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FIELD TRYOUT OF A PROCEDURE FOR EVALUATING THE PROFICIENCY OF AIR ROUTE TRAFFIC CONTROLLERS

by

John A. Nagay

Report of a project conducted by the American Institute for Research, Incorporated, Pittsburgh, Pennsylvania, under the auspices of the National Research Council Committee on Aviation Psychology, with funds provided by the Civil Aeronautics Administration, supplemented by a grant under Task Order IX, Contract No. N7onr-291, from funds made available by the Division of Aviation Medicine, Bureau of Medicine and Surgery, U. S. Navy, through the Office of Naval Research.

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NATIONAL RESEARCH COUNCIL

2101 Constitution Avenue, Washington, D. C.
Division of Anthropology and Psychology

Committee on Aviation Psychology

October 17, 1950

Dr. Dean R. Brimhall
Coordinator of Research
Civil Aeronautics Administration, W-2B
Department of Commerce
Washington 25, D. C.

Dear Dr. Brimhall:

The attached report entitled, Field Tryout of a Procedure for Evaluating the Proficiency of Air Route Traffic Controllers, by John A. Nagay, is submitted by the Committee on Aviation Psychology with a recommendation that it be included in the series of technical reports of the Division of Research, Civil Aeronautics Administration.

The study described in the report represents an extension of an earlier project in which an improved procedure for evaluating the proficiency of Air Route Traffic Controllers had been developed. The objectives of the present study were to determine the observer-observer and test-retest reliability of this form and to determine the extent to which it was acceptable to field personnel and practicable for use as a field instrument.

The study provides evidence that the new procedure has advantages over rating methods currently in use for evaluating the work of air traffic controllers. The findings lead to the recommendation that the form, known as Performance Record: Air Traffic Controller, be adopted by the Air Traffic Control Division, Civil Aeronautics Administration, on an extended trial basis, for obtaining periodic efficiency ratings on controllers. Such an extended try-out will not only provide an opportunity for determining empirically the reliability of the procedure under day-to-day operating conditions, but as a device for the training of seniors in the use of the Performance Record, and in further assessing the advantages of systematic observation and recording of performance at regular intervals.

The research presented in this report was supported by funds provided by the Civil Aeronautics Administration. The completion of the report was facilitated by a supplemental grant by the Division of Aviation Medicine, Bureau of Medicine and Surgery, U. S. Navy, made available under a contract between the Office of Naval Research and the National Academy of Sciences.

Sincerely yours,

Morris S. Viteles, Chairman
Committee on Aviation Psychology
National Research Council

MSV:maf

EDITORIAL FOREWORD

It is generally recognised that the air traffic control system is a major factor in determining the effectiveness of commercial aviation. The efficiency with which the current air traffic control system is operated is largely dependent upon the ability, skill and attitudes of air traffic control personnel. It seems likely that this will continue to be the case for some time to come, and it seems highly appropriate to center attention upon research designed to eliminate factors which may interfere with optimal day-to-day performance of such personnel.

As a result, at the request of the Civil Aeronautics Administration, research was undertaken, in 1948, under the auspices of the National Research Council Committee on Aviation Psychology, with the view of developing improved procedures for evaluating the proficiency of air traffic control personnel.[1] This resulted in the construction of a Performance Record: Air Traffic Controllers. The present report describes research directed towards the refinement of evaluation procedures and the determination of observer-observer and test-retest reliability. The study also provided an opportunity for assessing the advantages of this approach to the evaluation of the proficiency of air traffic controllers and of the acceptability and practicability of the form in the field situation.

The findings suggest that the new form has advantages over current CAA personnel rating procedures in that (1) ratings are based on actual records of observed behavior; (2) they are based on the most important aspects of the job; (3) the influence of personal bias is reduced, and (4) the reports can be used as an aid in the training and development of personnel. While obtained reliability coefficients are low, the suggestion is made that the use of the improved rating procedures over an extended number of watches will result in acceptably consistent ratings. However, a period of supervised use, emphasizing the training of seniors in the use of the Performance Record: Air Traffic Controllers and stressing the need for systematic observation and recording at regular intervals, is necessary as a basis for determining empirically the reliability of the procedures under day-to-day operating conditions. For this reason, the recommendation is made that the Performance Record: Air Traffic Controllers be adopted on an extended trial basis for obtaining periodic efficiency ratings on controllers, as a preliminary to final adoption as standard operating procedure.

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[1]Nagay, John A. The development of a procedure for evaluating the proficiency of air route traffic controllers. Washington, D. C.: CAA Division of Research Report No. 83, February 1949.

The investigation described in this report was conducted under the auspices of the Committee on Aviation Psychology by the American Institute for Research. It grew, in part, out of work done earlier under the direction of Dr. L. Dewey Anderson, Consultant to the Civil Aeronautics Administration, who also cooperated in this investigation. The project was carried out under the general direction of Dr. John C. Flanagan, and under the immediate supervision of Mr. John A. Nagay. Financial support by the Civil Aeronautics Administration was supplemented by a grant from funds made available by the Division of Aviation Medicine, Bureau of Medicine Surgery, U. S. Navy, through the Office of Naval Research.

October 17, 1950

Morris S. Viteles, Chairman
Committee on Aviation Psychology

CONTENTS

ACKNOWLEDGMENTS

The original planning of this research program in the field of air traffic control was done by Dr. John C. Flanagan in cooperation with Dr. L. Dewey Anderson and Dr. Dean R. Brimhall of the CAA and Dr. Morris S. Viteles, Chairman of the Committee on Aviation Psychology.

The entire project was conducted under the direction and guidance of Dr. John C. Flanagan, Director of Research of the American Institute for Research. Other staff members assisted at various stages, notably Dr. Elmer D. Jest, Dr. Ralph F. Wagner, Miss Geraldine Spaulding, Mrs. Sally B. Webster, Miss Virginia Edmonds and Mrs. Veronica Lange. Mr. Robert Fitzpatrick gave valuable assistance in the planning of the tryout and in the collection of data. The sections of the report dealing with the activity analysis of senior controllers were for the most part written by Mr. Fitzpatrick.

Dr. Morris S. Viteles, Chairman of the Committee on Aviation Psychology, and the members of that committee gave valuable advice and support throughout.

The continuous support of Dr. Dean R. Brimhall, Coordinator of Research of the CAA is gratefully acknowledged.

Dr. L. Dewey Anderson, Research Consultant, and Mr. Leslie L. Kullenberg, Chief of the Operations Inspections Staff of the CAA, gave invaluable assistance in preparing the way for the field tryout and assisting with the tryout design.

Finally, mention must be made of the splendid spirit of cooperation evidenced by all personnel at the various centers at which the tryouts, preliminary and formal, were carried out. Special acknowledgment is due the controllers, senior controllers, assistant chiefs and the following chief controllers who gave generously of their time and made the facilities of their centers available to the investigators.

Mr. C. A. Church, Cleveland ARTCC
Mr. Paul Goodert, Denver ARTCC
Mr. G. S. Porter, Pittsburgh ARTCC
Mr. M. J. Roy, New York ARTCC
Mr. H. M. Stiles, Chicago ARTCC
Mr. G. H. C. Tredick, Washington ARTCC

SUMMARY

The objectives of the study were to determine the observer-observer and test-retest reliability of a procedure for evaluating the proficiency of air route traffic controllers developed in an earlier project and to determine the extent to which it was practical for field use and acceptable to field personnel.

Several revisions in the procedure involving changes in format and wording were made, based on the findings of preliminary tryouts and discussions with air traffic control personnel. As used in the formal tryout, the form, titled Performance Record: Air Route Traffic Controller, consisted of a single sheet of 23 job elements, under which space was provided for seniors to record observed instances of outstanding and unsatisfactory controller behavior. A Manual was also prepared to accompany the form. Its purpose was to aid seniors in the correct classification of observed behaviors.

The main tryout was carried out at 3 centers: New York, Washington and Chicago. Forty-eight senior and acting senior controllers observed 42 controllers at these centers for two periods, averaging 12 watches for each controller per period. During the first period, 2 seniors, or in most cases, 2 groups of seniors, observed the same individuals. In the second tryout period these same individuals were observed by 2 different seniors, or by 2 more groups. The seniors in the second group were not the same ones who observed in the first -- for any given controller. In addition to the reliability data that the above design provided, Civil Service ratings, over-all performance ratings by the chief controllers of the centers, and the comments and suggestions of participants were collected.

The obtained reliability coefficients were relatively low, being .43 for observer-observer reliability with an N of 80; and .22 for test-retest reliability with an N of 156. However, on the assumption that the conventional statistical techniques are applicable in correcting these figures to cover a one-year period of observation with the Performance Record, it is estimated that the reliabilities over this longer period would be .94 for observer-observer reliability, and .85 for test-retest reliability.

Correlations between Performance Record scores and ratings based on the judgments of the Chief and Senior Controllers range from .24 to .37. Again, assuming that the conventional statistical techniques are applicable, these coefficients, corrected to cover a one-year period of observation are estimated, respectively, as .45 and .73. These are considered about as high as could be expected in view of the limitations of the ratings and the small sample of observations.

A limited activity analysis conducted on senior controllers at the New York center showed that seniors do not observe controllers systematically and suggests that the use of the Performance Record will serve to encourage systematic observation.

It was concluded that the Performance Record is a reliable and practical procedure, acceptable to the personnel whose job it will be to use it. It was recommended that the Air Traffic Control Division of the Civil Aeronautics Administration adopt the new procedure on an extended trial basis for determining periodic efficiency ratings on controllers.

I INTRODUCTION AND OBJECTIVES

In May of 1948, the American Institute for Research, at the request of the Coordinator of Research of the Civil Aeronautics Administration and the Chairman of the National Research Council Committee on Aviation Psychology, undertook a program of research in the field of air traffic control. Air traffic control in the United States is in a stage of transition; a fifteen year program has been initiated, the goal of which is all-weather flight and an almost complete mechanization of the control process. As new procedures, practices and equipment are introduced, the need for criterion measures against which to measure the effect of these innovations on the proficiency of control personnel becomes increasingly evident. It was with the aim of providing a suitable measure of controller proficiency that the developmental phase of the research program was carried out. This project, described in an earlier report[1], was completed in February 1949 and will be summarized briefly as follows:

A. SUMMARY OF THE DEVELOPMENT OF THE PROFICIENCY MEASURE

The developmental project was concerned with the study of only one specific job in air traffic control, that of air route traffic controller. These are the control personnel whose responsibility it is to maintain adequate separation between aircraft enroute from departure point to destination from the time they are beyond the radius of the airport or tower controllers' jurisdiction until they are again "cleared to the tower" for the purpose of landing. It was believed that an intensive survey of the requirements of one important activity would better serve the needs of the Civil Aeronautics Administration than a more general study of several.

Examination of Existing Measures of Proficiency

The first step in the project was to examine the existing measures of proficiency available in Civil Aeronautics Administration files. Civil Service efficiency ratings, training examination scores, performance ratings, certification and area rating examination scores, years of controller experience, hours of flying time, and File Thirteen data were all considered as potential criteria of proficiency or as the

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[1] Nagay, John A. The Development of a Procedure for Evaluating the Proficiency of Air Route Traffic Controllers. Washington, D. C.: Civil Aeronautics Administration Division of Research, Report No. 83, February, 1949.

components of composite criteria. The examination of Civil Service ratings revealed that they fail to discriminate adequately among employees and there were indications of the presence of halo effect in their use. In general, records were too incomplete or procedures were not used uniformly enough to provide sufficient data upon which to apply statistical tests that would reveal significant trends or produce conclusive findings.

Survey of Available Job Analysis Methods

In order to achieve the purposes of the project, it was next necessary to select a method for the analysis of the job under study. During the course of the survey of available methods, three general approaches to job analysis were considered. These were:

(1) Analyses of the worker on the job
(2) Analyses of the job requirements
(3) Analyses of the worker requirements

Since the principal objective of the research was to devise a procedure for evaluating the proficiency of air route traffic controllers, a technique was chosen that would provide data most readily adaptable to the construction of such measures. The method chosen was the critical requirements approach to job analysis which, it was felt, would satisfy the needs of the project because: (1) its end product is a statement of the abilities, characteristics and skills that are critical to success in the activity; and (2) these requirements are stated in behavioral terms.[2]

Activity Analysis

Before the critical requirements study was started, an activity analysis of the controller's job was undertaken as an exploratory first step to determine the usefulness of such a technique as an indicator of the relative importance of the various job components in terms of the time devoted to them. Observations were made of the activities of controllers during three watches at two centers. A total of 7397 such observations were made at 15-second intervals. Some interesting results were obtained that might have real significance for the job if the study were carried out on a larger sample of centers. Watch 2 (0800-1600) appeared to be the busiest period and, as is to be expected, controllers have less time for scanning the board and talking with their associates in IFR (Instrument Flight Rules) than in VFR (Visual Flight Rules) weather. The amount of time spent on the interphone (the task which occupies most

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[2] Flanagan, John C. Army Air Forces Aviation Psychology Program Research Reports. Report No. 1, U. S. Government Printing Office, Washington, D. C., 1948.

of the controller's time regardless of watch or weather) also increases in Watch 2 and in IFR weather. Indications of the operation of fatigue were also present in the data. It was concluded that although the activity analysis provided a picture of observable job components and served to give the investigators a better understanding of the job, other job analysis methods would better serve the primary purpose of the present project.

The Critical Requirements Study

The critical requirements of the job were determined by applying a method known as the critical incident technique. Aeronautical specialists of the Civil Aeronautics Administration were assigned to the American Institute for Research to act as interviewers and covered a substantial portion of the control towers, centers, and communications stations throughout the continental United States during the collection of incidents. These incidents were reports (by individuals in the best position to observe) of the specific behaviors of controllers in particular situations that were responsible for their having been considered especially effective or ineffective at the job. Each individual behavior was then classified under the job area in which it had occurred. Ten such categories evolved in the course of the analysis along with 47 sub-headings. Critical requirements were then formulated to cover the combined groups of behavior that were listed under the categories - one critical requirement for each set of matched effective and ineffective behaviors. The critical requirements were behavioral statements of what controllers had been observed to do on the job that made for excellent or failing performance.

During the collection of incidents, data were obtained in addition to the descriptions of behavior. The highest frequency of report of critical behaviors was found to occur during the winter months and during IFR weather. Some indications were discovered that pointed to the possibility that the frequency of incidents in the "Aiding Aircraft in Trouble" area may have been increased beyond its true importance due to a tendency of interviewees to recall these spectacular events more readily. Corroborating the findings in the activity analysis, Watch 2 showed the highest frequency of report of incidents, and the first and last hours of the 3 watches (with the exception of the first hour of the second watch) were ones in which critical situations frequently arise.

The Proficiency Measure

The development of a procedure for evaluating the proficiency of air route traffic controllers became a task of arranging statements of the critical behaviors in such a way that an observer could determine the extent to which controllers met the critical requirements of the job. Several ways of presenting the critical behaviors were tried and

the method offering the fewest difficulties and the most advantages was chosen. The same framework of 10 main and 47 sub-categories that had been used in the analysis of the incidents was utilized as the foundation around which 313 specific check items were assembled. The items consisted of statements of critical behaviors, effective and ineffective, stated with a degree of specificity that would enable the observer to recognize them easily and yet stated generally enough to encompass all the behaviors classified under their respective headings. Effective and ineffective behaviors were listed side by side. This first tentative form was titled, "A Check List of Critical Requirements for the Evaluation of Air Route Traffic Controllers."[3]

The most fundamental contribution of "observational record forms" of this type to employee rating is that ratings derived from their use are based on actual records of what employees are observed to do throughout the rating period rather than on the rater's general and frequently vague recollection of his employee's ineffectiveness. The rating plan for this form involved checking by senior controllers in the appropriate section of the form when the controllers under their supervision were seen to perform critical behaviors, either outstanding or unsatisfactory. For example, should a senior controller observe a controller clear a departing aircraft to climb higher than the altitude assigned to planes flying over but not landing at the airport without providing the minimum separation requirements, he would record this instance of critical behavior (on the unsatisfactory side, of course) by first determining the job area in which the behavior occurred. In this case it would be under Job Area I, "Issuing Departure Clearances." A finer breakdown of this job area includes a sub-category named, "Assigning Climbing Courses," under which the specific item which most closely describes the observed behavior will be found. The rater checks this item and thus makes a record of a critical act on the part of the controller which will be taken into consideration when his periodic efficiency rating is made.

B. THE PRESENT PROJECT

The developmental project ended with the construction of a proficiency measure for air route traffic controllers based on the critical requirements of the job. To be of value, however, the new procedure had to be tested to determine its practicality for field use and the extent to which it was free from errors of measurement. It was necessary to apply statistical tests to the procedure to determine how closely different raters would agree in their ratings of the same men and to determine how consistently the procedure measured controller proficiency. Obviously a rating procedure is not very reliable if a number of raters assign vastly different ratings to the same man over the same period or if a number of individuals' scores over two rating periods are extremely high for the first and fall to the bottom of the scale for the second.

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[3] See Navay, John A. op. cit., pp. 58-70.

This testing of the new procedure, determining its practicality and reliability, became the objectives of an additional research project conducted by the American Institute for Research. This study was also carried out under the auspices of the National Research Council Committee on Aviation Psychology with funds from the Division of Research, Civil Aeronautics Administration.

The report which follows will describe the techniques used to attain these objectives. The revisions made in the earlier form as a result of preliminary tryouts and conferences with control personnel will be discussed first. Secondly, the experimental design of the formal tryout and reliability study of the final form will be described; the sample, the plans and training procedures, the forms used, and the participating centers. The section on "Results" is the next to be reported; the reliabilities obtained; the evaluation of the form by participants; and a discussion of a supplementary study carried out at one of the centers. The final section of the report summarizes and presents the conclusions of the study.

II CONDUCT OF THE STUDY

A. REVISIONS OF THE FORM

Prior to the start of the formal field tryout and reliability study, the form of the evaluation procedure underwent two revisions. These were based on the findings of preliminary informal tryouts and conferences with experts in the field of air traffic control. This preliminary work was carried out in order that data could be obtained which would be helpful in formulating the plans for the formal tryout by:

(1) Indicating how long it would take to get a sufficiently large number of observations to score the form.

(2) Indicating how frequently critical situations arise that would provide opportunities to record critical behaviors on the form.

(3) Pointing out areas where changes of wording or format might help clarify the procedure.

(4) Indicating in advance to some degree the reception the form would be likely to receive in the field.

(5) Pointing out the areas upon which special stress should be placed in training personnel in the use of the form.

