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Massachusetts Institute of Technology
Lincoln Laboratory
Cambridge, Massachusetts

To: Dr. A. G. Hill

From: Jay W. Forrester

Date: May 12, 1953

Subject: Selection of a Company to Work with the Lincoln Laboratory on the Transition System

This memorandum expands on the information given in my memorandum of November 5, 1952 to Paul Cusick regarding our selection of the International Business Machines Corporation to be a sub-contractor to the Lincoln Laboratory in preliminary design studies of a digital computer and associated terminal equipment for an air defense control center.

By June of 1952 it had become evident that the time was at hand for bringing an industrial manufacturer into the Whirlwind II program aimed at getting digital computing equipment for what has now come to be called the Transition System. During July 1952, the Lincoln Laboratory selected from a list of 15 or 20 possible industrial companies a group of 5 which were felt most promising for detailed investigation. The 5 chosen were:

1. Bell Telephone Laboratories
2. Remington Rand
3. International Business Machines Corporation
4. Raytheon Manufacturing Company
5. Radio Corporation of America

A preliminary meeting was held with representatives of each of these companies, where the broad program and objectives of the Laboratory were outlined, and a proposed basis for cooperative work between the two organizations was explained. This included our views on how cooperative research and development would be carried out and our feeling that technical supervision would for some time reside with the Lincoln Laboratory.

The Bell Telephone Laboratories and RCA chose to withdraw from being considered after the preliminary meeting, on the basis that their existing commitments did not allow them to undertake the work. The other three companies were visited by Jay W. Forrester, Robert R. Everett,

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Norman H. Taylor, and C. Robert Wieser to study the characteristics and qualifications which we felt were important to our work. The same group of four visited each of the three companies.

With the Remington Rand organization a day was spent at the Laboratory for Advanced Research in South Norwalk, Connecticut. A day was devoted to the Eckert-Mauchly Division in Philadelphia and one day at Engineering Research Associates in St. Paul, Minnesota. ERA, which we considered the strongest and most competent of the three Remington Rand development groups, was already well known to us through prior trips and because of orders for magnetic drums which we were buying from them.

The visit to International Business Machines Corporation consisted of one day at the Poughkeepsie laboratory and plant, one and one-half days at the Endicott laboratories and plant, and one day in New York at the Watson Scientific Computing Laboratory and at the headquarters offices.

The visit to Raytheon occupied one day at their Waltham and Newton plants.

Policy on the inspection trips was to look at those things which the company wished us to see and to allow them to plan the schedule. The IBM tour was as originally requested by IBM. The Remington Rand tour had originally been set up by them for a day in Norwalk and a day in Philadelphia. During the first day it became evident that the ERA people wished to include a visit to their organization so that the trip was extended to St. Paul.

The group visiting the three organizations were unanimous in their relative placing of the companies and were unanimous in feeling that a wide margin existed between each. The order of choice was:

1. International Business Machines Corporation
2. Remington Rand
3. Raytheon

Based on the people whom we met, the laboratories which we inspected, and the facilities which we had seen, there existed no doubt of proper order of preference. The more important reasons for the choice will be given in paragraphs to follow.

Particular attention in the following paragraphs will be given to comparisons between the organizations which placed first and second in our evaluation. There follows first a description of each of the two companies so far as location of facilities is concerned.

The parts of the International Business Machines Corporation of interest to us are located at Poughkeepsie, N.Y., Endicott, N.Y., and New York City. At Poughkeepsie are located the principal electronic research and development laboratories of the company and the principal electronic production. At this location they were producing in their factory electronic digital computing equipment, using about 60,000 vacuum tubes per month. This was a closely integrated development and production organization where the transition from research and development to production had been well established. In Endicott is located the principal electro-mechanical research, development, and production of the company and also the IBM school which has the responsibility for training the company's field service men and the customers' operators. In New York City is located the company headquarters and the Watson Scientific Computing Laboratory, connected with Columbia University.

The Remington Rand organization consists of research laboratories in South Norwalk, Connecticut, where also are located the executive offices of the company. The company includes some 60 or 65 organizations which have been purchased over the period of time Mr. Rand has been building up the company. These are located at various points in the country. At the time of our visit the Eckert-Mauchly Company in Philadelphia had been a part of Remington Rand for a relatively short time of some two years and was operating as a division of the parent company. It had developed the Eckert-Mauchly UNIVAC computer, of which the fourth and fifth were under construction on a semi-model shop basis. No substantial production capacity existed there. The ERA organization in St. Paul had been very recently acquired by Remington Rand and was operating as a wholly-owned, separate corporation with its own corporate officers. It had operated primarily on a one-of-a-kind development and production basis so far as its larger electronic products were concerned. It did not have sufficient production capacity, and it was generally assumed by Remington Rand people that any Lincoln equipment which reached the production stage would be placed in one of the other Remington Rand factories, a principal one being located at Elmira, N.Y. This plant was not visited since it was producing little electronic equipment and had not as yet worked with either Eckert-Mauchly or Engineering Research Associates.

