film were to become imminent this approach would provide a satisfactory solution at a cost at least no greater than any other solution. There are questions to be resolved before such a project could be instigated. Should the printer accept the specific width then expected to materialize or should it accept any width up to 24 inches in expectation of further changes? Should the printing width be fixed or variable? What should the limits of variation be? How much overlap in printing should be provided? In short, a more thorough hardware-oriented analysis is necessary to establish requirements and feasibility.

Under the assumption that more than one wider film is possible over the years and that there is a loss of effectiveness created by a variety of film widths, it is necessary to look to other alternatives for the longer term. The right angle printer and the chip printer both hold forth the prospect of a permanent solution to the uncertainties of film width and the benefits accruing from uniformity. Each is worthy of further serious consideration, however, for differing reasons.

A right angle printer has the obvious advantage of providing material completely compatible with present exploitation equipment. Since the prints produced are in the familiar roll form no changes in method, procedure, or equipment need be made. The sequence of frames on the roll, on the other hand, is not so familiar. Herein lies an avenue for further investigation. Furthermore, it is necessary to determine, if such a development were to proceed, the extent of the loss of effectiveness due to providing for several film sizes. It is also necessary to investigate whether there is an optimum film size and, if so, what it is. Similarly, the feasibility of successfully developing an instrument capable of the necessary speed must be investigated.

The alternative of resorting to chips presents the most problems of all, not because of the printer but because of system considerations. Full and effective use of a chip system requires large scale replacement of present equipment. A partial chip system does not completely resolve the wide film issue. Thus, operational requirements must be investigated more rigorously and trade off considerations examined in devising the most effective chip system within the constraints. For instance, it is necessary to know which tasks now consume significant amounts of time with respect to total system processing time in order that intelligent use of machines and automation may be made. The size of the chip itself is a decision not to be made casually. The distribution of target sizes, scale of photography, and equipment design considerations are among the items to be taken into account.

In view of the information developed within the scope of this study and the questions which remain to be resolved, the following recommendations for further action are offered:

1. make a comprehensive analysis of the exploitation system to identify and evaluate the critical problem areas so that development action may be devoted to those most significant to overall performance,
2. make a study to establish design objectives for a partial width printer and right angle printer,
3. make a study of the feasibility of developing one or both of the above printers,
4. make a conceptual design study of the application of chips in the entire exploitation process.

APPENDIX A

ESTIMATED COSTS OF ALTERNATIVE EQUIPMENT CONSIDERATIONS

Estimation of costs for the various alternatives cannot be made with any great precision. First, the figures are no better than the educated guesses which the manufacturers could provide. There are a great number of uncertainties regarding the details of design which make the process hazardous. Consequently, there should be no thought of holding the sources of these numbers to them, should future development actions evolve. Estimates which the suppliers would be obligated to stand behind are only possible on the basis of more specific design requirements.

A second factor in a cost comparison of alternatives is the absence of a direct relationship between the items of equipment in use now and those which would be necessary were a wider film to come into being. In several instances there are a variety of equipment models performing a similar function, though possibly for different reasons and to different standards. For instance, there are a number of different printers and enlargers in use. It simply was impractical to consider each type in replacement of of each one with a wide film version. Rather, equipment was grouped, insofar as possible, into general types for estimating purposes.

Thirdly, there are many assumptions which might be made regarding which specific items of equipment and how many would have to be replaced in the event that a wider film would have to be accommodated by the center. This matter was discussed at some length in the main body of the report. The costs of Alternative 1 for various film widths is particularly sensitive to this factor since this is the only instance in which a large number of items enters into the evaluation. In preparing the tables which follow, it was assumed that all, or most all, items of each type of equipment affected would be replaced. The total costs involved would be scaled up or down in keeping with any desired change in quantity.

Table A1 presents a summary of the cost information obtained from equipment manufacturers. The costs indicated are those for a single item. In the cases where more than one item is contemplated, the estimated cost reflects both development and production considerations.

25X1A

Based on the information of Table A1 and the above assumptions, the costs of the various alternatives were determined as discussed in the following paragraphs.