Preliminary Tryouts at the Pittsburgh and Cleveland Centers[4]

Copies of the tentative form of the evaluation procedure titled, "A Checklist of Critical Requirements for the Evaluation of Air Route Traffic Controllers" were distributed among senior controllers and other supervisory personnel at the Pittsburgh and Cleveland centers. In general, the comments received were favorable; and the personnel questioned felt that a fairer job of rating could be accomplished by the use of the checklist. The question arose as to whether items which indicated "standard performance;" i.e., those behaviors which represent adequate not outstanding performance on the effective side, should be

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[4] In the course of field trips to these and other centers, data were collected on the problem of delays to incoming and departing aircraft. A report of this supplementary survey may be found in Appendix A.

included in the form. Without exception, the senior controllers contacted felt that items of this type should be deleted from the form. It was pointed out that a controller who issued departure clearances, for example, would receive a tally on the item "Provided standard separation requirements", each time he issued a clearance that did not result in a conflict. At some departure sectors, this might amount to 60 or more departures per watch with a resulting overloading of tallies on such items.

No great difficulty was experienced by the seniors who used the form in locating the proper place to make entries. They felt that the form was well-organized and that after reading it once or twice they were able to locate the appropriate item **without time consuming searching.**

A few minor changes were suggested involving ambiguous phrases or items which had become obsolete with recent changes in traffic control regulations.

The controllers felt that the form covered adequately all situations which might be encountered on the job and felt that to be effective, observations should be recorded frequently. The principal objection to the use of such a procedure was a feeling on the part of some that they were too busy in periods of IFR weather (when opportunities for observing and recording are most numerous) to be able to devote sufficient time to the task of recording performance immediately after observing it. However, the belief was also expressed that it was quite possible to recall the details of the work period with sufficient clarity at the end of the watch or for even longer intervals to enable them to record their observations after the pressure of the work load diminished.

At this point, a revised form of the "checklist" was prepared. Changes made were chiefly in items which appeared to describe standard or adequate, rather than outstanding or effective, behaviors. These items were eliminated or, in most cases, redrafted to indicate clearly outstanding behavior, by reference to the incidents from which the behaviors were originally abstracted. This usually involved the addition of a qualifying phrase; the following example is typical:

Old Form - "Provided standard separation requirements."

Revised Form - "Provided standard separation requirements, in spite of bad weather, heavy traffic, or personnel shortages."

Other changes included improvements in phraseology and use of terms more familiar to controllers. The revised form of the checklist, dated April 1949, was prepared in dittoed form for immediate use.

A printed form of the evaluation procedure was next prepared. Discussions and criticism of the April form led to further minor improvements in phraseology of items and to the use of a new title for the printed form. In view of the plans to use the booklet not as a systematically completed checklist but as a means of recording behavior as it occurs, the printed form was titled: "Observational Record Form: Air Route Traffic Controllers." Several changes were also made in the format of the booklet. It was reduced to four pages, with outstanding behaviors listed below, rather than beside, unsatisfactory behaviors. Outstanding behavior statements were underlined to differentiate them clearly from unsatisfactory behaviors. In general, the areas and sub-areas were made clearly separate so that it would be easy for senior controllers to locate items. The printed form is appended to this report, along with a supplementary sheet giving a short summary of the development of the form, instructions on use of the form, and a summary form. (Appendix B)

The form was again distributed to senior controllers at the Pittsburgh and Cleveland centers for a two-day period during which they were to try it out on some of the controllers under their supervision. In this tryout, it was desired to determine (1) what difficulties might arise in use of the revised form, and (2) what methods of recording and what time intervals between recordings would be at the same time convenient for senior controllers and adequate for evaluation of controllers' job behavior.

Few difficulties were reported by senior controllers in the use of the revised form. Seniors preferred to record at specified times and directly on the booklets, rather than on separate summary sheets. It appeared to make no difference in number or type of behaviors reported whether recording was done at the end of each four-hour period, or at the end of the eight-hour watch, although there were indications that seniors might often find it difficult to put aside other duties at times other than the end of the watch. Other results of the tryout are summarized in Table 1. It is of interest to note that, in this short tryout, behaviors were reported in all areas, except Area III: "Aiding Aircraft in Trouble". Since the behaviors in this area depend on the existence of an emergency situation, it was to be expected that few tallies would appear in the area even with more extended use of the record form. The fact that seniors at the Cleveland center reported a considerably larger number of behaviors than did Pittsburgh seniors was no doubt chiefly a function of the poorer weather at Cleveland during the tryout period. At both centers, more outstanding than unsatisfactory behaviors were tallied. Although this inequality was not unexpected in view of the highly skilled nature of the controller's job, it also suggested that some of the outstanding statements still did not define clearly outstanding and non-routine behavior. This problem was dealt with in a later revision.

TABLE 1

MEAN NUMBERS OF OUTSTANDING AND UNSATISFACTORY BEHAVIORS PER MAN PER WATCH RECORDED BY SENIOR CONTROLLERS IN TEN BEHAVIORAL AREAS FOR PRELIMINARY TRYOUT OF THE OBSERVATIONAL RECORD FORM: AIR ROUTE TRAFFIC CONTROLLERS

	PITTSBURGH CONTROLLERS (3 seniors, 21 sets of observations)		CLEVELAND CONTROLLERS (4 seniors, 19 sets of observations)	
Behavioral Area	Outstanding Behaviors	Unsatisfactory Behaviors	Outstanding Behaviors	Unsatisfactory Behaviors
I Issuing departure clearances	1.4	0.3	16.5	1.9
II Revising flight plans and clearances	1.7	0.2	4.5	1.2
III Aiding aircraft in trouble	0.0	0.0	0.0	0.0
IV Coordinating with others	4.0	1.3	36.8	2.7
V Planning approach procedures	1.5	0.3	21.6	0.8
VI Supervising personnel	0.9	0.2	2.4	0.2
VII Handling the board	2.0	0.2	1.3	0.7
VIII Helping other controllers	0.8	0.0	0.3	0.0
IX Maintaining harmonious relations with others	0.8	0.0	0.8	0.4
X Maintaining emotional control	0.3	0.0	0.8	0.3
All Areas	13	3	85	8

Preliminary Tryout at the Denver Center

A further preliminary tryout was conducted at the Denver center as a final check on the form. The design of this tryout was essentially the same as it was for the Pittsburgh and Cleveland centers except that instructions to the seniors were considerably expanded.

Each senior observed three controllers for a period of three days. The distribution of recorded behaviors among the ten work areas was essentially the same as in the tryout at Pittsburgh and Cleveland. There was again a preponderance of outstanding over unsatisfactory behaviors, but this tendency was in no case as pronounced as had been found with some seniors in previous tryouts.

The seniors expressed general satisfaction with the form, and indicated no specific difficulties in its use. One senior commented that there were "too many items to grade", but it seemed likely that this complaint would disappear with continued use of the form.

Conferences

Conferences with Civil Aeronautics Administration research and air traffic control division officials were held from time to time throughout the planning and preliminary tryout phases of the project.[5] Problems of obtaining the participation and cooperation of field personnel, planning of the tryouts, clearance to visit centers, and discussions of the evaluation procedure comprised the subject matter for most of these discussions. One such conference, however, was particularly significant in that it resulted in a major revision in the mechanics of recording on the form.

Dr. L. D. Anderson, Research Consultant, and Mr. L. L. Kullenberg of the Operations Inspections Staff, had taken several forms to Kansas City for a Civil Aeronautics Administration sponsored tryout on control personnel of the Fifth Region. The findings of this tryout were discussed in a conference attended by members of the Civil Aeronautics Administration Washington staff and representatives of the American Institute for Research in August, 1949. The conclusions reached were as follows:

The form as currently organized is too long. Field personnel are oriented to the use of a single page form. It was recommended, therefore, that the present list of over three hundred "critical tasks" be reduced

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[5] Dr. L. D. Anderson, Dr. Dean R. Brimhall, Mr. L. Bitzler, Mr. J. L. Huber, Mr. L. L. Kullenberg, Mr. B. R. Moore, Mr. F. L. Smith, Dr. J. C. Flanagan, Dr. B. D. West, and Mr. J. A. Nagay participated in one or more of these conferences.

to a number somewhere in the vicinity of twenty. However, since the field personnel are used to rather complex manuals explaining the use of the single page forms, it was further recommended that the detailed materials be incorporated into an instruction booklet. The group agreed that the essential principle of the evaluation procedure; i.e., that ratings be based on records of on-the-job behavior rather than on memory or general impression, would not be lost by revising the procedure as recommended.

Final Revision of the Form

The final form, entitled Performance Record: Air Route Traffic Controller, (Appendix C) as used in the formal tryout was based upon the recommendations of the participants in the Washington conference. It consisted of 23 job elements grouped under two main areas, "Control Duties" and "Personal Relationships" and 10 more specific sub-headings. Each of the 23 job elements had a row of 50 small squares or "boxes" printed underneath it; these were for the recording of critical behaviors observed to have occurred in these elements of the job - outstanding acts indicated by X's marked in the boxes to the left of the center line and unsatisfactory acts to the right. A larger box was provided to the left of each element for indicating the required +, ✓, or - score for each.

The Manual of Instructions

A manual to accompany the Performance Record (also included in Appendix C) was developed for the purpose of aiding senior controllers in recording under the correct job element the critical behaviors they observe. It consists of a brief history of the development of the form and its purpose, a definition of outstanding and unsatisfactory controller behavior, an explanation of how to use the manual, and how the form is scored.

The 23 job elements of the Performance Record are repeated in the manual and have listed under them the specific types of controller behavior, outstanding and unsatisfactory, which fall under each category. These behavioral statements were derived from the original critical incidents obtained during the developmental phases of the project. The process senior controllers go through when first using the form to determine where to record the observed behavior is illustrated by the following example:

> Senior Controller A observed Controller B place an aircraft which was dangerously close to exhausting its fuel reserve at the top of a holding stack when he might have cleared it in first with only minor inconvenience to other traffic. The first decision that Senior Controller A makes is that here is a critical behavior; something Controller B

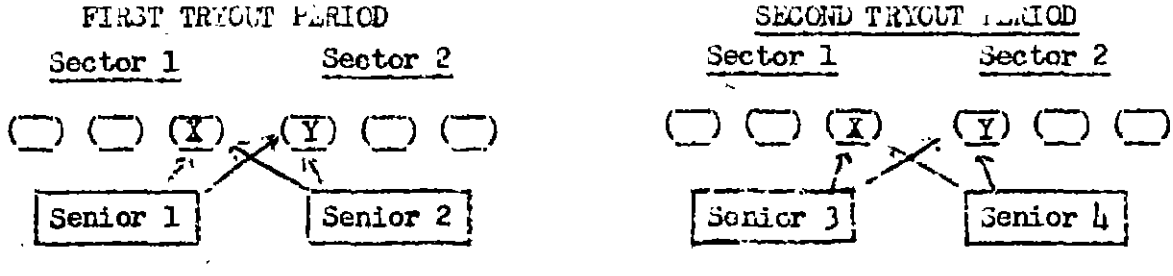
has done which should be taken into consideration when his next efficiency rating is made. In deciding it to be a critical behavior, the observer has also decided whether it is an outstanding or unsatisfactory act. Having decided it to be unsatisfactory, he then determines whether it has to do with Controller X's control duties or his personal relationships on the job (the 2 main breakdowns of the Performance Record). Then checking the lettered sub-headings of the form he finds one under the letter "C" called "Planning Approach Sequence", and under this category, Job Element 9, "Holding Aircraft" appears to be most appropriate. If he is in doubt about the classification, he may turn to the manual and examine the critical behaviors listed under Job Element 9. The column on the right-hand side of the page lists examples of unsatisfactory acts that were classified under "Holding Aircraft." Item d, "Ignored special limitations of aircraft when stacking," covers the type of behavior he observed quite closely and he then marks an X in one of the boxes in the "Unsatisfactory" column of the Performance Record under Job Element 9. Of course, when he has become familiar with the form and the behaviors listed in the manual, many of these steps can be eliminated.

5. THE DESIGN OF THE FORMAL TRYOUT AND RELIABILITY STUDY

With the completion of the revised Performance Record: Air Route Traffic Controller and the manual to accompany it, the main phase of the study was ready to be started - the testing of the procedure's reliability and practicality. Three of the country's largest air route traffic control centers were chosen for the tryout: New York, Washington, and Chicago.

Design

Air route traffic control centers are divided into a number of sectors (about 8 in the larger centers), each manned by one or more controllers and divided among the available number of senior controllers for supervisory purposes. Since the objective of the reliability study was to determine the Performance Record's test-retest and observer-observer reliability, the original plans called for the observation of pairs of controllers by pairs of seniors for two thirty-day periods, thus:



Senior 1 fills out the Performance Record form for the last man in the sector under his supervision and for the first in the sector of Senior 2; Senior 2 observes the same two men. The same process is repeated for a second thirty-day period by different seniors on the same controllers. Thus for each pair of controllers for whom 4 different seniors could be assigned, 4 sets of scores were to be obtained for the determination of the procedure's observer-observer reliability:

1.	Senior	1	and	Senior	2	observing	Controller	X	(1st	period)
2.	"	1	"	"	2	"	"	Y	("	")
3.	"	3	"	"	4	"	"	X	(2nd	period)
4.	"	3	"	"	4	"	"	Y	("	")

For determining the test-retest reliability, eight sets of scores were to be used:

1.	Senior	1	and	Senior	3's	observations	on	Controller	X
2.	"	1	"	"	4's	"	"	"	X
3.	"	2	"	"	3's	"	"	"	X
4.	"	2	"	"	4's	"	"	"	X
5.	"	1	"	"	3's	"	"	"	Y
6.	"	1	"	"	4's	"	"	"	Y
7.	"	2	"	"	3's	"	"	"	Y
8.	"	2	"	"	4's	"	"	"	Y

Training Procedures

All the senior controllers at each of the three centers participated in the tryout. Each man underwent a brief training period, usually of an hour or more in duration, during which the development and use of the Performance Record and manual were explained and a practice session carried out.

A copy of the Performance Record form, the manual, and a mimeographed sheet explaining the design of the tryout, (Appendix C), were distributed to the participating seniors. After the development of the procedure was briefly described, seniors were asked to read the distributed materials and any questions raised were answered. When it was believed that the seniors were familiar with the essential principles involved in the use of the procedure, they were asked to read a list of five sample incidents (Appendix D) and to indicate where such controller behaviors would be recorded on the form. Four of these sample incidents were actual "critical incidents" reported during the developmental phases of the project as indicative of outstanding or unsatisfactory controller behavior, and the fifth (#3 in the list) was deliberately composed in "non-critical" fashion as a check on the seniors' understanding of the concept of "criticalness." Most of the group of seniors demonstrated an understanding of the concept by pointing out the flaws in this incident and did not attempt to classify it. In general, they agreed in their classification

of the balance of the incidents and in cases where incidents were misclassified, the research personnel conducting the training continued or repeated the training until it was believed that all participants were thoroughly indoctrinated.

Scheduling

The working schedule of the seniors and controllers at the Washington and Chicago centers was such that it was impossible to arrange to have controllers observed by the same pairs of seniors for ten watches during a thirty-day period as originally planned. It was necessary, therefore, (and more realistic since some similar procedure would probably be more appropriate for field use) to have several seniors record on a controller's Performance Record. The seniors were divided into two groups, A and B, and a schedule was prepared listing the names of the controllers who would be observed by the seniors on each 0800-1600 and 1600-0000 watch for each of thirty days. Thus, if Controller Doe, for example, worked the 0800-1600 watch on November 24th, two seniors observed him and recorded their observations in either his "Group A" or "Group B" form, depending of course, on the group to which they were assigned. If, on the following day, Controller Doe worked the same watch but the seniors supervising him changed, their places were taken by their successors. However, in no case did the same senior record in more than one of Controller Doe's Performance Records. In the cases where it was necessary to shift seniors from one group to another, they never recorded on the same controller from both groups.

The following method was used during the scheduling of the second tryout period at these centers. The groups of seniors observing each controller during the first period comprised about half the total number of seniors available, leaving the other half for the second period. In the case of the Washington center, for example, about 7 of the total of 14 seniors and watch supervisors made up groups A and B for any given controller. For most controllers there were 3 seniors in Group A and 4 in B. Thus it was possible to schedule the second tryout period with completely different seniors doing the observing for any one controller.

The situation at the New York center was slightly different from that at Washington and Chicago. Since, at the New York Center, controllers remain in intact groups under the supervision of the same senior controller, the original plan was used; i.e., two seniors in adjacent sectors observed the same pair of controllers for a number of watches - in this case, eight per tryout period. (A given group of seniors and controllers worked together on the same watch for eight days out of the period allotted for the tryout.)

C. ADDITIONAL DATA OBTAINED

Comment Sheets

All participants in the tryout were given an opportunity to comment on the procedure and make any suggestions they desired. They were given a "Comment Sheet" (Appendix D) on which space was provided for their comments on controller evaluation in general or their reactions to and suggestions for the new Performance Record. An analysis of these comment sheets follows later in the report.

Supplementary Ratings

It was suggested in conferences with personnel of the Air Traffic Control Division that a good criterion of controller effectiveness might be the alacrity or reluctance of the chief controller to assign controllers to the more difficult and busier of the center's control positions, the assumption, of course, being that only the best men would be assigned the "hot spots." A supplementary rating form, or "Chief's Rating" as it was called, was developed based on this hypothesis and the ratings obtained by its use were compared with Performance Record scores. The form consisted of 5 statements one of which was to be checked by the chief controller of the center. The statements ranged from one indicating the highest level of confidence in the controller's ability which read

> "I would assign this controller to any sector in any weather and feel confident he could do the job without any supervision."

through to Number 5,

> "This controller is capable of handling only the least busy of the sectors under instrument or borderline conditions and requires close supervision at all times."

Chief controllers completed a form on each controller participant. They were instructed to make the rating without consulting any senior controller or without reference to the controllers' Civil Service efficiency ratings. The entire "Supplementary Experimental Rating Form" is attached as Appendix E.

The last official Civil Service rating and the last and next-to-last unofficial quarterly ratings on each controller participant were also obtained.

Judgments About Importance of Performance Record Elements

Senior controllers were requested at the end of the second tryout period to underline those of the 23 elements of the Performance Record

form which were especially important for the job. These data were collected as an aid to the construction of a scoring procedure which would give an over-all rating in terms of the five adjectives (Excellent, Very Good, Good, Fair, and Unsatisfactory) required by the Civil Service Commission.

D. SUPPLEMENTARY DATA OBTAINED AT THE NEW YORK CENTER

At the New York center, additional data were obtained which were intended to serve two main purposes:

1. To provide, by a supplementary 2-weeks tryout, some indication of how the Performance Record would be used in the field - in contrast to the rather artificial conditions imposed by the formal tryout design.