At all points of contact we observed certain fundamental differences between the two companies which seemed to underlie the difference in specific technical and administrative points to be discussed later. In the IBM organization we observed a much higher degree of purposefulness, integration, and esprit de corps than we found in the Remington Rand organization. Also, of considerable interest to us, was the evidence of much closer ties between research, factory, and field maintenance in IBM. Many of the comparative shortcomings in the Remington Rand organization can be traced directly to the very recent acquisition of their two strongest electronic groups and the fact that the two had not yet worked with each other

or with a Remington Rand factory. The ERA organization, which we considered the best of the Remington Rand company, had been so recently acquired that it was almost impossible to tell what its future in the rest of the company would become.

I will now discuss several separate aspects of the companies which we considered important in making a choice:

1. Key Staff. In key technical staff we found a superior technical ability amongst the IBM engineers and also a more evident availability of key people since they had two major projects terminating on a time schedule which would match our need for senior people. Remington Rand presented no satisfactory plans for how they would relieve people from their existing duties, and it seemed they would be more dependent on the hiring of new personnel.

2. Supporting Professional Staff. There did not seem to be a great difference between the two organizations in junior professional staff. More people from within the organization appeared available at IBM.

3. Technical Contribution. We found IBM superior by a wide margin in work done toward procurement of reliable vacuum tubes and other electronic components and in the design of circuits of interest to us. The two groups were about equal in hardware and packaging, in the development of storage devices, in magnetic tape units, and cathode ray indicators. In the latter category, Raytheon had more to offer than either of the first two. ERA, as a part of Remington Rand, was considered superior to IBM in magnetic drum work last fall. (Recent experience with ERA drums and a two-day trip by a number of our senior staff to IBM tends to reverse this in favor of IBM.)

4. Transition from Development to Production. IBM seemed to us clearly superior in their experience in transferring electronic equipment from development to factory production. This included experience in setting up the production of high quality electronic equipment and an understanding of the kinds of inspection and test required and the availability of trained people for these purposes.

5. The Production Organization. At the time of our visit IBM had built much more electronic digital computing equipment. They had some 3,000,000 vacuum tubes operating in their own equipment in commercial service at the time of our inspection. There was greater similarity between our work and the standard company product in the IBM organization than in Remington Rand.

6. Service Organization and Training Program. We placed strong emphasis on experience in field maintenance of electronic equipment and the facilities and organization for training maintenance personnel. We feel IBM is much superior in the size and quality of its field service force, their existing experience with electronic digital equipment, and the closeness of the tie between field experience and the development and production groups.

7. Proximity to MIT. Because of the very close relationship which we believe necessary between the Lincoln Laboratory and the manufacturer, we attached importance to the proximity of the commercial group to MIT. With respect to this, Raytheon rated high; IBM average; and Remington Rand low, since we felt that Remington Rand participation would be in St. Paul, Minnesota.

8. Ease of Information Exchange and Technical Cooperation. There seemed no important choice between the two organizations on this point.

9. Estimate of the Company's Contribution to Rapid Completion of the Program. We felt that our overall estimate of expeditious handling of the work as a result of both management, personnel, and technical factors was very important, and that in this area we had much greater confidence in IBM as a result of what we had seen in the two companies.

10. Experience in Large-Scale Computers. Remington Rand rated higher in the number of large-scale digital computers which had been made, but IBM rates higher in the amount of vacuum tube production which has been turned out of their factory and in the degree to which the factory itself has experience in electronic digital computers. In the Remington Rand organization suitable factory personnel have not received training, since most of their electronic computer construction has been on an expanded model shop basis connected with the research groups.

We feel that our survey of the companies was much more effective than could have been obtained through the submission of formal proposals. Our evaluation was based on meeting the people, evaluating their ability and attitudes, seeing their facilities, talking to enough of their people to evaluate morale and company spirit and a consideration of the reputation and past activities and products of the organizations. In our tour of IBM there was no information withheld from us in which we expressed any interest. In Remington Rand we had full access to everything of interest to us at Norwalk, St. Paul, and Philadelphia, except for two strictly technical items at Eckert-Mauchly in Philadelphia which were in the research stage and which we agreed with them not to explore. These were ultra-high-speed drums and magnetic circuits. We saw the exteriors of some of these devices and the laboratories in which they were being developed. We also received informal comments from competent engineers who had examined the

developments. It was evident from general discussion that these two items were not of great interest to our program and probably not developed far enough to be employed on our time schedule even if superior in principle.

Remington Rand had, at South Norwalk, a fairly large new laboratory building which was empty and which apparently had been built in the hopes of obtaining some kind of government project work. They did not, however, have suitable staff at this location for carrying on our program. A good, though not outstanding, technical staff exists at Eckert-Mauchly in Philadelphia, but their experience has been entirely with serial-type digital computers and serial-type components which are very different from those which we wish to employ. Based on previous experience with the company and their opinions expressed during the visit, it appeared that Eckert-Mauchly would want to employ their particular components and techniques in the design of the Lincoln equipment. We felt that this would lead to considerable lost time and to unsatisfactory working relationships between the two groups. ERA in St. Paul were heavily committed to programs for the Armed Forces Security Agency, and we were doubtful that a large group of key people could be drawn from their present organization.

At IBM we found at a location not too distant from MIT a very competent development staff with experience in working with an established and adjacent production facility.

At Remington Rand there was the prospect of working with a competent but overloaded technical staff at a much greater distance from MIT who would, in turn, be remotely located from its production facility.

Jay W. Forrester

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