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Memorandum L-5

MEMORANDUM: PROJECT WHIRLWIND, PRINCIPLES GOVERNING SERVOMECHANISMS LABORATORY RESEARCH AND DEVELOPMENT

From: Jay W. Forrester

Date: October 11, 1945

In setting down the general philosophy and plan of attack followed in Project Whirlwind, I will first list those principles which underlie work of the Servomechanisms Laboratory.

A. SERVOMECHANISMS LABORATORY

1. Systems Projects. The laboratory prefers to undertake those projects which combine engineering research and development with systems considerations.

The knitting together of important and valuable new systems from old and new components is of greater interest to the laboratory than component research which terminates in a report without opportunity to demonstrate the useful application of the research results. Producing a satisfactory working system often requires greater technical contribution than producing the basic components of that system.

2. Training. In a development of national value, postgraduate training is essential to disseminate information and to extend the circle of those who can use and appreciate the value of the new development. In the Servomechanisms Laboratory about 30% of the staff are graduate students on a rotating basis.

3. Continuity. In systems work depending on the efforts of many persons and the utilization of diverse components, continuity of effort must be achieved. Reduction of equipment to accurate drawings, and results to well-written reports, must be a part of the activity.

4. Specifications. Where specifications of a job are sound and practical these specifications should not be sacrificed for the sake of expediency. High standards of performance leading to long-term contributions

should not be compromised to meet immediate objectives which may lead to results of transitory importance.

5. Flexibility. Most Servomechanisms Laboratory designs lead to pilot model equipments in new fields. Exact specifications for the equipment often cannot be foreseen. Overdesigning is followed as a basic principle to allow flexibility for meeting the requirements of a rapidly changing defense. This is in contrast to meeting the minimum requirements at the time of project initiation with the resulting danger of obsolete results at project conclusion.

6. Experimental Work. Laboratory and pilot models should be of such design that adaptation to operational equipment is possible. Experimental equipment, merely for demonstration of principle and without the inherent possibility of transformation to designs of value to others, does not meet the principle objectives of this laboratory.

7. Reliability. In most projects undertaken by the Servomechanisms Laboratory new advances in reliability are at least as important as new advances in performance. In many systems the greatest difficulties lie in achieving the required reliability. Achieving such reliability has been amply demonstrated by laboratory pilot model equipment which has given thousands of hours of relatively trouble-free operation in military service.

8. Subsidiary Development. The Servomechanisms Laboratory has always undertaken development in fields related to its projects where necessary to guarantee success of the work. Such subsidiary developments, if representing substantial time and expenditure, must have inherent value beyond the immediate project. In the present computer research such related developments include storage tubes, pulse transformers which have been reduced to a production basis, high power gate tubes of which the 7007 is now available to any purchaser, and computer test equipment which should become of widespread value.

B. Project Whirlwind

The foregoing general principles can be extended to their relating directly to digital computer research in this laboratory.

1. Computer Importance. We believe digital computers to be of great future importance in control systems for both military and civilian application.

2. Aircraft Problem. The present contract specifies digital computer research to develop methods of using digital computation in an aircraft design simulator. All development to date applies directly to this problem. However, the scope of the project might not be justified by this application alone were it not for the benefits which will accrue to all other digital computer applications. These other applications might become so important that the Navy would choose to redirect future work and if so, the development accomplished to date should be equally useful to the new problems.