2. To provide, by means of a limited activity analysis of the senior controller's job, some indication of how much time seniors spend observing the controllers under their supervision closely enough to observe and record instances of critical controller behavior.

Procedures for the Supplementary Tryout

The names of 43 controllers (including those acting as seniors but excluding assistants acting as controllers) were placed on Performance Records and bound in a book which was made easily accessible to all seniors. Seniors were asked to record any critical behaviors which came to their attention by marking the boxes of the appropriate form by a code letter rather than the usual check or "X". This, of course, was done so that individual differences among seniors in their tendency to record incidents could be noted. In addition, a form was attached to the front of the book of Performance Record forms on which seniors were asked to record the number of tallies entered each day. Results of this study and also those of the activity analysis carried out at New York (a description of which follows) will be reported in later chapters along with the findings of the main study.

The Activity Analysis

Early in the development of the Performance Record, it was found helpful to observe controllers at their job and to conduct an analysis of their activities. This analysis, which has been described in the earlier report[6], provided the project staff with valuable insight into

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[6] Nagay, John A., op.cit., p. 10 ff.

the details of the controller's job and contributed to the development of a realistic means of evaluating proficiency in this job.

In the present project, there was little need for further information about the controller's job. The center of attention now was the senior controller, who would be responsible for the use of the Performance Record in evaluating controller effectiveness. Senior controllers have many other responsibilities which compete for their time with the task of evaluating proficiency. It was felt that a more thorough knowledge of the senior controller's job would be valuable both in interpreting the results of the tryout of the Performance Record and in recommending procedures for training seniors to use the Performance Record routinely.

In the course of numerous visits to control centers, staff members made it a point to watch the activities of the seniors and to question center personnel, with a view to learning more about the practical problems in evaluation of controller proficiency. These informal observations were, by their nature, selected and reported subjectively. It was felt that a sample of senior controllers' activities should be observed and reported objectively. Although the scope of the project precluded extensive observation periods, it seemed that some systematic analysis of the senior controllers' job would, along with supplementary information gathered informally, allow generalizations about the ways seniors supervise and evaluate controllers.

Procedure

Observations of activities of senior controllers were made at the New York center, during 20 hours within a 3-day period. For most of the time, an observation was made every 5 minutes; for 3 hours, the interval between observations was 2-1/2 minutes. Periods of observation were distributed from 0630 to 2400 so that approximately equal numbers of observations were made at all times in the two daylight watches. The total number of observations was 792.

The observer recorded the location and action of both seniors and acting seniors. Ordinarily, there were 2 seniors and 1 acting senior on duty; however, the number varied from 1 senior and 1 acting senior to 2 seniors and 2 acting seniors. Two aspects of activity were recorded each time: visual actions -- what was the senior looking at? -- and vocal actions - to whom was the senior speaking or listening? Additional details were added when they appeared relevant and when they were known. Since the observer attempted to intrude as little as possible into the activities of the center, he could not observe these things precisely at all times. Thus, it was not possible to determine whether a senior was actually reading control information, but only that he was standing behind a controller looking in the direction of

the strips. The observations were made in terms of the overt, observable actions of seniors; the emphasis was on determining the extent to which seniors could and did observe the actions of controllers, so that they could report them in the Performance Record.

The New York Center

The results of the observations depend partly on the specific characteristics of the New York center. This center is one of the largest and busiest, with especially difficult control problems in the immediate vicinity of New York City. The need for coordination within the center, with other centers, and with outside agencies is unusually great in New York.

At the time this study was conducted, some changes had recently been made in the physical setup of the center, and other changes were in process or contemplated. The control area was divided into ten sectors, numbered 2 through 11, and a radio position. In addition, an approach control board was manned when instrument approaches were being made to La Guardia Field. Sectors 2 through 5, which handle relatively distant traffic to the south and west, are arranged in a line along one wall. The next three boards form a quarter circle; and boards 9, 10 and 11 continue in a line perpendicular to the first four boards. The radio is temporarily in a niche between sectors 8 and 9. A large desk for the use of senior controllers lies along a line between boards 4 and 11; a senior sitting at this desk can see all the control positions, although not without some difficulty due to obstructions. In front of the seniors' desk, near board 5, is a small desk used by acting seniors. At the other end of the large desk facing sector 8 is the approach control board. The desk has a bank of interphone connections, two private line telephones, and two regular Bell system telephones. Behind the desk is a Tel-Autograph, which transmits weather information, and a desk for a typewriter, ordinarily used to type the center log. A diagram of the layout of the center may be found in Appendix E.

The job of acting senior at the New York center rotates among a number of the more experienced controllers. This is done partly for training purposes and partly to provide assistance to the seniors both in routine administrative duties and in supervising and coordinating control procedures. Acting seniors in New York perform a number of functions which seniors in smaller centers are likely to handle themselves. For example, acting seniors often relieve controllers for short periods; seniors in New York do this only occasionally; while seniors in smaller centers do it regularly. Hence, the acting seniors were included in this study, since it was felt that their activities are indicative of those of some seniors. However, it should be noted that acting seniors do not participate directly in evaluating proficiency of controllers and, in fact, are themselves evaluated as controllers.

III RESULTS

A. THE SAMPLE

Although the tryout periods were scheduled to last for 30 days each, it actually took considerably longer to obtain the desired number of days of observations on each controller. Difficulties of scheduling, military and annual leave, and other complications accounted for most of the delay. In one center however, it was discovered when the forms were picked up at the end of the first tryout period, that less than half of the controllers had any X's at all on their Performance Records. The weather during this 30-day period had been particularly good, with only 4 out of the 60 watches observed having had IFR or borderline weather and heavy traffic. Consequently seniors at this center had only limited opportunities to observe critical acts on the part of their controllers since control activity is generally at a minimum during periods of good weather. It was shown in the earlier study that only slightly over 6% of the 1249 critical incidents reported occurred during periods of VFR weather.[7] An additional 30 days was allotted for this center with either 9 or 10 additional watches scheduled for each controller. It was also necessary to extend the tryout periods at the other centers past the 30 days originally allotted to take care of interruptions caused by some of the factors mentioned earlier.

Altogether, 48 senior or acting senior controllers observed 42 controllers over two tryout periods. The average number of watches during which the controllers were scheduled to be observed was 12 per tryout period. Table 2 shows the number of critical behaviors recorded on the controllers by these 48 observers at 3 centers over the two tryout periods and also indicates the number of completed Performance Records obtained on each participant.

Ten hundred and sixty critical behaviors were recorded: 803 outstanding and 257 unsatisfactory, a ratio of slightly more than 3 to 1. Similarly, this same preponderance of outstanding over unsatisfactory tallies occurred during the supplementary tryout at the New York center (Table 3). This finding was not unexpected, for it is presumed that the selection and training procedures employed in the air traffic control division would in general have resulted in the elimination of incompetent control personnel. Also the larger numbers of outstanding acts recorded by the New York seniors may have been the result of a feeling on their part that large numbers of tallies were essential to the success of the tryout and outstanding acts may have been reported less realistically than unsatisfactory ones.

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[7] Nagay, J. A., op.cit. pp. 48.

TABLE 2

NUMBER OF CRITICAL BEHAVIORS RECORDED BY SENIOR CONTROLLERS OVER TWO TRYOUT PERIODS AT THREE CENTERS

Average No. of watches during which Controllers were scheduled to be observed = 12 per tryout period

O = Outstanding U = Unsatisfactory

Controller	First Tryout Period				Second Tryout Period				Total		Total
	Group A		Group B		Group A		Group B				
	O	U	O	U	O	U	O	U	O	U	O + U
(New York Center)											
A	21	0	39	0	6	0	———		66	0	66
B	23	0	19	0	6	2	9	1	57	3	60
C	7	0	6	0	6	0	———		19	0	19
D	0	5	0	15	0	0	44	17	44	37	81
E	10	8	2	4	4	0	6	0	22	12	34
F	12	5	———		7	0	20	7	49	19	68
G	81	4	———		5	0	———		86	4	90
(Washington Center)											
A	15	0	2	0	6	0	0	0	23	0	23
B	0	0	8	1	3	0	0	0	11	1	12
C	2	0	0	0	4	0	0	0	6	0	6
D	0	0	0	0	0	0	0	0	0	0	0
E	3	0	0	1	0	0	0	0	3	1	4
F	0	3	5	4	4	1	0	0	9	8	17
G	5	0	13	1	9	1	0	0	27	2	29
H	4	0	1	0	0	0	0	0	5	0	5
I	0	0	5	0	7	0	0	0	12	0	12
J	12	2	5	0	0	0	19	3	36	5	41
K	0	0	9	0	0	0	0	0	9	0	9
L	0	0	0	1	17	0	0	0	17	1	18
M	0	1	0	0	0	0	0	0	0	1	1
N	1	0	0	0	27	2	0	0	28	2	30
O	0	0	0	0	0	0	1	0	1	0	1
P	2	3	7	19	0	0	0	0	9	22	31

TABLE 2 (con't)

Controller	First Tryout Period				Second Tryout Period				Total		T
	Group A		Group B		Group A		Group B				
	O	U	O	U	O	U	O	U	O	U	O +
(Washington Center) (con't)											
Q	4	0	2	0	1	0	0	0	7	0	
R	5	10	0	4	0	0	0	0	5	14	1
S	2	3	14	0	2	2	0	0	18	5	
T	7	1	3	0	0	0	0	0	10	1	
U	1	0	10	0	0	0	0	0	11	0	1
V	3	3	2	3	0	0	6	0	11	6	1
(Chicago Center)											
A	7	3	3	0	4	0	8	3	22	6	
B	2	0	15	1	13	0	0	0	30	1	
C	6	2	1	0	0	1	0	0	7	3	1
D	7	0	7	0	0	0	1	0	15	0	1
E	0	5	0	0	17	9	1	3	18	17	
F	5	2	1	0	2	0	2	2	10	4	
G	1	4	2	10	0	14	4	9	7	36	1
H	3	1	15	0	4	0	6	0	28	1	
I	7	0	6	1	11	0	2	0	26	1	
J	3	5	0	0	0	0	3	0	6	5	
K	4	2	2	2	1	0	4	0	11	4	
L	0	1	0	5	0	0	4	4	4	10	
M	2	4	0	10	5	5	1	6	8	25	
TOTALS (42 Controllers)									803	257	10

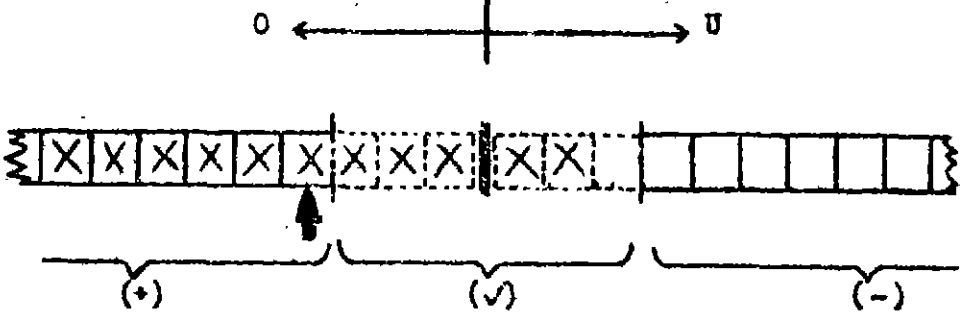
TABLE 3

DISTRIBUTION OF CRITICAL BEHAVIORS RECORDED BY SENIOR CONTROLLERS AT THE NEW YORK CENTER

Seniors	Number of Matches	Outstanding Tallies	Unsatisfactory Tallies	Total Tallies
A	3	25	0	25
B	6	55	7	62
C	1	16	1	17
D	6	43	6	49
E	2	21	1	22
F	5	24	6	30
G	7	0	4	4
H	2	22	11	33
Total	32	206	36	242

B. SCORING

Civil Service regulations with respect to rating procedures stipulate that scoring systems should provide for obtaining a +, ✓, or - score for each element of the rating procedure. The Performance Record form was so arranged that such element scores could easily be obtained by raters by simply determining the midpoint of the row of X'ed boxes under each element and checking to see whether that point fell to the left or right of a series of 6 dotted boxes surrounding the center line. Thus, in the example below, the midpoint falls to the left of the dotted box area and the rating on this element would be a +; if it were on the line or within the dotted box area it would be a ✓; and a - if it fell to the right.



This element scoring procedure was based on the assumption that ratings would be made annually and that a fair amount of critical activity would have taken place over that period; i.e., a large number of boxes would be checked. Whether or not this will be so, however, depends on the results of further service testing or field use of the form. It may prove

to be advisable later to reduce the "neutral zone" of 6 dotted boxes to 4, to enable the assignment of + or - scores on a fewer number of X'ed boxes.

Special situations and circumstances should also be taken into consideration in the assignment of element scores and seniors should be permitted to exercise their judgment in such matters. A situation where special scoring of this sort could be employed, might be when the consequences of a controller's act were so drastic, either on the effective or ineffective side, that the single act would in itself be sufficient to determine an element rating — a mid-air collision or a particularly effective rescue for example.

Numerical Scores

For the purposes of the tryout, numerical element scores were obtained. Since each controller was observed for only an average of 12 watches per tryout period, there were very few cases where sufficient numbers of boxes were checked to give + or - scores. Consequently, each X'ed box to the left of the center line was assigned a value of +1 and each box on the unsatisfactory side was assigned a value of -1, with a maximum score of ±3 for any one element. The over-all score was the algebraic sum of these + and - values and the Performance Record score used for the calculation of the various coefficients to be reported was the sum of the 4 over-all scores available for each controller (2 forms were completed on each controller during each of 2 tryout periods).

Chief's ratings and Civil Service efficiency ratings were converted to numerical scores for these computations by assigning values of 4, 3, 2, 1, and 0 to the 5 points of the Chief's rating form and the E, VG, G, F, and U ratings of the Civil Service ratings.

Over-all Adjective Scores

Civil Service regulations also stipulate that rating procedures should provide an over-all score on ratees in terms of five adjectives: Excellent, Very Good, Good, Fair, and Unsatisfactory. This is obtained on Form 51 by the following method:

"Plus marks on all underlined elements[8], and check marks or better on all other elements rated . . . . . Excellent

Check marks or better on all elements rated, and plus marks on at least half of the underlined elements . . . . Very Good

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[8]The underlined elements referred to are those judged especially important to the job.

Check marks or better on a majority of underlined elements, and all weak performance overcompensated by outstanding performance . . . . . Good

Check marks or better on a majority of underlined elements, and all weak performance not overcompensated by outstanding performance . . . . . Fair

Minus marks on at least half of the underlined elements . . . . . Unsatisfactory"

It will be recalled that senior controllers participating in the tryout were requested to underline those of the 23 elements on the Performance Record in the same manner; i.e., those "especially important to the job." These results are shown in Table 4. The frequency with which elements were underlined by the 23 seniors who returned the forms ranged from 22 or 95.66%, who underlined Elements 1 and 22, to 3, or 13.04%, who underlined Element 20.

It is suggested that the over-all adjective score for the Performance Record be obtained by underlining those elements checked by more than half of the seniors (the first 14 listed on Table 4) and using the same procedure as is used with Form 51. However, it is also recommended because of unusual situations and differences in local conditions that seniors at the various centers be permitted the final decision as to which elements should be underlined. Further field use and service testing of the procedure might also lead to the development of a scoring system based on the counting of Outstanding and Unsatisfactory behaviors, but it appears at present that the procedure outlined above would be satisfactory.

C. ACTIVITY ANALYSIS RESULTS

A summary of the results of the activity analysis of senior controllers and acting seniors at the New York center is provided in Tables 5 and 6. These tables are subdivided to show results separately for seniors and acting seniors and for two conditions of weather and traffic. It appeared useful to categorize weather and traffic conditions in order to estimate the kinds of changes in activities of seniors with changes in the control work load. The two particular categories used are, of course, arbitrary and dictated partly by the conditions obtaining during the period of observation. During this entire period, at least part of the New York control area operated under Instrument Flight Rules; but Visual Flight Rules prevailed part of the time in the immediate vicinity of New York city and in other parts of the area. The observations labeled IFR in Tables 5 and 6 were made when the whole area was IFR, or a substantial part was IFR and the traffic was moderate to heavy. Observations labeled VFR were made when most of the area was VFR; or substantial parts, including New York city, were VFR and the traffic was light to moderate.

