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JANAIR

JOINT ARMY-NAVY AIRCRAFT

INSTRUMENTATION RESEARCH

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ANALYSIS OF PICTORIAL DISPLAYS

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AEROSPACE GROUP

HUGHES

DISPLAY SYSTEMS DEPARTMENT
HUGHES AIRCRAFT COMPANY
CULVER CITY, CALIFORNIA

SECOND QUARTERLY PROGRESS REPORT
DECEMBER 1964

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JOINT ARMY-NAVY AIRCRAFT INSTRUMENTATION RESEARCH
ANALYSIS OF PICTORIAL DISPLAYS

SECOND QUARTERLY PROGRESS REPORT
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PREPARED BY: W. L. CAREL
UNDER CONTRACT NONR 4468 (00)

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RESEARCH AND DEVELOPMENT DIVISION
HUGHES AIRCRAFT COMPANY
CULVER CITY, CALIFORNIA

This report presents work which was performed under the Joint Army-Navy Aircraft Instrumentation Research (JANAIR) Project, a research and development program directed by the United States Navy, Office of Naval Research. Special guidance is provided to the program for the Army Material Command, the Office of Naval Research and the Bureau of Naval Weapons through an organization known as the JANAIR Committee. The Committee is currently composed of the following representatives:

U. S. Navy Office of Naval Research
Capt. J. D. Kuser

U. S. Navy, Bureau of Naval Weapons
CDR. W. A. Engdahl

U. S. Army, Material Command
Mr. W. C. Robinson

The goals of JANAIR are:

a. The Joint Army-Navy Aircraft Instrumentation Research (JANAIR) project, is a research project, the objective of which is to improve the state of the art of piloted aircraft instrumentation.

b. The JANAIR Project is to be responsive to specific problems assigned, and shall provide guidance for aircraft instrumentation research and development programs.

c. The JANAIR Project will conduct feasibility studies and develop concepts in support of service requirements.

I. Progress

During the past quarter, the work has centered around four main topics. In list form, the topics are as follows:

1. The conception of the pilot's job as a set of hierarchal tasks.
2. The development of a model for target recognition in literal pictorial displays.
3. The development of a graded series of landing and low level flight hypothetical pictorial displays.
4. The generation of data to fill in the cells on the chart described in the first quarterly report.

None of these tasks has been completed, so a full discussion will be deferred until the time they are sufficiently developed to warrant substantive treatment. Because the ideas are not completely developed, progress will be described only in broad outline.

1. The conception of the pilot's job as a set of hierarchal tasks arose as a consequence of attempting to develop pilot information requirements and, subsequently, display requirements by using standard procedures of mission analysis, function analysis, and the like. A great dissatisfaction arose in attempting to do this and there were long periods spent staring at the hieroglyphics of mission and task analyses whilst trying to figure out how one could logically get from the analyses to the design of displays. There is no logical way. What the analyses may tell one are the ranges, accuracies, and data rates which are required for each of the needed displayed quantities or dimensions for each of the mission phases. How to encode the required dimensions does not follow from the analysis and the encoding problem is, of course, precisely the question at issue. Given that the ranges, accuracies, and data rates can be met, the appropriateness of a coding scheme depends on the properties of man, the tasks of the pilot, the dynamics of the aircraft, the type of control, and the state of the art. One might almost suspect that the appropriate code is independent of the mission - all that the mission implies are certain categories of information over a given range, etc.

A way of analyzing the pilot's overall job that (with the exception of the state of the art) will take account of these factors is in the process of being formulated. This method of analysis takes a much closer look at the actual cognitive, perceptual, and motor processes carried out by the pilot. In particular, the relationship between supra- and sub-ordinate goals in the pilot task hierarchy are examined. One index of efficiency of a display may be the number of transformations the pilot has to make to program a subordinate task if he is provided information at the next supraordinate level in the hierarchy. It is expected that this form of analysis, which is as yet incomplete, will be a considerable aid in the design of displays for it will show the relationship between the classes of information used by the pilot. Such relationships are critical in the design of pictorial displays. The analysis will continue during the next quarter and, it is hoped, the method will be fully developed within a month.

2. The development of a crude model of the limits of human behavior in target recognition using literal pictorial displays is also under way. The model will be highly simplified and is intended to be used only to provide initial estimates of the boundaries of human performance in target recognition. It will tell us the minimum display size, resolution required, and the limit capacity of the operator to recognize targets as certain critical sensor and operational variables are changed. This simplified limit model is nearly complete and will be described in the next quarterly report.