Alternative 1a. Modify Equipment. Although some companies discussed the feasibility of modifying their equipment, most claimed it could not be done. None was willing to even guess at the costs or consequences. Therefore, it was not possible to compile any cost figures related to this alternative. The guess might be ventured, however, that even for the small range of widths (up to about 12") that modification could be considered for any equipment, the costs would not be much less than those of replacement.

Alternative 1b. Replace Equipment. The costs of this alternative are based on the assumption that one printer must be provided the processing site and that the quantities of each type of item required at the center are as indicated. Costs may be adjusted to suit other assumptions regarding the quantities needed. The table reflects the assumption that nearly all equipment currently in frequent use is replaced or duplicated. Table A2 indicates the cost of exploitation equipment necessary to accommodate several specific film sizes. The cost of other sizes can be obtained by interpolation.

The site printer assumed in Table A2 would be a continuous contact printer capable of about 100 feet per minute. The 3 film and print processors assumes the Eastman Kodak PAR 215 can be readily adapted for roll film and would replace the [redacted] for any wider film. The processing chemistry would also have to be developed. The correcting printer is a [redacted] machine, it being assumed that the enhancement feature is still desirable. No evaluation equipment has been considered essential. There are a number of [redacted] densitometers of sufficient flexibility to handle the situation. Only the [redacted] type comparators are considered in replacing measuring equipment.

25X1A 25X1A 25X1A 25X1A

Alternative 2a. Slit Film in Widths Compatible with Equipment. The film would be printed and processed in the same width as the original negative, then slit in widths compatible with present exploitation equipment (9-1/2 inches or less). This requires the same printer-processor at the site as Alternative 1b, which represents, for all practical purposes, the total cost of this alternative. The cost to slit would be trivial compared to the development costs of the printer-processor. No equipment changes would be required at the center, except of course, if a second printer-processor were essential for additional prints, a condition which does not currently obtain. It is assumed that all center responsibilities may be fulfilled utilizing the second generation positive transparencies.

Alternative 2b1. Contact Prints Less Than Full Width of the Negative. This alternative requires development of an unusual printer which presents some problems. It is very likely more difficult than printing the entire width of the negative. For this reason the cost of the printer is somewhat higher than the continuous printer indicated in Table A2. It was assumed essential to maintain current quality standards and printing rates. Since the prints produced would be compatible with all other equipment, development of the printer is the only cost of this alternative.

Alternative 2b2. Right Angle Printer. As with the previous alternative the cost, assuming the center does not need to work with the original negative, would be entirely concerned with development of the printer. A step and repeat type printer appears to be the only answer at this time. Whereas the cost of developing one such printer does not appear too great, about [redacted] the slow speed apparently inherent in such a device would require a number of them to produce the same volume of material as one continuous printer. The exact number depends on the relative speeds of the two printers, claimed by some to be a factor of 100! If this is the case the whole idea of a step and repeat printer is subject to question. It has been assumed here that a step and repeat printer capable of 1/10th the speed of a continuous printer is possible. Table A3 reflects the quantity in estimating the cost of this alternative. 25X1A

Alternative 2c. Reduction Printer. Because of the doubt concerning the practicality of this alternative no cost information was obtained.

Alternative 2d. Chip System. As discussed in the main body of the report, the use of chips could be either complete or partial. In the event of a wider film the cost of the two different concepts would not be the same. A complete system in which all PI tasks use chips would require development of new equipment for the immediate and mission coverage tasks. Detailed analysis could be performed with present equipment. A hybrid system in which roll film is used for everything but the detailed analysis would, for wider film, require a roll printer as well as chip printers. Thus, there are two cost estimates for this alternative, one for the complete system and one for the hybrid.

The speed of the chip printer was not considered as a factor, although it should be. A comparison with a roll printer requires a much more detailed study than was possible here. The quantity and distribution of targets on the film as well as the characteristics of the printer influence the rate of production. Finding the targets on the roll may well be more time consuming than making the chips.

Each of the above alternatives presents a problem in mensuration. In every case it is necessary to provide for position location marks on the prints. The exact methods may well vary depending on the characteristics of the printer. Except for the case of the chip printer, this factor has not been included in the cost estimates.

25X1A

Next 2 Page(s) In Document Exempt

STATINTL

Approved For Release 2001/08/13 : CIA-RDP78B04747A002100050006-8