TABLE 4

JOB ELEMENTS OF THE PERFORMANCE RECORD: AIR ROUTE TRAFFIC CONTROLLER RANKED IN ORDER OF THE FREQUENCY WITH WHICH SENIOR CONTROLLERS INDICATED THEM TO BE ESPECIALLY IMPORTANT TO THE JOB

(N = 23)

ELEMENT	FREQUENCY	PERCENT
1. Arranging takeoff sequence and minimizing takeoff delay	22	95.66
22. Maintaining composure under stress	22	95.66
5. Providing altitude separation	20	86.96
6. Providing lateral separation	20	86.96
4. Providing time separation	19	82.61
11. Coordinating traffic (inter-sector, inter-center, and with other agencies)	19	82.61
21. Accepting responsibility	19	82.61
7. Providing time separation	18	78.26
8. Organizing approach sequence	18	78.26
2. Assigning altitudes	16	69.57
3. Assigning courses	15	65.22
9. Holding aircraft	15	65.22
13. Providing airspace for emergency descents and landings	14	60.87
12. Utilizing communications facilities	13	56.52
10. Releasing aircraft to approach control	11	47.83
17. Training assistants	11	47.83
19. Obtaining cooperation from others	11	47.83
23. Accepting criticism	11	47.83
15. Posting and removing flight progress strips	10	43.48
14. Organizing search and rescue facilities	9	39.13
18. Helping other controllers	9	39.13
16. Delegating responsibility to assistants	8	34.78
20. Criticizing others	3	13.04

TABLE 5

PERCENTAGES OF RECORDED TIME SPENT BY NEW YORK SENIOR CONTROLLERS AND ACTING SENIORS IN VARIOUS LOCATIONS ACCORDING TO WEATHER AND TRAFFIC CONDITIONS

Location		SENIORS		ACTING SENIORS		TOTAL
	Weather:	Poor	Good	Poor	Good	
	Traffic:	Heavy	Light	Heavy	Light	
	Number of Observations:	(252)	(252)	(119)	(169)	(792)
At seniors' desk		30	43	17	9	28
At or near controllers' positions		34	9	36.	40	27
At acting seniors' position (front of desk)		4	0	32	17	10
At typewriter near seniors' desk		6	3	0	0	3
Back of board (assistants' positions)		1	0	0	1	1
Elsewhere in center		15	7	12	8	11
Out of center		10	38	3	25	21
	TOTAL	100	100	100	100	100
	Number of Observations:	(85)	(22)	(43)	(67)	(217)
At or near sectors						
2		1.2	0	2.3	0	0.9
3		1.2	4.5	4.7	0	1.8
4		1.2	0	9.3	16.4	7.4
5		1.2	9.1	14.0	0	4.1
6		5.9	0	4.7	1.5	3.7
7		4.7	0	16.3	0	5.1
8		36.5	13.6	14.0	31.4	28.1
9		28.2	0	11.6	3.0	14.3
10		10.6	9.1	11.6	23.9	14.7
11		7.1	4.5	9.3	17.9	10.6
Radio		2.4	59.1	2.3	6.0	9.2
	TOTAL	100.0	100.0	100.0	100.0	100.0

TABLE 6

PERCENTAGES OF RECORDED TIME SPENT BY NEW YORK SENIOR CONTROLLERS AND ACTING SENIORS IN VARIOUS ACTIVITIES ACCORDING TO WEATHER AND TRAFFIC CONDITIONS

ACTIVITY	SENIORS IFR*	SENIORS VFR**	ACTING SENIORS IFR*	ACTING SENIORS VFR**	T...
1. Check or coordinate control procedures	30	4	30	1	18
2. Act as controller	9	8	6	39	14
3. Confer - with (a) seniors	6	5	10	5	6
(b) acting seniors	4	3	1	2	3
(c) controllers	5	10	3	2	5
(d) chief or asst. chief	3	3	0	0	2
(e) others	2	4	5	1	3
4. Talk - on (a) interphone	3	3	9	2	4
(b) telephone	3	10	2	11	6
5. Write or typewrite - in (a) control log	5	2	0	3	3
(b) personnel forms	4	1	7	0	3
(c) other	1	1	2	0	1
6. Consult or read - (a) control records or procedure manuals	1	6	0	2	3
(b) administrative material	4	4	6	2	4
(c) weather bulletins	3	3	1	0	2
7. Check or handle equipment	1	1	3	2	2
8. No specific job activity observed	16	32	17	28	23
NUMBER OF OBSERVATIONS	228	157	115	127	627

*Entire area IFR or a substantial part IFR with moderate to heavy traffic

**New York area VFR with light to moderate traffic

Part I on Table 5 shows, in percentages, the time spent by seniors at various locations. Seniors were most often at their desk, especially in VFR weather. In IFR weather, seniors spent about one-third of the time at or near controllers' boards — in a position to observe a controller directly. Seniors spent considerably less time near the boards in good weather; acting seniors were there a little more in VFR than in IFR weather. The second part of Table 5 provides a breakdown of this category by sectors. Boards 8 and 9 and the radio position, which are grouped together physically, receive more than half the attention devoted to controllers' positions by seniors and acting seniors. Boards 10 and 11 receive another 25 percent, while the first six sectors share the remaining time.

The other categories in Part I of Table 5 refer to locations from which seniors would ordinarily not observe the actions of controllers. The category "elsewhere in center" includes the weather desk near Sector 12, a large table paralleling Boards 1 to 5, either end of the line of boards, and other open parts of the center not otherwise specified. Probably most of the times that seniors were observed to be "elsewhere in center", they were there for only a few minutes.

From Table 5, it would appear that seniors spend a considerable portion of their time at other duties out of the center: 21 percent over all, comprising 165 observations. Rarely, however, are both seniors out of the center at once; this happened only 7 times when there were 2 seniors on duty. Absences from the center rise sharply in good weather. It is apparently quite common for one senior to spend most of the watch at some non-control task. During one observed VFR watch, a senior left the center shortly after coming on duty to spend the day transcribing recorded control messages. He returned occasionally, but was observed to be in the center only 10 percent of the time. If this senior's absences had been tallied separately, the "out of center" figure for seniors in VFR conditions would have been 11 percent, about the same as the proportion observed for IFR conditions. Except when engaged in some special duty, seniors go out of the center most often to the chief controller's office, and less often to the Oceanic control sectors, the weather forecast office and the communications station, all adjacent to the domestic control center.

Table 6 summarizes the observations made of the activities of seniors and acting seniors when they were in the center. It is apparent that seniors could be performing more than one of the listed activities at the same time. However, a given observation is in no case included twice in Table 6; the activities are those judged to be the primary actions of seniors. For the purpose of categorization, the first two categories were praferred. For example, if a senior was talking to a controller at his board, the observation was classified in Category 1, "check or coordinate control procedures", since it was assumed that

the conversation concerned control procedures. Category 3c refers only to conversations held when the controller was not at his post.

It may be noted in Table 6 that seniors and acting seniors check or coordinate control procedures a good deal in IFR weather, but very little under VFR conditions. Acting seniors spend a large fraction of their time acting as controllers — that is, taking over immediate responsibility for a sector — in VFR weather, when controllers are often assigned to other duties, such as training activities. During IFR weather, controllers remain almost constantly at their boards, and the acting seniors take over only for short relief periods or to take care of routine matters for a controller when he is busy with an important and complex problem. In the sample of observations made, senior controllers spent a little less than 10 percent of the time acting as controllers in all weather conditions. In VFR weather, all this time was spent at the relatively new radio position; no doubt, less time will be used this way by seniors when the radio is operating more routinely and when more controllers are considered qualified to man the radio position. It may be noted, incidentally, that this activity accounts also for the large percentage shown in the second part of Table 5 for seniors in VFR conditions at the radio position.

Seniors and acting seniors spend about 19 percent of their time in the center conferring with various people, often with other seniors and acting seniors. (Of course, it should be noted that when two seniors conferred, two observations were tallied in Category 3a.) Seniors also conferred often with controllers in VFR weather, about such things as recent control problems or personnel matters, such as scheduling and leave. The percentages for the chief controller and assistant chief probably include only a fraction of such conferences, which ordinarily take place in the chief's office. The "others" in Category 3e include weather forecast personnel, telephone repairmen, and other non-control visitors to the center.

Talking on one of the 4 telephones or of the numerous interphone connections takes up about 10 percent of seniors' time. Another 7 percent is occupied with writing the center log, personnel records, and other occasional messages, such as clearance requests received over the telephone. Seniors must also read various bulletins, look up disputed points in procedure manuals, check over personnel records, etc; they do this about 9 percent of the time. Checking or handling equipment is also a task, but a minor one.

The last category in Table 6 is indicative of the sporadic nature of the senior's job. Seldom does he continue at one activity for an appreciable length of time. Conversations are brief and often interrupted. Control problems are diagnosed and solved quickly. Short sections of the log are typed periodically. It takes only a moment to check the latest weather bulletin. Almost all of the senior's activities in the

center are of this same nature. It follows that an appreciable part of the senior's time is used in shifting from one task to another. Many times when the senior is doing nothing which can be observed to be job-related, he is actually performing constructive planning or other mental activity. The observer's notes confirm this interpretation of the observations in this category. In addition, the category includes activities which are clearly not job-related, such as eating and conversations of a social nature. Activities of the latter sort account for a larger proportion of the observations in this category in VFR than in IFR weather.

In the strictest sense, these findings apply only to the New York center and broad generalizations from the data should be avoided; even with respect to the New York center. However, some of the findings are probably typical enough of the activities of seniors in general to throw light upon the results of the main tryout.

D. RELIABILITIES

Two types of reliability coefficients were calculated: (1) the agreement between seniors observing the same controller at the same time; and (2) the agreement between scores assigned by different seniors in the first and second tryout periods. They were found to be as follows:

(1) Observer-observer reliability of the form, $r = .43$ ($N = 80$)

(2) Test-retest reliability of the form, $r = .22$ ($N = 156$)

These coefficients are low but they are sufficiently large to make it unreasonable to suppose that no relationship exists. These values could be expected to be low because of several factors.

First it frequently happened that one of the pair of seniors assigned to observe a controller would be assigned to a sector in a corner of the center opposite to that of his "partner". Hence the observer-observer reliability may not be an index of the agreement between 2 seniors watching the same man at the same time but may be between 2 seniors observing him at different times. It also seems likely that one of the two seniors may have been out of the center at the time the other observed a critical behavior. The activity analysis showed that seniors spend 21% of their time outside the center and that the distribution of their time among the sectors frequently favored some sectors over others.

Many controllers shifted their positions during the tryout periods; perhaps from a busy sector during one period to one less active on another. Also differences due to variations in weather from tryout period to tryout

period, which would be expected to cancel out over a long period of observations, could be expected to affect a tryout period as short as this. The activity analysis also revealed that seniors are not able to observe their controllers systematically. In this connection, it appears that the use of the Performance Record will serve to encourage such systematic observation, particularly as seniors develop the habit of recording at regular intervals.

The Performance Record type of evaluation procedure assumes that proficiency must be determined by observing a sample of the workers' behavior on the job. However, it is fundamental to the concept that a fairly large number of observations be obtained. In the twelve watches during which each controller was observed, only 6.5 observations were recorded on the average by each of the seniors. (See Table 2). When the obtained reliability coefficients were corrected for what they would be expected to be if the tryout had been extended to a whole year (estimated 237 watches) they became:

Observer-observer, r = .94
Test-retest, r = .85

These are based on the assumption that seniors would continue using the procedure in the same way it was used during the tryout. It is believed that there are factors which would tend to both increase and decrease these values. Probably they represent good estimates of the reliability of the form if the seniors who use it are well-trained, well-motivated, and supervised in its use.[9]

E. FURTHER DATA OBTAINED

The Relationship between Performance Record Scores and Other Ratings

The correlation between the "Chief's" ratings (See description, page 15) and Performance Record scores and between Civil Service Ratings and these same scores are shown in Table 7.

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[9]These coefficients are computed on the basis of corrected scores; i.e., a maximum score of ±3 was used for any one element of the Performance Record. The Spearman-Brown formula is strictly applicable for scores computed in this manner only if later performance is scored for short periods and the results for these periods combined. The coefficients were therefore recomputed on the basis of uncorrected scores; i.e., the element scores were the algebraic sum of the plus and minus values with no limit and therefore were entirely appropriate for estimating the reliability of a total score from the Spearman-Brown formula. These are shown in Appendix G. Recalculation resulted in only minor changes to the coefficients, indicating that the use of the corrected scores in the original computation had but slight effect on the predicted reliability for a full year of observation.

TABLE 7

CORRELATIONS BETWEEN PROFICIENCY MEASURES

Variables	N	r	r_c*
"Chief's" Ratings and Performance Record Scores	42	.24	.45
Last Official Civil Service Ratings and Performance Record Scores	40	.31	.61
Sum of Last Official CS Rating + 2 Quarterly Ratings and Performance Record Scores	42	.37	.73

*The coefficients in this column show the correlation between the variables corrected for a 1 year period of observation for the Performance Record. No information is available regarding the reliability of the chief's or Civil Service ratings.

"Chief's" ratings and Civil Service ratings are believed to have fairly low reliability due to the fact that they are essentially subjective and likely to be biased. They are not based on systematically recorded behavior but are dependent on the rater's memory of and general impression of the worker's effectiveness. These correlations show that the present judgments of the chief and seniors of the center agree with the Performance Record scores about as well as could be expected considering the limitations of the ratings and the small sample of observations.

Evaluation by Participants

Comment sheets were returned by 20 of the senior controllers participating in the tryout. No comments were made which reflected unfavorable attitudes to the new procedure in any over-all sense, although several specific suggestions for improving the form were offered. The comments of the participants indicated that they felt that the form had definite merit; that it represented an improvement over the present rating system; was more descriptive of the job; the breakdown of the job was good; that it would provide a good picture of controllers' performance; or that its adoption should improve employee morale and subsequent performance.

The most frequently reported comments on the negative side were to the effect that the form could not be adequately tried out in the time allotted due to unexpected leave or other absences, position assignments, or other difficulties of this nature. A few seniors felt that the statements of outstanding behavior in the Manual were sometimes descriptive of only adequate controller performance. Other comments involved suggestions for

adding or deleting elements or for making minor changes in the format; a comment to the effect that the use of the form increased the seniors' workload; and suggestions to the effect that the tryout should be extended and the next unofficial quarterly rating based upon the results. The specific suggestions offered by participants may be found in Appendix F.

IV SUMMARY AND CONCLUSIONS

The present project is a follow-up study of an earlier project in which a procedure for evaluating the proficiency of air route traffic controllers had been developed. The objectives of the present project were to determine the observer-observer and test-retest reliability of the form developed and to determine the extent to which it was practical for field use and acceptable to field personnel.

Before the start of the main tryout and reliability study, several preliminary tryouts were carried out at nearby centers. Several revisions in the procedure involving changes in format and wording were made based on the findings of these tryouts and discussions with air traffic control personnel. The reaction of senior controllers to the procedure during the preliminary tryouts was generally favorable; they felt that a fairer job of rating could be accomplished with the use of the form and they experienced no great difficulties in its use. As used in the formal tryout, the form, titled Performance Record: Air Route Traffic Controller, consisted of a single sheet of 23 job elements, under which space was provided for seniors to record observed instances of outstanding and unsatisfactory controller behavior. A Manual was also prepared to accompany the form. Its purpose was to aid seniors in the correct classification of observed behaviors.

The main tryout was carried out at 3 centers: New York, Washington and Chicago. Forty-eight senior and acting senior controllers observed 42 controllers at these centers for two periods, averaging 12 watches for each controller per period. During the first period, 2 seniors, or in most cases, 2 groups of seniors, observed the same individuals. In the second tryout period these same individuals were observed by 2 different seniors, or by 2 more groups. The seniors in the second group were not the same ones who observed in the first — for any given controller. In addition to the reliability data that the above design provided, Civil Service ratings, over-all performance ratings by the chief controllers of the centers, and the comments and suggestions of participants were collected.

The reliability coefficients obtained were .43 for observer-observer with an N of 80 and .22 for test-retest with an N of 156. When corrected for a longer tryout period; i.e., for a year instead of the average of twelve watches and 6.5 recorded observations, they were .94 for observer-observer and .85 for test-retest.

Correlations between Performance Record scores and the ratings based on the judgments of the chief and senior controllers ranged from .24 to .37. Corrected for a 1-year period of observation with the Performance Record, they ranged from .45 to .73. These were about as

high as could be expected considering the limitations of the ratings and the small sample of observations.

A limited activity analysis conducted on senior controllers at the New York center showed that seniors do not observe controllers systematically and suggests that the use of the Performance Record will serve to encourage systematic observation.

Conclusions and Recommendations

The conclusions that can be drawn regarding the main objectives of the project; i.e., the reliability and acceptability of the Performance Record are as follows:

1. The obtained reliability coefficients are low. However on the assumption that the conventional statistical techniques are applicable it can be anticipated that the use of the procedures over an extended number of watches will result in consistent ratings which will agree about as well as could be expected with other available measures of on-the-job effectiveness.

2. The form is acceptable to the personnel whose job it will be to use it. The elements of the form represent a comprehensive coverage of the job and the principles of its proper use can be readily understood and applied by senior controllers.

It is recommended that the Performance Record: Air Route Traffic Controller be adopted by the Air Traffic Control Division, Civil Aeronautics Administration, on an extended trial basis, for obtaining periodic efficiency ratings on controllers. A period of supervised use, emphasizing the training of seniors in the use of the Performance Record, and stressing the need for systematic observation and recording at regular intervals, is necessary as a basis for determining empirically the reliability of the procedure under day to day operating conditions.

In conclusion it can be said that the new procedure has the following advantages over rating methods presently in use:

1. Ratings are based on actual records of observed job behavior. Thus they are not based on what seniors can recall about his controllers proficiency at the end of a long rating period, but on an accurate record of what he was actually observed to do on the job.

2. Records are kept of controllers' behavior in those aspects of the job which were shown by research to be most important in discriminating safe, effective control practices from those which result in hazards to aircraft.

3. The form is less affected by bias than subjective rating procedures; a fairer job of rating can be accomplished. The recorded behaviors on which ratings are based are spelled out specifically for the rater, leaving little opportunity for the haphazard interpretations that are often made of trait-names.

4. The procedure has implications for employee development -- a record of this sort enables supervisors to pin-point the employee's weak areas where practice and training would improve his performance as well as pointing up the areas where he excells.

APPENDIX A

THE PROBLEM OF DELAYS TO APPROACHING AND DEPARTING AIR TRAFFIC

THE PROBLEM OF DELAYS TO APPROACHING AND DEPARTING AIR TRAFFIC

Data pertaining to the problem of why aircraft are delayed on take-off or landing during IFR weather were collected in connection with field trips on the Air Traffic Control project. The following materials were obtained either from the manuals listed or from notes taken during conversations with the following individuals:

(1) Mr. C. A. Church, Chief Air Route Traffic Controller, Cleveland
(2) Mr. Clark Croft, Chief Airport Traffic Controller, Cleveland
(3) Mr. Fred Lorch, Senior Air Route Traffic Controller, Cleveland
(4) Mr. D. E. Barrows, Aeronautical Specialist, 3rd Region
(5) Mr. L. L. Kullenberg, Chief, Operations Inspections Staff, Washington
(6) Mr. L. Bitzler, Office of Federal Airways, Washington
(7) Mr. W. E. Britton, Air Traffic Control Division (airport), Washington
(8) Dr. L. B. Anderson, Research Consultant, Civil Aeronautics Administration, Washington

The single factor contributing most to delays to air traffic in IFR weather is the need for maintaining certain separation minima. The basic rules concerning separation requirements state "...that any aircraft estimated to be less than fifteen (sometimes ten) minutes ahead of, or behind..." another aircraft "...must be at least a thousand feet higher or lower or must be so located laterally that no possibility of collision exists."[1] The many complexities and exceptions that affect these basic rules are too numerous to list but are largely dependent on weather condition, or availability of radio facilities. The following excerpts from a manual of air traffic control procedures may serve to illustrate the types of exceptions that exist:[2]

(Longitudinal Separation Minimums)

2.01011 Aircraft flying on crossing courses:
(1) Ten minutes if radio facilities permit frequent determination of position and speed; otherwise fifteen minutes.

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[1] U. S. Department of Commerce, Civil Aeronautics Administration, Airways Operations Service: Air Route Traffic Control Study Guide, Washington D. C., July, 1947.

[2] U. S. Department of Commerce, Civil Aeronautics Administration: Procedures for the Control of Air Traffic. Washington, Effective Date: May 1, 1948.

(Vertical Separation Minimums)

2 0201 Minimum 1000 feet, except as provided in 2.11013 and by all operators on long transoceanic routes where a reduction in altitude separation is necessary due to the relatively few cruising altitude levels available which permit proper fuel economy below altitudes which require continuous use of oxygen equipment.

(Lateral Separation Minimums)

2.0301 (3) Geographical Separation -- Separation positively indicated by position reports over different geographical locations as determined visually or by reference to a radio facility.