3. A graded series of hypothetical displays appropriate for landing and low level flight are being drawn. These will be graded by complexity and the primary purpose is to use the series as a base for making engineering analysis of the sensors and data processing requirements as well as estimating display system weight, space, reliability and cost. As soon as the proposed series of displays is well enough along for serious discussion - which should be towards the end of January - they will be reviewed by the contracting officer. We should like this review to precede the engineering analysis.

4. The cells in the chart described in the first quarterly report are gradually being filled in with data. The chart format has been changed and expanded somewhat and a revised format is shown in Figure 1. Because of the complexity of the data and the size of the chart, the reproduction problems are formidable and it will not be published until completed unless a cheap way can be found to show partial progress.

II. Manpower

Manpower expenditure is shown in Figure 2.

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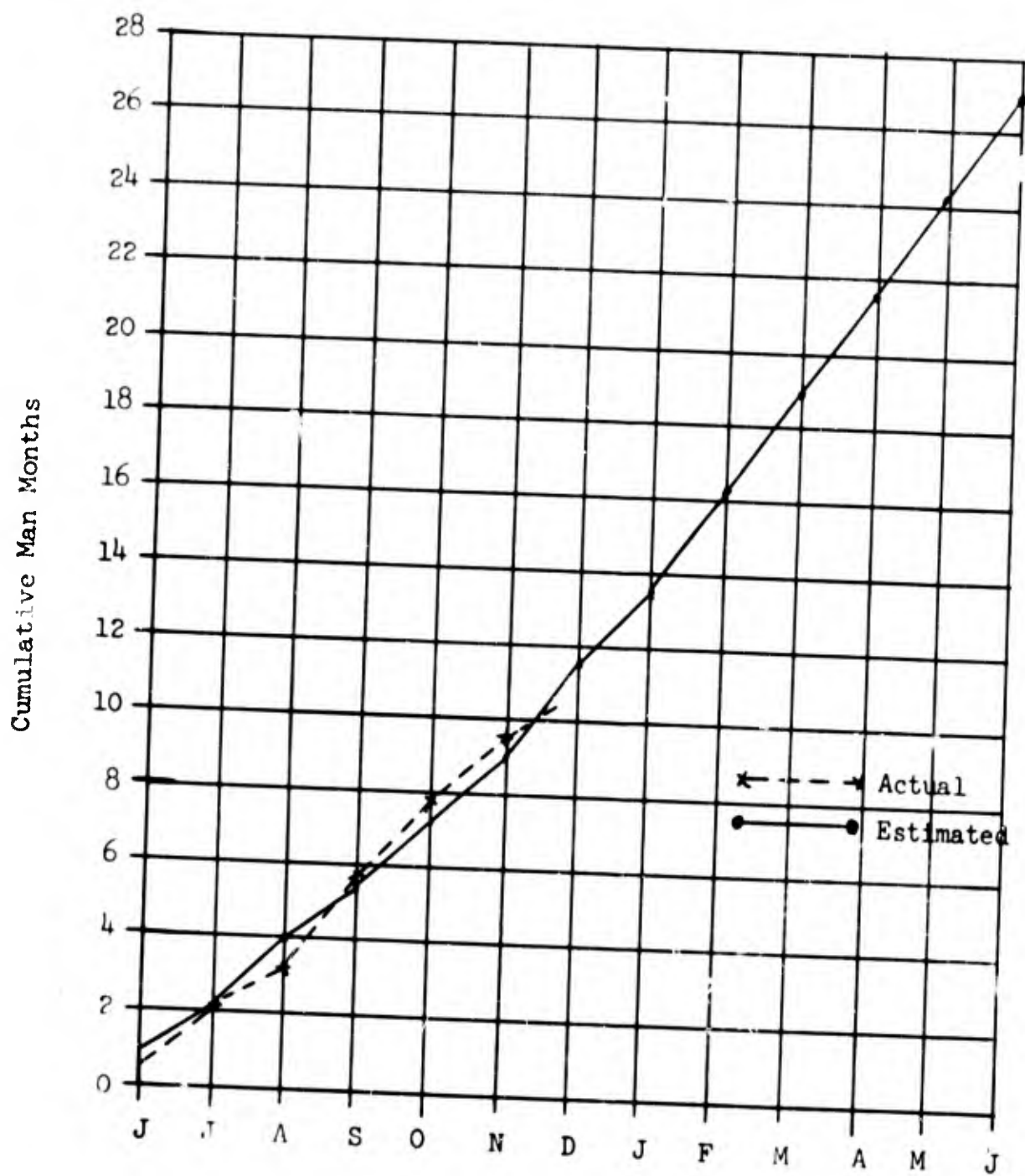


Figure 2. Schedule