Air Traffic Control Project
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SUBJECT: BI-WEEKLY REPORT, JULY 22, 1949

1.0 GENERAL

(W. G. Welchman)

After the visits of which mention has been made in earlier Bi-Weekly Reports, C. R. Wieser and I felt that we needed a breathing space to sort out our impressions. As a result of searches carried out in various libraries by Mrs. Ulman, we have found a good deal of useful literature. A bibliography is being prepared. I have been preparing a general statement of the position as it appears to us at present which will appear as a memorandum during the next few weeks. I am hoping that we shall get further information by obtaining criticisms of this memorandum from people with real knowledge of air traffic.

All-weather flying means that pilots must fly prescribed courses by means of navigational aids. The close sequencing that will be needed in the neighborhood of an airport in order to obtain landings on a single runway at the rate of two a minute will mean that pilots must also be able to fly to a close schedule. We have been considering how these things can be done. It is clearly important that the normal smooth running of a control system must put the minimum of strain on pilots so that they can have plenty in reserve for emergencies. (The same, of course, applies to ground controllers.) In this respect, we feel increasingly certain both that the principles behind the Sperry Zero Reader, which helps a pilot to fly a prescribed path on instruments, represents a major advance and also that the development of another zero reader to assist schedule flying might, if it proved practical, make a big difference to the whole problem of air traffic control. Next month we shall examine the process of flying under control instructions as a servo loop in which information is supplied either continuously or discontinuously and in which the response of the aircraft is controlled either by a human pilot or by an auto-pilot. In particular, it will be important to find out the repetition rate of discontinuous information that would be needed to obtain satisfactory performance.

Professor Franklin, C. R. Wieser and I will all be away on vacation during the next bi-weekly period. There will, therefore, be no Bi-Weekly Report on August 5.

1.0 GENERAL (continued)

(P. Franklin)

Studied the problem of controlling the time of arrival and velocity at arrival of an aircraft travelling on a straight line. One method of calculating a workable value of acceleration continuously was described in M-2012.

(C. R. Wieser)

As a result of interviews with airline and traffic control people, the following principles have been tentatively established:

1. The bottleneck of the traffic control system is the approach zone with its problems of sequencing aircraft arriving from several different directions.

2. In a busy approach zone it is not sufficient to display before the pilot his location and the locations of nearby aircraft and leave the pilot to deduce his next move. The pilot should be presented with continuous flight instructions.

Some time has been spent reading about various proposed systems of control and navigation, including war-time aids such as Gee, Oboe, Rebecca, Decca, POPI, and Shoran.

The General Railway Signal Company fixed-block system (Pamphlet 652) has been studied. It is difficult to visualize just how this system would be applied in an approach zone.

The requirements in congested terminal areas favor a system which allows the aircraft to be located anywhere within the area. Its position can then be compared (by means of a digital computer) with any prescribed course within the area, and the deviation from the prescribed course can be used to furnish data for computing instructions for the pilot. A system such as this is closed-cycle in the sense that it is a dynamic system with feed-back. It must, therefore, be examined to determine its stability in the same way that a servomechanism is studied.

(A. Orden)

A simple plan of airport approach control is being worked out as a model for setting up a computer code. The tasks of the calculator will be assumed to be:

a. Setting up an approach schedule for each plane

b. Providing control signals by which each plane can travel on its schedule.

1.0 GENERAL (concluded)

(A. Orden) - continued

A model for setting up the schedule has been completed, and I am working on a model for schedule control. It seems desirable to set up a model quickly and code it. We can then proceed to more realistic models as we obtain more information on operating problems, characteristics of various equipments, etc.

(A. J. Perlis)

The coding of the simplified, though representative, problem of calculating position and altitude of aircraft from range readings obtained by three radar stations at the vertices of an equilateral triangle has been completed. A detailed report on the feasibility of using range measurements alone to obtain position and altitude of many aircraft in a radar net containing several stations reporting simultaneously is being prepared.

(D. R. Israel)

A code which satisfies the requirements of M-2010 has been completed. Further study on problems of the "private line" and on the determination of aircraft position coordinates with and without aircraft cooperation is continuing. I am studying the IAS Reports by Goldstine and von Neumann.