The requirements illustrated in the above regulations were based on the opinions of many qualified people and are required to allow margins of safety for two important variables - pilot and instrument error.

Other delay-producing factors are:

(a) The variety of equipment - many different types of aircraft - all with different cruising speeds.
(b) The necessity for indirect communication with pilots - to get a pilot out of a holding stack on to the approach now consumes approximately five minutes more than it would if controllers communicated with the pilots directly instead of going through company radio.
(c) Manual posting of flight information is another contributing factor.
(d) The involved coordination between agencies that is required under the present system.
(e) In some cases, Cleveland, for example, overtraffic delays departures and arrivals.
(f) Physical limitations of the airport - size of field, amount of navigational aid equipment, radar, etc., and topography of airport locale - trees, buildings, etc.
(g) The type of operations conducted at the airport - the degree to which commercial, military, or private flying predominates.
(h) The "first come first served" policy of approaches - one aircraft which is not equipped to take advantage of ILS systems, for example, delays those who can.
(i) Errors of dispatching.
(j) Small accidents - lost passengers, baggage, late mail, etc.
(k) The fact that many of the center and tower personnel are relatively new and inexperienced - in many instances where an experienced controller will clear an aircraft without delay, a less experienced man will hold the plane for ten minutes because "...he isn't sure".

(l) Inaccuracy of position reports.
(m) The separation required at a holding fix is 1000 feet. The best descent aircraft make is 500 feet per minute. Even if no other delay is experienced a minimum of two minutes is required to get the plane down to the approach.
(n) The tendency of airport traffic controllers to wait until the number one plane to land out of a stack is within sight before clearing number two to start his descent rather than advising number two to descend five minutes after the first is cleared.
(o) Delay is fundamentally an equipment problem. We need equipment that simulates VFR conditions, such as pictorial radar.
(p) The competition among airlines to get in first is a delay causing factor.

Reasons for Differences in Records Set by the Airlift and those in the U.S.

The opinions of the Civil Aeronautics Administration personnel regarding the reasons underlying the record of the Berlin Airlift's traffic control are:

(a) The airlift is equipped with the last word in radar equipment. A recent installation at one field cost $1,500.000.
(b) Direct communication between pilots and center is maintained.
(c) Pilots fly constant airspeed.
(d) All one type of equipment - DC-4's.
(e) No "go-arounds" or missed approaches.
(f) The most important difference is that in Berlin the pilots are told what to do not requested and violators of regulations can be disciplined.
(g) Separation requirements are lower.
(h) The army operates on the principle that 10% of the ships and personnel are expendable.
(i) The Air Traffic Control centers in Berlin control the whole picture - in the U.S. "...we never know who is coming next. If we could say that all traffic landing at Cleveland had to come in over Columbus at three minute intervals - we could do it too".
(j) Berlin airlift approach controllers control traffic from the face of the radar scope. By the use of this method, they have eliminated the use of the flight progress board.

APPENDIX B

OBSERVATIONAL RECORD FORM
AIR ROUTE TRAFFIC CONTROLLER

SUMMARY AND INSTRUCTION SHEET

NAME _____

FROM _____ TO _____

OBSERVATIONAL RECORD FORM: AIR ROUTE TRAFFIC CONTROLLERS

I. ISSUING DEPARTURE CLEARANCES

1. Assigning Altitudes

_____a. Assigned an altitude occupied by other acft.
_____b. Failed to assign altitudes in order of request.
_____c. Ignored acft type and limitations in his clearances.
_____d. Used high or low altitudes when others were available.
_____e. Assigned below minimum altitude.
_____f. Ignored proposed flight plans in his clearances.

_____A. Provided standard separation requirements despite bad weather, heavy traffic, or personnel shortages.
_____B. Assigned altitudes in order of request in spite of unfavorable conditions.
_____C. Assigned altitudes appropriate to acft type and limitations.
_____D. Utilized all available altitudes.
_____E. Devised a new method to gain additional altitudes.

2. Assigning Climbing Courses

_____a. Assigned a course resulting in a confliction.
_____b. Failed to use all available climb-out procedures.
_____c. Failed to issue the simplest climb-out instructions.
_____d. Issued incomplete climb-out instructions.
_____e. Assigned courses too late to prevent delay.

_____A. Provided standard separation requirements for all acft in spite of adverse conditions.
_____B. Utilized all available climb-out procedures.
_____C. Devised a new method to facilitate climb-out.

3. Arranging the Takeoff Sequence

_____a. Ignored the differences in speed between acft in his clearance.
_____b. Made no arrangements for a takeoff sequence of a mass flight.

_____A. Cleared fast acft off before slow.
_____B. Cleared a mass flight with a single procedure.

4. Estimating or Preventing Takeoff Delays

_____a. Issued a clearance which ignored relevant information.
_____b. Did not use all available routes.
_____c. Delayed issuing departure clearances.
_____d. Scheduled delay time in the air.
_____e. Blocked departures with arrivals and over traffic.
_____f. Used a hazardous short-cut method.
_____g. Declared an emergency when none existed.

_____A. Obtained all pertinent information for accelerating departures.
_____B. Used all available routes.
_____C. Had clearances ready on request.
_____D. Scheduled delay time on the ground.
_____E. Prevented arrivals from blocking departures.
_____F. Devised a new method which prevented delays.
_____G. Advised those involved of schedules.

****

II. REVISING FLIGHT PLANS AND CLEARANCES

5. Changing VFR-IFR Flight Plans

_____a. Used VFR flight instead of providing standard separation requirements.
_____b. Utilized VFR flight in IFR weather.
_____c. Failed to advise pilot of change in flight plan.

_____A. Provided standard separation requirements despite bad weather, heavy traffic or personnel shortages.
_____B. Kept traffic in continuous flight.

II. (continued)

6. Changing Destinations

_____a. Failed to provide standard separation requirements.
_____b. Suggested destination change without apparent reason.

_____A. Provided standard separation requirements for all acft in spite of adverse weather, traffic or personnel conditions.
_____B. Recommended changes to avert hazards.
_____C. Anticipated changes and issued them on request.

7. Changing Altitudes

_____a. Failed to use altitude changes to provide standard separation requirements.
_____b. Failed to provide standard separation requirements after need had been pointed out.
_____c. Issued irrelevant instructions.
_____d. Used an altitude previously vacated because of hazards.
_____e. Sent one acft through altitude of another without providing standard separation requirements.
_____f. Utilized an already filled altitude.
_____g. Failed to give specific instructions.

_____A. Provided standard separation requirements immediately on receiving requests.
_____B. Anticipated the need for changing altitudes.
_____C. Applied only those restrictions which were relevant.
_____D. Changed acft to altitude suitable to such acft.

8. Changing Courses and Routes

_____a. Failed to use alternate routes to provide standard separation requirements.
_____b. Delayed acft instead of using available alternate routes.
_____c. Changed course of acft to intersect course of another.

_____A. Provided emergency separation requirements by changing courses.
_____B. Utilized alternate routes to avoid delays.
_____C. Utilized alternate routes to avoid hazards.
_____D. Anticipated the necessity of changing routes to avoid hazards.

9. Changing Time Schedules

_____a. Failed to provide standard time separation when needed.

_____A. Provided emergency separation requirements by changing time schedules of acft.
_____B. Utilized change to avoid delays.

****

III. AIDING AIRCRAFT IN TROUBLE

10. Clearing Airspace for Emergency Descents

_____a. Failed to descend acft upon request.
_____b. Failed to provide standard separation requirements.
_____c. Failed to keep acft from entering the emergency area.

_____A. Acted in sufficient time for safety of acft.
_____B. Provided standard separation requirements for descent immediately upon notification.
_____C. Anticipated necessity for clearing airspace.
_____D. Did not penalize other traffic.
_____E. Selected appropriate altitude for relieving emergency condition.

11. Locating Lost Aircraft

_____a. Failed to use all available means for locating acft.
_____b. Suggested an impracticable and irregular method for locating acft.
_____c. Failed to check location of acft which had been lost.

_____A. Used all standard means of locating acft.
_____B. Devised an original method for locating acft.
_____C. Continued search when it was no longer his responsibility.

12. Orienting Lost Pilots

_____a. Failed to put acft in contact with direction finding agencies.
_____b. Failed to exhaust all standard means for orienting a lost pilot.

_____A. Put acft in immediate contact with appropriate direction finding agencies.
_____B. Ferret out information leading to location and orientation of acft.
_____C. Continued the search after other agencies stopped.

13. Organizing Rescue Facilities

_____a. Failed to alert rescue facilities in time for safety of acft.

_____A. Alerted rescue facilities immediately upon request.
_____B. Anticipated the need for rescue facilities.
_____C. Instituted his own rescue procedure.
_____D. Prevented duplication of rescue facilities.
_____E. Alerted sufficient facilities to cover the area.

14. Clearing Airspace for Lost Aircraft

_____a. Sent acft into same area as a lost acft.

_____A. Cleared area as soon as acft reported lost.
_____B. Cleared area into which acft might go.
_____C. Notified pilot of clear airspace.

15. Contacting Aircraft with Radio Failure

_____a. Delayed issuing information to acft by blind broadcast.
_____b. Failed to exhaust all means of contacting acft.

_____A. Anticipated a radio failure and prepared to use emergency methods.
_____B. Utilized all radio facilities in area to establish contact.
_____C. Utilized inter-plane communication facilities.

16. Providing Alternate Bases

_____a. Failed to provide an alternate when requested.
_____b. Provided an alternate out of fuel range of acft.
_____c. Made no arrangements for providing alternates.

_____A. Provided several alternates.
_____B. Provided alternate within fuel range.
_____C. Provided alternate suitable to acft.
_____D. Prepared to handle requests for alternates in advance.
_____E. Provided alternate for acft no longer his responsibility.

17. Providing for Emergency Landings

_____a. Failed to make any arrangements for emergency landing.

_____A. Organized personnel and equipment at emergency base.
_____B. Issued complete instructions to pilot.
_____C. Arranged an escort for the approach.
_____D. Utilized all possible approach courses.

****

18. Utilizing Communication Facilities

_____a. Made individual calls instead of conferencing.
_____b. Made several calls where only one was needed.

_____A. Conferenced calls to ease interphone congestion.
_____B. Relayed information through other agencies.
_____C. Arranged to send information through seldom used communication channels.
_____D. Handled several transactions during one call.

19. Coordinating Inter-Sector Traffic

_____a. Sent acft from his sector at altitudes most convenient to himself.
_____b. Recommended a revision of flight plans in another sector without a reason.
_____c. Would accept acft from other areas only at altitudes convenient to him.
_____d. Failed to provide standard separation requirements for inter-sector traffic.
_____e. Failed to use all the altitudes available for inter-sector traffic.
_____f. Failed to restrict the use of altitudes by other centers.
_____g. Disregarded another controller's disapproval of a clearance.
_____h. Failed to check with other controllers when sending acft from his sector.

_____A. Arranged traffic to suit the pattern in other sectors.
_____B. Rearranged traffic in his sector to provide standard separation requirements for inter-sector traffic.
_____C. Used all altitudes available for inter-sector traffic.
_____D. Restricted traffic from entering congested sector.
_____E. Kept altitudes open for inter-sector traffic.

20. Issuing or Requesting Pertinent Information

_____a. Neglected to ask for essential information.
_____b. Issued or requested information at times inconvenient to others.
_____c. Issued or requested superfluous information.
_____d. Failed to issue expected approach or delay times.
_____e. Failed to advise another controller of inter-sector traffic.
_____f. Failed to inform others of change in plans.
_____g. Argued control procedures on interphone.
_____h. Failed to explain clearance cancellation.

_____A. Issued or requested information essential to the safety of the acft.
_____B. Issued or requested essential information without bothering others.
_____C. Issued or requested only essential information.
_____D. Issued expected approach or delay times in advance of requests.

21. Issuing or Requesting Information Promptly

_____a. Delayed answering clearance requests or accepting information while performing routine tasks.
_____b. Waited for requests before delivering flight plans.
_____c. Failed to stand by when requesting information.
_____d. Failed to answer a request for a clearance.
_____e. Hesitated and made many amendments when issuing information.
_____f. Failed to repeat information as requested.
_____g. Delayed assigning available altitudes to other sectors.

_____A. Answered the interphone upon receipt of signal.
_____B. Anticipated necessity for issuing or obtaining information.
_____C. Avoided callbacks by standing by when obtaining information.
_____D. Issued or requested information in sufficient time to take action.

22. Issuing Traffic and Weather Advisories

_____a. Failed to prevent hazards by issuing advisory information.
_____b. Refused to issue requested advisory information.

_____A. Advised acft in advance to avoid hazardous area.
_____B. Issued advisory to acft not his responsibility.

23. Issuing and Requesting Accurate Information

_____a. Issued or accepted incorrect information with subsequent callbacks or conflictions.
_____b. Issued or obtained incomplete information with subsequent callbacks or conflictions.
_____c. Revised a clearance without cancelling the original,
_____d. Based his clearances on inaccurate data.

_____A. Issued or obtained accurate information which did not need callbacks, revisions or repeats.
_____B. Issued or obtained complete information which did not need callbacks, revisions or repeats.

24. Speaking Intelligibly

_____a. Failed to use standard phraseology.
_____b. Spoke so rapidly that repeats were necessary.
_____c. Failed to enunciate clearly and made repeats necessary.

_____A. Spoke at a rate which enabled communicator to copy information.
_____B. Enunciated clearly making repeats unnecessary.

25. Briefing His Successor at the Board

_____a. Failed to give his successor complete information.
_____b. Failed to complete a particular operation before turning the board over.

_____A. Advised his successor of all information pertinent to traffic.
_____B. Prepared all information needed to handle flights on successive watch.

****

V. PLANNING APPROACH PROCEDURES

26. Arranging Holding and Stacking Patterns

_____a. Prevented approaches from using holding points by holding other traffic unnecessarily.
_____b. Held acft when he could have kept them in flight.
_____c. Failed to provide standard separation requirements for acft in stack.
_____d. Ignored special limitations of acft when stacking.
_____e. Made no provision for stacking if the weather closed in.
_____f. Utilized a prohibited holding point.

_____A. Facilitated approaches and departures by method of stacking.
_____B. Devised a makeshift holding point to expedite traffic.
_____C. Provided standard separation requirements for acft in stack in spite of bad weather, heavy traffic or personnel shortages.

27. Organizing Approach Sequences

_____a. Failed to sequence acft in order of arrival.
_____b. Blocked approach courses with over traffic.
_____c. Failed to give preference to acft with low fuel supply.
_____d. Failed to provide standard separation requirements.
_____e. Gave indefinite instructions concerning use of approach courses.
_____f. Lowered approaching acft before courses were open.
_____g. Made no provision for standard separation requirements in event of weather change.

_____A. Reorganized traffic in his sector in order to sequence acft according to order of arrival.
_____B. Kept over traffic away from approach courses.
_____C. Gave preference to acft low on fuel.
_____D. Provided standard separation requirements despite unfavorable weather, traffic or personnel conditions.
_____E. Carefully allocated approach courses to heavy traffic.
_____F. Approached acft at low altitudes.
_____G. Sequenced approaches and handled an emergency simultaneously.

28. Releasing Aircraft to Approach Control

_____a. Failed to provide standard separation requirements.
_____b. Released acft to tower before it reached legal limit.
_____c. Released acft to tower at high altitudes when lower altitudes were available.

_____A. Provided standard separation requirements for all acft in spite of adverse conditions.
_____B. Improved communication with acft by releasing it to tower sooner than usual.

29. Determining the Saturation Point

_____a. Failed to restrict traffic from entering a congested area.

_____A. Restricted traffic from entering congested area.
_____B. Anticipated congestion and restricted traffic.

30. Estimating and Preventing Delay Time in Approaches

_____a. Failed to obtain accurate approach times.
_____b. Used an involved approach when simpler ones were possible.
_____c. Failed to utilize all available altitudes.
_____d. Blocked low altitudes with other traffic.
_____e. Failed to provide standard separation requirements until acft were on the same course.
_____f. Allowed acft to enter his sector in random order.
_____g. Placed irrelevant restrictions on acft.

_____A. Issued approach times in advance of approaches.
_____B. Utilized all available approach courses.
_____C. Kept approach courses free of over traffic.
_____D. Held acft until needed altitudes were available.
_____E. Conferenced all personnel involved in a complex approach pattern.
_____F. Suggested alternates to acft unable to take delay time.

****

VI. SUPERVISING PERSONNEL

31. Training Assistants

_____a. Explained a procedure incorrectly.
_____b. Gave an incomplete explanation of a procedure.
_____c. Refused to explain a control problem.
_____d. Neglected to give any instructions to an assistant.
_____e. Did not apply a training aid as instructed.
_____f. Made a derogatory remark about the center's training program.
_____g. Failed to find an assistant's error.

_____A. Provided a definite explanation of a procedure so that assistant understood it.
_____B. Provided several solutions to a control problem.
_____C. Voluntarily devised a training aid.
_____D. Noted and corrected an assistant's error.

32. Delegating Responsibility to Assistants

_____a. Assigned an assistant to handle more work than he could.
_____b. Rejected the suggestions of his assistants.
_____c. Did not supervise an assistant who was handling the board.
_____d. Refused to help a busy assistant.

_____A. Encouraged his assistant to assume responsibility.
_____B. Offered help to assistant without "taking over."

33. Allocating Personnel

_____a. Failed to request aid when it was impossible to handle traffic without it.
_____b. Failed to anticipate personnel needs in advance of watch.

_____A. Asked for assistance with congested sector.
_____B. Utilized assistants where they were needed.
_____C. Assigned personnel to tasks they were able to perform.

VII. [illegible] BOARD

26. Removing Data Strips

_____a. Failed to remove strips from board after completion of flight.

_____A. Kept only those strips needed for current flights.

27. Posting Complete and Accurate Data

_____a. Posted information which others were unable to read.
_____b. Failed to post all required traffic information.
_____c. Posted information on wrong strips.
_____d. Posted incorrect information.

_____A. Posted information so that others could use it without requesting information.
_____B. Posted all required information.

28. Organizing the Board Quickly

_____a. Posted flights so slowly that others were inconvenienced.

_____A. Familiarized himself with the board within a few minutes after taking over.

****

VIII. HELPING OTHER CONTROLLERS

29. Recognizing Conflictions in Other Sectors

_____a. Failed to avert a confliction which he noticed in an adjacent sector.

_____A. Pointed out a confliction to another controller.
_____B. Volunteered to assist another controller with a confliction.
_____C. Applied standard separation requirements for conflicting data in another sector.

30. Assuming Another Controller's Responsibilities

_____a. Refused to assist an overworked controller.
_____b. Neglected part of the work he had offered to do.

_____A. Took over some of a busy controller's work when he was not busy himself.
_____B. Although busy himself, volunteered to take over part of another's work.

31. Helping in the Solution of Other's Problems

_____a. Refused a request for advice.

_____A. Pointed out the solution to another's problem.
_____B. Pointed out procedures for avoiding other problems in the future.
_____C. Corrected the misconceptions of others concerning control procedures.

****

IX. MAINTAINING HARMONIOUS RELATIONS WITH OTHERS

40. Demonstrating Confidence in Others

_____a. Changed procedures instituted by another without reasonable cause.
_____b. Ignored the suggestions of others.
_____c. Checked up on the control procedures of others for no apparent reason.
_____d. Rudely refused to accept the suggestions of others.

_____A. Accepted the suggestions of others.

IX. (continued)

41. Criticizing Others

_____a. Was harsh in criticizing a fellow worker.

_____A. Corrected errors so that others accepted criticism.
_____B. Allowed others to correct their own mistakes after they were pointed out.

42. Maintaining Good Public Relations

_____a. Was rude to airlines personnel.
_____b. Reprimanded airlines personnel.
_____c. Refused to give information or help to an outside agency.
_____d. Was criticized by airlines for failure to issue information.
_____e. Ridiculed center to airlines.

_____A. Diplomatically explained a traffic situation to airlines personnel.
_____B. Assisted in a situation unrelated to controlling activities.
_____C. Was commended by an outside agency for help which he had given them.

43. Accepting Responsibility

_____a. Ridiculed procedures and practices of the center.
_____b. Attempted to evade responsibility for a confliction by falsification.
_____c. Refused to conform to center regulations.
_____d. Refused to correct an error he had made.
_____e. Failed to get complete information before presenting findings of investigation.
_____f. Failed to apply a new control procedure.
_____g. Delayed performing a task and left it for another to do.
_____h. Left the board without informing anyone.
_____i. Refused to cooperate with other controllers.
_____j. Took sick leave when not ill.

_____A. Upheld procedures and practices of the center to others.
_____B. Accepted responsibility for his errors.
_____C. Remained overtime to complete a piece of work.
_____D. Volunteered a helpful suggestion.

44. Obtaining Cooperation from Others

_____a. Failed to get cooperation from others because he demanded it.

_____A. Asked for help in such a way that others cooperated willingly.

****

X. MAINTAINING EMOTIONAL CONTROL

45. Accepting Criticism

_____a. "Told off" person offering criticism.
_____b. Refused to cooperate after being criticized.
_____c. Blamed someone else for his errors.

_____A. Accepted a just criticism without comment.
_____B. Made an effort to correct error for which he had been criticized.

46. Maintaining Composure under Stress

_____a. Was unable to use control procedure under pressure of heavy workload.
_____b. Annoyed other workers by continually requesting help in an emergency.
_____c. Became physically ill during period of heavy traffic because he could not control traffic.
_____d. Was unable to continue controlling traffic safely after making a mistake.

_____A. Did not become confused under pressure of heavy workload.
_____B. Worked entire shift under peak conditions without becoming flustered.
_____C. Prepared for an emergency without becoming excited.
_____D. Did not become disorganized after discovering an error he had made.

****

OBSERVATIONAL RECORD FORM: AIR ROUTE TRAFFIC CONTROLLER

FACILITY OF CIVIL AERONAUTICS ADMINISTRATION

THE DEVELOPMENT OF THE FORM

The Observational Record Form was developed from data provided largely by senior controllers, chiefs, controllers, and other Air Traffic Control personnel. The data consisted of 1249 reports of incidents in which controllers were considered successful or unsuccessful at some important element of their job. These reports were given by individuals who knew the problems of air traffic control and who had had a great deal of experience with controllers and their work. The incidents were gathered in centers all over the country and represent the types of control situations met in the various areas. All incidents were pooled and then sorted in terms of the elements of the job with which they were concerned. It was found that the controller's job could be divided into ten major elements and 46 sub-elements. In each incident the controller's critical act was isolated and classified under one of the 46 sub-elements. Each critical act appearing on the form is a description of the actual behavior of a controller, as reported by ATC personnel. Incidents containing the same act were grouped. The Observational Record Form contains 309 descriptions of acts which were considered by ATC personnel to be either successful or unsuccessful ways of performing important elements of the job. By observing controllers on the job, and recording their actions in terms of the critical acts in the form, it will be possible to evaluate their performance on the important elements of their jobs.

INSTRUCTIONS ON THE USE OF THE FORM

The observer should become familiar with the contents of the Observational Record Form by reading over the entire booklet before making any observations. When using the booklet, he should observe the controller in as many work situations as possible in order to get an accurate picture of the controller's effectiveness in all parts of the job. The form covers outstanding and unsatisfactory performance on the most important elements of the controller's job. The first set of statements appearing in each section represents unsatisfactory performances and each statement is preceded by a lower case letter. Outstanding performances are represented by statements which are underlined and identified by capital letters.

The two examples given below show the way in which the Observational Record Form should be used.

A controller was observed by his Senior to clear an aircraft to descend through the altitude of a lower flying aircraft without providing separation. To record this action, the observer should first locate the job element which the controller was performing when it occurred. In this case, the job element is that of changing clearances. Area II- Revising Flight Plans and Clearances covers this part of the job. Sub-area 7 is specifically concerned with "Changing Altitudes." Item "e" in sub-area 7 - "Sent one acft through altitude of another without providing standard separation requirements" closely resembles the observed action. A tally mark should be placed on the appropriate line.

Another controller was observed to issue a specific departure clearance to the first of a large group of military aircraft with instructions that this aircraft report when reaching top and release the next aircraft which would do the same. To record this action the observer should locate the area covering the issuance of departure clearances. This is Area I - Issuing Departure Clearances. Sub-area 3 - "Arranging the Takeoff Sequence" contains an item specifically describing the use of a single clearance for the departure of a group of aircraft. Item B, "Cleared a mass flight with a single procedure" closely resembles the observed behavior. A tally mark should be placed on the appropriate line.

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SUMMARY FORM

NOTE: Count up the unsatisfactory and outstanding tally marks which you made in the booklet under each sub-area. Enter these totals in the appropriate space in the "Unsatisfactory" and "Outstanding" columns.

	Unsatisfactory	Outstanding	Total
I. ISSUING DEPARTURE CLEARANCES			
1.			
2.			
3.			
4.			
II. REVISING FLIGHT PLANS AND CLEARANCES			
5.			
6.			
7.			
8.			
9.			
III. AIDING AIRCRAFT IN TROUBLE			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
IV. COORDINATING WITH OTHERS			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
V. PLANNING APPROACH PROCEDURES			
26.			
27.			
28.			
29.			
30.			
VI. SUPERVISING PERSONNEL			
31.			
32.			
33.			
VII. HANDLING THE BOARD			
34.			
35.			
36.			
VIII. HELPING OTHER CONTROLLERS			
37.			
38.			
39.			
IX. MAINTAINING HARMONIOUS RELATIONS WITH OTHERS			
40.			
41.			
42.			
43.			
44.			
X. MAINTAINING EMOTIONAL CONTROL			
45.			
46.			

COMMENTS:

APPENDIX C

PERFORMANCE RECORD: AIR ROUTE TRAFFIC CONTROLLER

AND

MANUAL OF INSTRUCTIONS

PERFORMANCE RECORD: AIR ROUTE TRAFFIC CONTROLLER

Controller's name _____ Center _____

Years of controller experience _____ Senior controller or other observer _____

This period of observation includes _____ full watches.

(NOTE: Do not attempt to use this form without consulting the manual.)

Mark √ - + in boxes, per instructions in manual.

OUTSTANDING ←——— | ———→ UNSATISFACTORY

I. CONTROL DUTIES

A. Departure and Enroute Clearances

- ☐ 1. Arranging takeoff sequence and minimizing takeoff delay
- ☐ 2. Assigning altitudes
- ☐ 3. Assigning courses
- ☐ 4. Providing time separation

B. Revising Clearances Enroute

- ☐ 5. Providing altitude separation
- ☐ 6. Providing lateral separation
- ☐ 7. Providing time separation

C. Planning Approach Sequence

- ☐ 8. Organizing approach sequence
- ☐ 9. Holding aircraft
- ☐ 10. Releasing aircraft to approach control

D. Coordinating With Others

- ☐ 11. Coordinating traffic (inter-sector, inter-center, and with other agencies)
- ☐ 12. Utilizing communications facilities

E. Applying Emergency Procedures

- ☐ 13. Providing airspace for emergency descents and landings
- ☐ 14. Organizing search and rescue facilities

F. Handling Flight Progress Boards

- ☐ 15. Posting and removing flight progress strips

G. Supervising Personnel

- ☐ 16. Delegating responsibility to assistants
- ☐ 17. Training assistants

II. PERSONAL RELATIONSHIPS

H. Relations With Others

- ☐ 18. Helping other controllers
- ☐ 19. Obtaining cooperation from others
- ☐ 20. Criticizing others

I. Personal Responsibility

- ☐ 21. Accepting responsibility

J. Emotional Control

- ☐ 22. Maintaining composure under stress
- ☐ 23. Accepting criticism

M A N U A L

TO ACCOMPANY THE PERFORMANCE RECORD: AIR ROUTE TRAFFIC CONTROLLER

Developed by the American Institute for Research with the cooperation of Air Traffic Control personnel as a research project under the auspices of the National Research Council Committee on Aviation Psychology with funds from the Civil Aeronautics Administration

A M E R I C A N I N S T I T U T E F O R R E S E A R C H

Pittsburgh 13, Pennsylvania

OCTOBER 1949

UNIT I

HOW TO USE THE OBSERVATIONAL RECORD FORM

How the Form was Developed

Senior controllers, chiefs, controllers and other Air Traffic Control personnel provided most of the data from which the Performance Record was developed. These people knew the problems of air traffic control and had a great deal of experience with controllers and their work.

The data consisted of 1,649 reports of "incidents" -- actions of controllers in which they were considered either successful or unsuccessful at some important element of their job. The individuals who reported the incidents had actually seen controllers perform these outstanding or unsatisfactory acts. Incidents came from centers all over the country; they represent the types of control situations met in all the various areas.

All incidents were pooled and then sorted into groups according to the elements of the job with which they were concerned. It was found that the controller's job could be divided into 23 elements and a number of sub-elements. These 23 elements appear on the Performance Record; they represent the critical parts of the job of Air Route Traffic Controller. Part II of this manual gives a list of the various sub-elements, or standards; do not attempt to use the Performance Record without consulting this list, as explained below.

The Purpose of the Performance Record

The purpose of the Performance Record is to help you in rating the performance of controllers. With the Performance Record, you base your ratings, not on memory or general impressions, but on records of the important things you actually observed the controller do on the job. Over a period of weeks or months, these behavioral records will accumulate in each controller's Performance Record. When the time comes to make efficiency ratings, you will have before you a history of performance from which you can extract an objective picture of his proficiency.

What to Record

You make a record of any action by the controller which is either outstanding or unsatisfactory. As long as a controller does his job in a merely satisfactory or average way, you make no record. But when he does something important - something either unusually effective or

ineffective - then you mark in the Performance Record. You will find that these actions are easy to see and remember; these are the actions which everyone can agree are either especially good or definitely unsatisfactory. They should also be the actions which are of critical importance for proficiency in the job of controller.

In general, an outstanding act is one which contributes markedly to the efficiency or effectiveness of the center. An outstanding act goes beyond what is normally expected of a controller; it expedites the safe flow of traffic to an unusual extent, often in the face of considerable difficulties.

On the other hand, an unsatisfactory act detracts from the effectiveness of the center. It is an act which falls below the standards you demand of all controllers; directly or indirectly, it hinders the safe flow of traffic. If the controller were to continue to behave in this way, you would begin to consider him incompetent in his job.

These general principles tell you the sort of thing to look for. To determine more specifically which acts are of critical importance in the controller's job and should therefore be recorded, you will need to refer to Part II of this manual.

How to Use the Manual

You will notice that the 23 elements of the job are repeated in this manual. Under the elements are a number of descriptions of behavior; these are generalized statements of critical actions which demonstrate standards of outstanding or unsatisfactory behavior on the part of a controller. You will want to become familiar with the general nature of these statements before you begin to use the Performance Record.

When you want to record an outstanding or unsatisfactory action of a controller, refer to the manual. Look for the description of behavior which most closely resembles the action you saw the controller perform. You can do this most efficiently by finding first the appropriate job element, and then the applicable behavioral statement. Here are two examples, to make this process clear.

1. Suppose that you have observed John Doe, a controller under your supervision, perform what you consider an unsatisfactory act: He placed an aircraft which was dangerously close to exhausting its fuel reserve at the top of a holding stack when he might have cleared it in first with only minor inconvenience to other traffic.

To record this action, turn first to the manual to find the applicable behavioral statement. This is found under element 9, "Holding Aircraft". Item d is the one: "Ignored special limitations of aircraft when stacking." So you should mark an "X" on controller Doe's record form in one of the small squares on the unsatisfactory side under element 9. To indicate unsatisfactory controller performance, start at the center line and first mark the dotted squares outward towards the right hand margin of the page.

2. Controller George Spelvin was checking traffic in adjacent sectors and noted a confliction on another controller's board. He pointed out the confliction and offered to issue the necessary clearances, since the other controller was busy. You feel (we will assume) that Spelvin's action was outstanding, and that his offer of help was the important thing that made it outstanding. In this case, the appropriate behavioral statement is item f: "Volunteered to assist another controller with a confliction" under element 18: "Helping other Controllers." Therefore, you mark an "X" under element 18 in one of the small squares of the Outstanding side. To record outstanding behaviors, mark the small squares to the left of the center line towards the left hand margin.

Of course, after you have used the Performance Record and the manual for a time, you will be familiar with many of the behavioral statements. You can then bypass part of this process. But be sure that you consult the manual, as we have indicated, whenever you observe an action which you have not previously checked in the manual.

When to Record

It is usually not feasible to record the incidents you observe immediately after they happen. From preliminary tryouts on the form, it was found that most senior controllers or other observers prefer to do their recording at or near the end of the watch in which they observed the actions. You will find that you can remember incidents until the end of the watch, since they involve unusual actions. But, if you wait until the next day, you may forget some of the incidents or forget just exactly what happened.

How to Make Efficiency Ratings

When you make entries on the Performance Record, you can indicate only two things: outstanding performance and unsatisfactory performance. This procedure has two advantages:

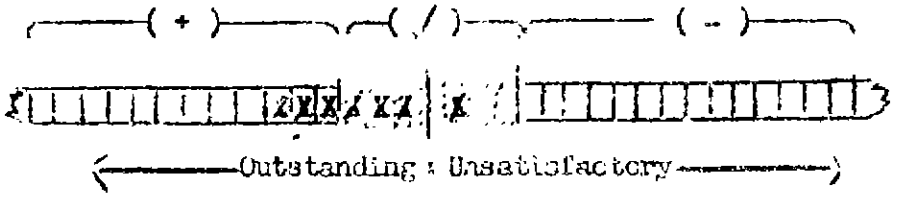
1. It makes your job of rating the controller's performance easier. You need only decide that an action is outstanding

or unsatisfactory; there are no fine distinctions to be made, such as whether a man's performance is 89% perfect or 90% perfect.

2. The judgments you make will be essentially the same as any other competent supervisor would make about the same controller in the same situation. It is easier to get agreement about what is outstanding than it is to agree, for example, on what is "a little above average." Thus, you will be as fair to the individual controller as possible.

however, to report a controller's performance on the 23 elements you want to have more than two ways to describe performance. The (+ ✓ -) descriptions used in Civil Service ratings were developed for this purpose. When you desire at appropriate times to prepare a summarizing efficiency report for the separate elements on the Performance Record, here is the procedure.*

Let us suppose that on element 9, "Holding Aircraft," controller Doe's Performance Record looks like this at the end of the rating period:



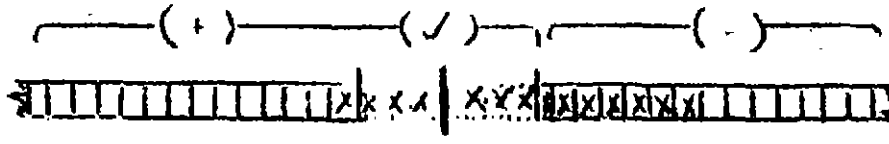
To arrive at a rating for controller Doe, simply count the number of "X's" and find the midpoint. The middle box in this case falls within the area of the dotted boxes; therefore, controller Doe's rating is a check (✓) for this element.† If the midpoint of the "X'ed" boxes had fallen to the left of the dotted box area, the rating would, of course, have been a plus (+).

---

*The procedure for determining a controller's over-all rating in terms of the 5 adjectives required by Civil Service is not included in the manual as yet. However the method will be essentially like that in the present Form 51.

†In cases when there are more than 5 "X'ed" squares on each side of the center line, the rating should be a check. (✓)

On another element, Doe's record looks like this:



Here the midpoint falls on the line separating the check (✓) from the minus (-) rating. In borderline cases such as this, the controller is ordinarily given a check. However, several factors might affect your decision as to the rating he should receive; such things as any trend you have noticed on the part of the controller to become more or less proficient over the rating period, "middle information" that doesn't get into the record, or other special circumstances or extenuating conditions. Although the form covers the critical aspects of the controller's job, there will be cases such as this where other factors will enter into your decision.

PART II

STANDARDS OF OUTSTANDING AND UNSATISFACTORY PERFORMANCE

This section is intended to help you locate the right element to cover some particular incident which you have seen and wish to record on a controller's Performance Record. Under each of the 23 elements you will find a list of statements of critical behavior, or standards. Statements of outstanding performance are on the left side of the page and are prefixed by capital letters (A); unsatisfactory standards are on the right and are prefixed by lower case letters (a). If the incident you observed does not exactly match some description under an element, fit the incident into the standard which most closely describes the important facts which were observed.

I CONTROL DUTIES
A. Departure and Enroute Clearances

1. Arranging takeoff sequence and minimizing takeoff delay

Outstanding	Unsatisfactory
A. Cleared fast aircraft off before slow.	a. Ignored the differences in speed between aircraft in his clearance.
B. Cleared a mass flight with a single procedure.	b. Made no arrangements for takeoff sequence of a mass flight.
C. Obtained all pertinent information for accelerating departures.	c. Did not use all available routes.
D. Used all available routes.	d. Delayed issuing departure clearances.
E. Had clearances ready on request.	e. Issued a clearance which ignored relevant information.
F. Scheduled delay time on the ground.	f. Scheduled delay time in the air.
G. Prevented arrivals from blocking departures.	g. Blocked departures with arrivals and over traffic.
H. Devised a new method which prevented delays.	h. Used a hazardous short-cut method.
I. Advised those involved of schedules.	i. Declared an emergency when none existed.

2. Assigning altitudes

Outstanding	Unsatisfactory
A. Provided standard separation requirements despite bad weather, heavy traffic or personnel shortages.	a. Assigned an altitude occupied by other aircraft.
B. Assigned altitudes in order of request in spite of unfavorable conditions.	b. Failed to assign altitudes in order of request.
C. Assigned altitudes appropriate to aircraft type and limitations.	c. Ignored aircraft type and limitations in his clearances.
D. Utilized all available altitudes.	d. Used high or low altitudes when others were available.
E. Devised a new method to gain additional altitudes.	e. Assigned below minimum altitude.
	f. Ignored proposed flight plans in his clearances.

3. Assigning courses

Outstanding	Unsatisfactory
A. Provided standard separation requirements for all aircraft in spite of adverse conditions.	a. Assigned a course resulting in a confliction.
B. Utilized all available climb-out procedures.	b. Failed to use all available climb-out procedures.
C. Devised a new method to facilitate climb-out.	c. Failed to issue the simplest climb-out instructions.
	d. Issued incomplete climb-out instructions.
	e. Assigned courses too late to prevent delay.

I CONTROL DUTIES
A. Departure and Enroute Clearances

4. Providing time separation

Outstanding	Unsatisfactory
A. Provided standard time separation requirements despite bad weather, heavy traffic, or personnel shortages.	a. Failed to provide standard time separation requirements.

5. Providing altitude separation

Outstanding	Unsatisfactory
A. Provided standard separation requirements immediately on receiving requests.	a. Failed to use altitude changes to provide standard separation requirements.
B. Anticipated the need for changing altitudes.	b. Failed to provide standard separation requirements after need had been pointed out.
C. Applied only those restrictions which were relevant.	c. Issued irrelevant instructions.
D. Changed aircraft to altitude suitable to such aircraft.	d. Used an altitude previously vacated because of hazards.
	e. Sent one aircraft through altitude of another without providing standard separation requirements.
	f. Utilized an already filled altitude.
	g. Failed to give specific instructions.

6 Providing lateral separation

Outstanding	Unsatisfactory
A. Provided emergency separation requirements by changing courses.	a. Failed to use alternate routes to provide standard separation requirements.
B. Utilized alternate routes to avoid delays.	b. Delayed aircraft instead of using available alternate routes.
C. Utilized alternate routes to avoid hazards.	c. Changed course of aircraft to intersect course of another.
b. Anticipated the necessity of changing routes to avoid hazards.	

b. Organizing approach sequence

Outstanding	Unsatisfactory
A. Reorganized traffic in his sector in order to sequence aircraft according to order of arrival.	a. Failed to sequence aircraft in order of arrival.
B. Kept over traffic away from approach courses.	b. Blocked approach courses with over traffic.
C. Gave preference to aircraft low on fuel.	c. Failed to give preference to aircraft with low fuel supply.
D. Provided standard separation requirements despite unfavorable weather, traffic, or personnel conditions.	d. Failed to provide standard separation requirements.
E. Carefully allocated approach courses to heavy traffic.	e. Gave indefinite instructions concerning use of approach courses.
F. Approached aircraft at low altitudes.	f. Lowered approaching aircraft before courses were open.
G. Sequenced approaches and handled an emergency simultaneously.	g. Made no provision for standard separation requirements in event of weather change.
H. Issued expected approach or delay times in advance of requests.	h. Failed to issue expected approach or delay times.

9. Holding aircraft

Outstanding	Unsatisfactory
A. Facilitated approaches and departures by method of stacking.	a. Prevented approaches from using holding points by holding other traffic unnecessarily.
B. Devised a makeshift holding point to expedite traffic.	b. Held aircraft when he could have kept them in flight.
C. Provided standard separation requirements for aircraft in stack in spite of bad weather, heavy traffic or personnel shortages.	c. Failed to provide standard separation requirements for aircraft in stack.
D. Restricted traffic from entering congested area.	d. Ignored special limitations of aircraft when stacking.
E. Anticipated congestion and restricted traffic.	e. Made no provision for stacking if the weather closed in.
F. Issued approach times in advance of approaches.	f. Utilized a prohibited holding point.
G. Utilized all available approach courses.	g. Failed to restrict traffic from entering a congested area.
H. Kept approach courses free of over traffic.	h. Failed to obtain accurate approach times.
I. Held aircraft until needed altitudes were available.	i. Used an involved approach when simpler ones were possible.
J. Conferenced all personnel involved in a complex approach pattern.	j. Failed to utilize all available altitudes.

(continued on next page)

9. Holding aircraft (con't)

Outstanding	Unsatisfactory
K. Suggested alternates to aircraft unable to take delay time.	k. Blocked low altitudes with other traffic.
	l. Failed to provide standard separation requirements until aircraft were on the same course.
	m. Allowed aircraft to enter his sector in random order.
	n. Placed irrelevant restrictions on aircraft.

10. Releasing aircraft to approach control

Outstanding	Unsatisfactory
A. Provided standard separation requirements for all aircraft in spite of adverse conditions.	a. Failed to provide standard separation requirements.
B. Improved communication with aircraft by releasing it to tower sooner than usual.	b. Released aircraft to tower before it reached the legal limit.
	c. Released aircraft to tower at high altitudes when lower altitudes were available.

11. Coordinating traffic (inter-sector, inter-center and with other agencies)

Outstanding	Unsatisfactory
A. Arranged traffic to suit the pattern in other control areas.	a. Sent aircraft from his sector at altitudes most convenient to himself.
B. Rearranged traffic in his sector to provide standard separation requirements for traffic from other areas.	b. Recommended a revision of flight plans in another control area without a reason.
C. Used all altitudes available.	c. Would accept aircraft from other areas only at altitudes convenient to him.
D. Restricted traffic from entering congested sector.	d. Failed to provide standard separation requirements for traffic from other areas.
E. Kept altitudes open for traffic from other areas.	e. Failed to use all the altitudes available.
F. Issued or requested essential information without bothering others.	f. Failed to restrict the use of altitudes by other control areas
G. Issued or requested only essential information.	g. Disregarded another controller's disapproval of a clearance.
H. Issued or requested information in sufficient time to take action.	h. Failed to check with other controllers when sending aircraft from his sector.
I. Issued or obtained accurate information which did not need callbacks, revisions or repeats.	i. Neglected to ask for essential information.

(continued on next page)

B. Coordinating traffic (inter-sector, inter-center and with other agencies) (con't)

Outstanding	Unsatisfactory
J. Issued or obtained complete information which did not need callbacks, revisions or repeats.	j. Issued or requested information at times inconvenient to others.
K. Anticipated necessity for issuing or obtaining information.	k. Issued or requested superfluous information.
L. Avoided callbacks by standing by when obtaining information.	l. Failed to inform others of change in plans.
M. Answered the interphone upon receipt of signal.	m. Failed to explain clearance cancellation.
	n. Delayed answering clearance requests or accepting information while performing routine tasks.
	o. Failed to answer a request for a clearance.
	p. Failed to keep another controller advised.
	q. Delayed assigning available altitudes to other controllers.
	r. Issued or accepted incorrect information with subsequent callbacks or conflictions.
	s. Issued or obtained incomplete information with subsequent callbacks or conflictions.

12. Utilizing communications facilities

Outstanding	Unsatisfactory
A. Conferenced calls to ease interphone congestion.	a. Made individual calls instead of conferencing.
B. Relayed information through other agencies.	b. Made several calls where only one was needed.
C. Arranged to send information through seldom used communication channels.	c. Failed to use standard phraseology.
D. Handled several transactions during one call.	d. Spoke so rapidly that repeats were necessary.
E. Spoke at a rate which enabled communicator to copy information.	e. Failed to enunciate clearly and made repeats necessary.
F. Enunciated clearly making repeats unnecessary.	f. Argued control procedures on interphone.
	g. Failed to stand by when requesting information.
	h. Hesitated and made many amendments when issuing information.
	i. Failed to repeat information as requested.

11. Coordinating traffic (inter-sector, inter-center and with other agencies) (con't)

Outstanding	Unsatisfactory
J. Issued or obtained complete information which did not need callbacks, revisions or repeats.	j. Issued or requested information at times inconvenient to others.
K. Anticipated necessity for issuing or obtaining information.	k. Issued or requested superfluous information.
L. Avoided callbacks by standing by when obtaining information.	l. Failed to inform others of change in plans.
M. Answered the interphone upon receipt of signal.	m. Failed to explain clearance cancellation.
	n. Delayed answering clearance requests or accepting information while performing routine tasks.
	o. Failed to answer a request for a clearance.
	p. Failed to keep another controller advised.
	q. Delayed assigning available altitudes to other controllers.
	r. Issued or accepted incorrect information with subsequent callbacks or conflictions.
	s. Issued or obtained incomplete information with subsequent callbacks or conflictions.

12. Utilizing communications facilities

Outstanding	Unsatisfactory
A. Conferenced calls to ease interphone congestion.	a. Made individual calls instead of conferencing.
B. Relayed information through other agencies.	b. Made several calls where only one was needed.
C. Arranged to send information through seldom used communication channels.	c. Failed to use standard phraseology.
D. Handled several transactions during one call.	d. Spoke so rapidly that repeats were necessary.
E. Spoke at a rate which enabled communicator to copy information.	e. Failed to enunciate clearly and made repeats necessary.
F. Enunciated clearly making repeats unnecessary.	f. Argued control procedures on interphone.
	g. Failed to stand by when requesting information.
	h. Hesitated and made many amendments when issuing information.
	i. Failed to repeat information as requested.

b. Providing airspace for emergency descents and landings

Outstanding	Unsatisfactory
A. Acted in sufficient time for safety of aircraft.	a. Failed to descend aircraft upon request.
B. Provided standard separation requirements for descent immediately upon notification.	b. Failed to provide standard separation requirements.
C. Anticipated necessity for clearing airspace.	c. Failed to keep aircraft from entering the emergency area.
D. Did not penalize other traffic.	d. Sent aircraft into same area as lost aircraft.
E. Selected appropriate altitude for relieving emergency condition.	e. Delayed issuing information to aircraft by blind broadcast.
F. Cleared area as soon as aircraft reported lost.	f. Failed to exhaust all means of contacting aircraft.
G. Cleared area into which aircraft might go.	g. Failed to provide an alternate when requested.
H. Notified pilot of clear airspace.	h. Provided an alternate out of fuel range of aircraft.
I. Anticipated a radio failure and prepared to use emergency methods.	i. Made no arrangements for providing alternates.
J. Utilized all radio facilities in area to establish contact.	j. Failed to make any arrangements for emergency landing.
K. Utilized inter-plane communication facilities.	
L. Provided several alternates.	

(continued on next page)

13. Providing airspace for emergency descents and landings (con't)

Outstanding	Unsatisfactory
L. Provided alternate within fuel range.	
N. Provided alternate suitable to aircraft.	
O. Prepared to handle requests for alternates in advance.	
P. Provided alternate for aircraft no longer his responsibility.	
Q. Organized personnel and equipment at emergency base	
R. Issued complete instructions to pilot.	
S. Arranged an escort for the approach.	
T. Utilized all possible approach courses.	

14. Organizing search and rescue facilities

Outstanding	Unsatisfactory
A. Used all standard means of locating aircraft.	a. Failed to use all available means for locating aircraft.
B. Devised an original method for locating aircraft.	b. Suggested an impracticable and irregular method for locating aircraft.
C. Continued search when it was no longer his responsibility.	c. Failed to check location of aircraft which had been lost.
D. Put aircraft in immediate contact with appropriate direction finding agencies.	d. Failed to put aircraft in contact with direction finding agencies.
E. Sought out information leading to location and orientation of aircraft.	e. Failed to exhaust all standard means for orienting a lost pilot.
F. Continued the search after other agencies stopped.	f. Failed to alert rescue facilities in time for safety of aircraft.
G. Alerted rescue facilities immediately upon request.	
H. Anticipated the need for rescue facilities.	
I. Instituted his own rescue procedure.	
J. Prevented duplication of rescue facilities.	
K. Alerted sufficient facilities to cover the area.	

I CONTROL DUTIES
F. Handling Flight Progress Strips

25. Posting and removing flight progress strips

Outstanding	Unsatisfactory
A. Kept only those strips needed for current flights.	a. Failed to remove strips from board after completion of flight.
B. Posted information so that others could use it without requesting clarification.	b. Posted information which others were unable to read.
C. Posted all required information.	c. Failed to post all required traffic information.
D. Familiarized himself with the board within a few minutes after taking over.	d Posted information on wrong strips.
	e. Posted incorrect information.
	f. Posted flights so slowly that others were inconvenienced.

(6) Delegating responsibility to assistants

Outstanding	Unsatisfactory
A. Encourages his assistant to assume responsibility.	a. Assigned an assistant to handle more work than he could.
B. Offered help to assistant without "taking over."	b. Rejected the suggestions of his assistants.
	c. Did not supervise an assistant who was handling the board.
	d. Refused to help a busy assistant.

17. Training assistants

Outstanding	Unsatisfactory
A. Provided a definite explanation of a procedure so that assistant understood it.	a. Explained a procedure incorrectly.
B. Provided several solutions to a control problem.	b. Gave an incomplete explanation of a procedure.
C. Voluntarily devised a training aid.	c. Refused to explain a control problem.
D. Noted and corrected an assistant's error.	d. Neglected to give any instructions to an assistant.
E. Asked for assistance with congested sector.	e. Did not apply a training aid as instructed.
F. Utilized assistants where they were needed.	f. Made a derogatory remark about the center's training program.
G. Assigned personnel to tasks they were able to perform.	g. Failed to find an assistant's error.
	h. Failed to request aid when it was impossible to handle traffic without it.
	i. Failed to anticipate personnel needs in advance of watch.

18. Helping other controllers

Outstanding	Unsatisfactory
A. Pointed out a confliction to another controller.	a. Failed to avert a confliction which he noticed in an adjacant sector.
B. Volunteered to assist another controller with a confliction.	b. Refused to assistan overworked controller.
C. Provided standard separation requirements for conflicting aircraft in another sector.	c. Neglected part of the work he had offered to do.
D. Took over some of a busy controller's work when he was not busy himself.	d. Refused a request for advice.
E. Although busy himself, volunteered to take over part of another's work.	
F. Pointed out the solution to another's problem.	
G. Pointed out procedures for avoiding other problems in the future.	
H. Corrected the misconceptions of others concerning control procedures.	

1. Obtaining cooperation from others

Outstanding	Unsatisfactory
A. Accepted the suggestions of others.	a. Changed procedures instituted by another without reasonable cause.
B. Asked for help in such a way that others cooperated willingly.	b. Ignored the suggestions of others.
C. Diplomatically explained a traffic situation to the personnel involved.	c. Checked up on the control procedures of others for no apparent reason.
D. Assisted in a situation unrelated to controlling activities.	d. Rudely refused to accept the suggestions of others.
E. Was commended by an outside agency for help which he had given them.	e. Failed to get cooperation from others because he demanded it.
	f. Refused to give information or help to an outside agency.
	g. Was criticized by an outside agency for failure to issue information
	h. Ridiculed concern of an outside agency.

20. Criticizing others

Outstanding	Unsatisfactory
A. Corrected errors so that others accepted criticism.	a. Was harsh in criticizing a fellow worker.
B. Allowed others to correct their own mistakes after they were pointed out.	

II PERSONAL RELATIONSHIPS
I. Personal Responsibility

21. Accepting responsibility

Outstanding	Unsatisfactory
A. Upheld procedures and practices of the center to others.	a. Ridiculed procedures and practices of the center.
B. Accepted responsibility for his errors.	b. Attempted to evade responsibility for a confliction by falsification.
C. Remained overtime to complete a piece of work.	c. Refused to conform to center regulations.
D. Volunteered a helpful suggestion.	d. Refused to correct an error he had made.
E. Advised his successor at the board of all information pertinent to traffic.	e. Failed to get complete information before presenting findings of investigation.
F. Prepared all information needed to handle flights on successive watch.	f. Failed to apply a new control procedure.
G. Advised aircraft in advance to avoid hazardous area.	g. Delayed performing a task and left it for another to do.
H. Issued advisory to aircraft not his responsibility.	h. Left the board without informing anyone.
	i. Refused to cooperate with other controllers.
	j. Took sick leave when not ill.
	k. Failed to give his successor at the board complete information.

(continued on next page)

21. Accepting responsibility (con't)

Outstanding	Unsatisfactory
	l. Failed to complete a particular operation before turning the board over to his successor.
	m. Failed to prevent hazards by issuing advisory information.
	n. Refused to issue requested advisory information.

II PERSONAL RELATIONSHIPS
J. Emotional Control

22. Maintaining composure under stress

Outstanding	Unsatisfactory
A. Did not become confused under pressure of heavy workload.	a. Was unable to use control procedures under presssure of heavy workload.
B. Worked entire shift under peak conditions without becoming flustered.	b. Annoyed other workers by continually requesting help in an emergency.
C. Prepared for an emergency without becoming excited.	c. Became physically ill during period of heavy traffic because he could not control traffic.
D. Did not become disorganized after discovering an error he had made.	d. Was unable to continue controlling traffic safely after making a mistake.

23. Accepting criticism

Outstanding	Unsatisfactory
A. Accepted a just criticism without comment.	a. "Told off" person offering criticism.
B. Made an effort to correct error for which he had been criticized.	b. Refused to cooperate after being criticized.
	c. Blamed someone else for his errors.

American Institute for Research
A-3J Form A
24 October 1960

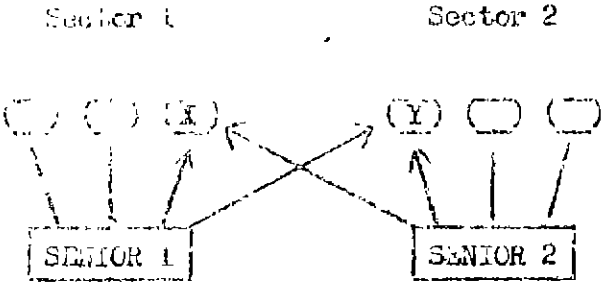
NOTES TO SENIOR CONTROLLERS ON THE EXPERIMENTAL TRYOUT OF THE PERFORMANCE RECORD: AIR ROUTE TRAFFIC CONTROLLER

The American Institute for Research with the close cooperation of Air Traffic Control Division personnel has devoted considerable time to the development of the Performance Record: Air Route Traffic Controller. After several revisions and preliminary tryouts, the form is now ready for final tryout.

Purpose and Plan

The objective of the tryout is to determine whether different Senior Controllers will observe (and record in the Performance Record) the same sorts of actions on the part of a controller. We want to find out how well seniors agree in their estimates of controllers' ability on the job and how consistently the Performance Record indicates performance from one period to the next. This is called the reliability of the procedure.

Here is how to go about determining the reliability of this record form. You and the senior who works next to you will each be asked to observe two controllers for ten days over a four-weeks' period, using the Performance Record as much to record your observations as outlined in the manual which accompanies the form. Thus:



If you are "Senior 1" in the above diagram, you would make a record of your observations using the Performance Record for the last controller among those under your supervision (controller x) as well as the first man among those supervised by your associate senior (controller y). It may take some juggling of schedules to arrange for the same controllers (x and y) to be seated at the spot most convenient for observation by the

same two seniors. Representatives of the American Institute for Research who are familiar with the use of the form will be at the center for the first couple of watches to answer any questions you may have or help with the scheduling. This same plan will be carried out in a number of other centers. At the end of the four week period the Performance Records will be collected from all the centers and the agreement between seniors calculated by statistical techniques.

To determine how consistently the Performance Record measures controller skill, the experiment will be repeated for ten more watches using the same controllers but different seniors. These data, when compared with those from the first period will show how consistently the Performance Record measured over the two periods. It is the Performance Record that is being tested - not the controllers themselves, nor the senior observers. All data will be treated as confidential and no record of the performance of individual controllers will become part of CAA records. If you prefer not to use the controller's name on the forms use an "X" or other symbol - so long as we can keep the Performance Records of one controller separate from those of another.

It is particularly important in this experimental tryout that observations be made independently by the senior controllers. When you and another senior are observing the same controller, don't discuss the incidents you have observed and recorded in the Performance Record with the other senior or with any other who might be observing the controller during the second period of the tryout. We will get a distorted picture of the consistency with which the form measures if seniors influence one another's rating, in any way.

Rating procedures similar in principle have been developed for private industry and military and other governmental organizations and have been shown to provide raters with a tool for rating that is based on what has actually been observed rather than on memory or general impression. It is a more impartial method than that presently used and will reduce to a considerable extent the effect of observe bias and subjective judgment upon ratings.

Your complete cooperation in this tryout is essential for a fair and accurate evaluation of the Performance Record: Air Route Traffic Controller.

APPENDIX D

SUPPLEMENTARY EXPERIMENTAL RATING FORM

COMMENT SHEET AND SAMPLE INCIDENTS

SUPPLEMENTARY EXPERIMENTAL RATING FORM

Center _____ Date _____ Controller _____ Chief Controller _____

Below are five statements descriptive of over-all controller proficiency. Check the one which most nearly describes your estimate of the controller's ability to control traffic. Like the ratings given these controllers on the new experimental form, these ratings are confidential. Please make these judgments independently without consulting any of the senior controllers who are participating in the experiment or referring to the controller's Civil Service ratings.

_____ 1. I would assign this controller to any sector in any weather and feel confident he could do the job without any supervision.

_____ 2. This controller is capable of working any position in the center and requires only normal supervision by his senior controller.

_____ 3. This controller is capable of working any position in the center but requires a little extra supervision in instrument or borderline weather.

_____ 4. This controller's level of proficiency is such that close supervision is required to insure that his work doesn't result in situations hazardous to air traffic.

_____ 5. This controller is capable of handling only the least busy of the sectors under instrument or borderline conditions and requires close supervision at all times.

[illegible]

[illegible]

1. At _____, two north bound aircraft were converging at 7,000 feet altitude with insufficient separation due to the navigational estimate on the second aircraft. Noticing the control of on sector 3 was tied up with instrument approach at _____, this controller immediately took the initiative and effected separation himself by clearing one aircraft to climb immediately 500 feet until standard separation could be provided.

2. This incident concerns an over flight and a departure. The controller in issuing instructions to the departing aircraft advised him to climb on the south leg of the _____ range to a specified altitude, but neglected to advise what procedure to follow after reaching that altitude. This omission of instructions resulted in the pilot following a procedure different from that the controller had anticipated and as a result the two departing aircraft and the southbound aircraft crossed the range station two minutes apart at the same altitude.

3. The controller received a flight plan from an adjacent center pertaining to an aircraft operating through the _____ area. The flight plan received contained the correct group information and was posted correctly on all the flight progress boards and indicated the correct group. In transmitting this information to the next adjacent center the controller gave the adjacent center incorrect enroute information, even though all the flight progress strips on his board stated the route correctly. The result was a traffic confliction within the adjacent center's area.

4. This controller answered a request for a departure clearance without causing delay to the departing aircraft. He quickly scanned the board; determined the best climb-out course; and relayed the clearance using clear and standard phraseology so that no repeats were necessary. He is a steady worker and always watches out for conflictions.

5. At _____ during IFR weather three aircraft were holding on the range station awaiting their turn to land. Each aircraft reported to a different communication agency. Severe icing existed at levels these aircraft were holding and one after the other requested emergency approach account of icing. The controller after receiving these requests advised each aircraft to use the same frequency and by doing this, simultaneous instructions were given and aircraft directed to maintain 1,000 foot separation in descent. All three aircraft descended on the same course of the range with adequate separation and two were again given holding instructions after reaching a level where no icing was reported and awaited their turn to land. Alertness and ability to utilize existing communication channels provided a rapid answer in an emergency situation.

13 October 1949

AMERICAN INSTITUTE FOR RESEARCH

413 Morewood Avenue
Pittsburgh 13, Pennsylvania

Comment Sheet for Air Route Traffic Control Personnel Participating in the Tryout of the Performance Record: Air Route Traffic Controller

The final tryout of the Performance Record would be incomplete unless the comments of all Air Route Traffic Control personnel participating are obtained and analyzed. Many valuable suggestions were obtained during previous tryouts at other centers most of which resulted in significant improvements in the earlier forms. The space below and the reverse side of this sheet is provided for you for recording your observations on control evaluation in general and your specific reactions to and suggestions for the new Performance Record. Your suggestions will be appreciated and given serious consideration.

REACTIONS, COMMENTS, AND SUGGESTIONS

Check whether during the tryout you acted as:

( ) a controller
( ) a senior controller or other observer

_____
(signature optional)

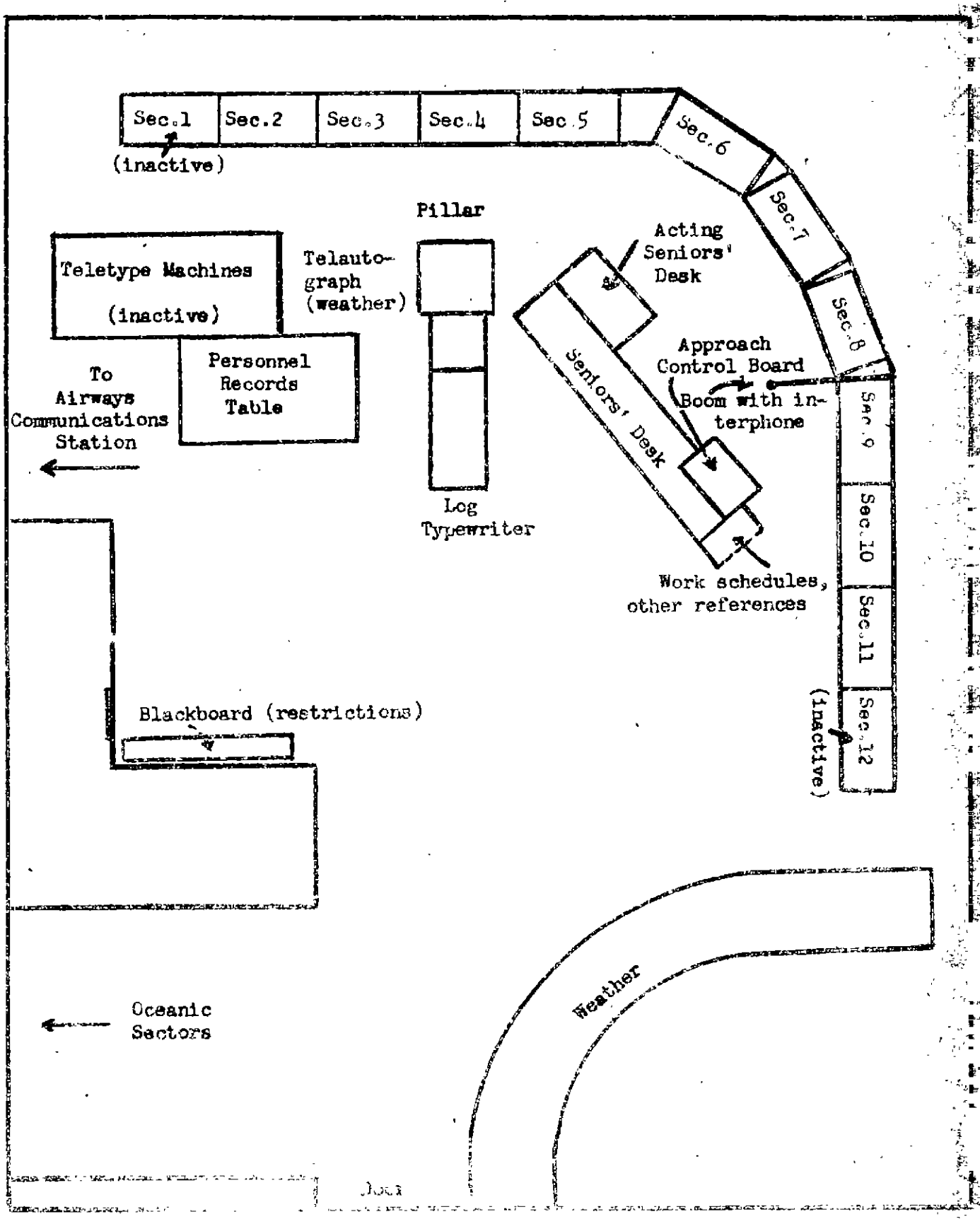
Please return this regardless of the length or nature of your comments. Either turn the form to the chief controller or, if you prefer, mail it directly to: American Institute for Research, 413 Morewood Avenue, Pittsburgh 13, Pa.

APPENDIX E

LAYOUT OF NEW YORK AIR ROUTE TRAFFIC CONTROL CENTER

Figure 1

LAYOUT OF NEW YORK AIR ROUTE TRAFFIC CONTROL CENTER



APPENDIX F

PARTICIPANTS' COMMENTS AND SUGGESTIONS

PARTICIPANTS' COMMENTS AND SUGGESTIONS

	COMMENT OR SUGGESTION	Frequency
1.	Form has merit; breakdown good; well organized	5
2.	Should raise employee morale and assessment performance	1
3.	More descriptive of the job than Civil Service Form 51	4
4.	Should provide a more accurate rating result; a very good picture of an individual's performance	2
5.	The statements of outstanding performance are sometimes descrptive of only adequate performance	4
6.	The form is too long; lettered sub-heads should suffice as elements	2
7.	Form should include an element on administrative work	1
8.	Tryout was inadequate due to absences, position assignments, shortness, or other difficulties of observation	9
9.	Some elements appear obsolete, for example: a. Assigned or failed to assign altitudes in order of request b. Gave preference to aircraft low on fuel c. Devised makeshift holding point to expedite traffic d. Issued or requested information at times inconvenient to others ("Necessary evil in IFR weather")	1
10.	Difficult to classify "tongue slips"	1
11.	Space should be provided for writing in additional observations not covered on the form	1
12.	Form should be used for the next unofficial rating	3
13.	Add an element on making suggestions helpful to the center	1
14.	Add an element on "knowledge of seldom-used procedures"	1
15.	Truly critical incidents occur too infrequently	
16.	Too much work	1
17.	Requires "vigilant observation"	2

APPENDIX G

SUMMARY OF TRYOUT DATA

SUMMARY OF TRYOUT DATA I.

Performance Record Scores

UPR = Uncorrected Performance Record Scores
(Algebraic Sum of Element Scores + 50)
CPR = Corrected Performance Record Scores
(Max. Element Score = ±3; Sum = 50)
OA = Group A Observers, 1st Tryout Period
OB = Group B Observers, 1st Tryout Period
OA' = Group A Observers, 2nd Tryout Period
OB' = Group B Observers, 2nd Tryout Period

(N.Y. Center) Controllers	First Tryout Period				Second Tryout Period				Total Scores	
	OA		OB		OA'		OB'		UPR	CPR
	UPR	CPR	UPR	CPR	UPR	CPR	UPR	CPR		
A	69	68	73	73	54	54	58	58	254	253
B	89	83	71	71	—	—	56	56	246	250
C	57	57	56	56	—	—	56	56	226	226
D	45	45	35	35	77	68	50	50	207	198
D*	62	59	102	76	77	68	50	50	—	—
E	52	52	48	48	56	56	54	54	210	210
F	—	—	57	57	73	73	57	57	219	220
G	—	—	124	86	—	—	55	55	237	199
(CHI Center)										
A	( )	( )			( )	( )			215	215
B	52	52	64	64	63	63	50	50	229	229
C	54	54	51	51	49	49	50	50	214	214
D	57	57	57	57	50	50	51	51	215	215
E	45	45			59	58			202	201
F	53	53	51	51	52	52	50	50	206	206
G	47	47	42	42	36	40	45	46	170	175
H	52	52	65	65	54	54	56	56	227	227
I	57	57	56	56	61	61	52	52	226	225
J			50	50	50	50			201	201
K	52	52			51	51			207	207
L	49	49	45	45	50	50	50	50	194	194
M	( )	( )					( )	( )	183	183

(DCA Center) Controllers	First Tryout Period				Second Tryout Period				Total Scores	
	OA		OB		OA'		OB'		UPR	CPR
	UPR	CPR	UPR	CPR	UPR	CPR	UPR	CPR		
A	65	65	52	52	56	56	50	50	223	223
B	50	50	57	57	53	53	50	50	210	210
C	52	52	50	50	54	54	50	50	206	206
D	50	50	50	50	50	50	50	50	200	200
E	53	53	49	49	50	50	50	50	202	202
F	47	47	51	51	53	53	50	50	201	201
G	55	55	65	62	58	58	50	50	228	225
H	54	54	51	51	50	50	50	50	205	205
I	50	50	55	55	57	57	50	50	212	212
J	60	60	55	55	50	50	66	63	231	228
K	50	50	60	59	50	50	50	50	210	209
L	50	50	49	49	67	67	50	50	216	216
M	49	49	50	50	50	50	50	50	199	199
N	51	51	50	50	75	71	50	50	226	222
O	50	50	50	50	50	50	51	51	201	201
P	49	49	38	43	50	50	50	50	187	192
Q	54	54	52	52	51	51	50	50	207	207
R	44	44	46	46	50	50	50	50	190	190
S	49	49	64	64	50	50	50	50	213	213
T	56	56	53	53	50	50	50	50	209	209
U	51	51	60	60	50	50	50	50	211	211
V	50	50	49	49	50	50	56	56	205	205

*An additional pair of completed Performance Record forms were obtained for Controller D. The scores in D's OA' and OB' column are repeats of his earlier scores and were used in the calculation of the test-retest reliability only.

Scores in red are adjusted totals; i.e., the sum of the available scores + their mean times the number of omitted scores.

Scores in green or in parenthesis were assigned by the same observers. For example, the Group A seniors observing Controller A in the Chicago center in the first and second tryout period were the same men - as were the seniors in Group B in this case. Only independent cases were used for the calculation of the reliability coefficients. Scores were paired in the following manner:

Observer-Observer	Test-Retest
OA - OB	OA - OA'
OA' - OB'	OA - OB'
	OB - OA'
	OB - OB'

SUMMARY OF TRYOUT DATA II.

Measures of On-the-Job Proficiency

CR = Chief's Ratings (1=4, 2=3, 3=2, 4=1, 5=0)
OCS = Last Official Civil Service Rating (E=4, VG=3, G=2, F=1, U=0)
CSQ = Last Quarterly Civil Service Rating
NCSQ = Next-to-Last Quarterly Civil Service Rating
SCS = Sum of Civil Service Ratings

(N.Y. Center) Controllers	CR	OCS	CSQ	NCSQ	SCS
A	3	3	2	2	7
B	3	3	3	2	8
C	4	3	2	2	7
D	2	2	2	2	6
E	2	2	2	2	6
F	2	2	2	2	6
G	2	3	3	4	10
(CHI Center)					
A	4	3	3	3	9
B	3	3	3	2	8
C	3	4	3	3	10
D	4	4	4	3	11
E	2	2	2	2	6
F	3	3	3	2	8
G	1	2	2	2	6
H	3	3	3	2	8
I	3	3	3	2	8
J	1	2	2	2	6
K	1	2	2	1	5
L	2	3	2	2	7
M	1	2	2	1	5
(DCA Center)					
A	3	2	3	-	7.5
B	4	3	2	2	7
C	2	2	2	2	6
D	3	2	3	3	8
E	2	2	2	2	6
F	1	3*	1	1	3
G	3	2	3	2	7
H	4	3	3	3	9

(DCA Center) Controllers	CR	OCS	CSQ	NCSQ	SCS
I	1	2	2	1	5
J	2	2	2	2	6
K	2	2	2	1	5
L	2	2	2	2	6
M	3	3	3	2	8
N	2	2	3	3	8
O	2	2	1	2	5
P	2	2	2	2	6
Q	2	2	2	2	6
R	2	2	2	2	6
S	4	3	3	2	8
T	3	3	3	2	8
U	3	2	3	2	7
V	2	3*	3	3	9

*Rated as assistant controller

SUMMARY OF TRYOUT DATA III.

Statistical Treatment of Tryout Results
(See legend, Tables I and II)

Variables 1		2	N	Mean of Var. 1	σ Var. 1	Mean of Var. 2	σ Var. 2	r	r_c
ΣCPR	vs.	OCS	40	214.23	21.45	2.48	.59	.31	.61*
ΣCPR	vs.	SCS	42	213.69	21.13	6.99	1.58	.37	.73*
ΣCPR	vs.	CR	42	213.69	21.13	2.45	.91	.21	.45*
(O–O Reliability, CPR) OA, OA′	vs.	OB, OB′	80	53.43	6.73	52.35	6.46	.43	.94**
(O–O Reliability, UPR) OA, OA′	vs.	OB, OB′	80	53.86	8.07	52.05	6.2	.38	.92**
(T–R Reliability, CPR) OA, OB	vs.	OA′ OB′	156	53.27	7.63	52.76	5.38	.22	.85**
(T–R Reliability, UPR) OA, OB	vs.	OA′ OB′	156	53.92	10.64	53.03	6.79	.20	.83**

*Correlation corrected for a 1 year period of observations for the Performance Rec... using CPR scores. No information is available regarding the reliability of the other variables.

**Correlations corrected (Spearman-Brown formula) to what the reliability would be expected to be if the tryout period were extended to 237 watches (estimated no. of watches worked per year).