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INFUSE REVIEW - 4th MAY, 1959

1. A review of the Infuse project from the beginning of installation till the end of April 1959 now seems appropriate: Mr E.T. Robinson (DS) and engineer in charge of installation will be returning to the Dept. of Supply in the middle of May; installation and engineering testing have been completed; a number of programs, including one which used more than three-quarters of the machine, have been run successfully; responsibility for maintenance was handed over by DS to QE2 on 15/12/58. Also, the matters of maintenance, programming, and development should be reconsidered in the light of the last six months' experience.

Installation

2. The machine-room was completed at the beginning of August 1957 and the assembling of Infuse parts, which had been arriving since early in the year, began immediately. By the end of November 1957 power supplies, racks and chassis were in position and wiring completed. The first air-conditioning units arrived at the end of January and the system had been installed and tested by the first week of April. The remaining jobs have been completed except for a small amount of tidying up which does not affect the operation of the machine and which will be done as soon as is practicable.

Testing

3. Testing began in December 1957. The engineers carried out their own tests on wiring, power supplies, etc. When testing chassis, however, they worked in close co-operation with the programmers. In this way Infuse was tested under conditions which were as near to operational as possible and there was a minimum of delay in detecting and correcting faults.

4. Individual chassis and combinations of a few different chassis were tested first and then programs of different types and increasing complexity (and where possible of operational value) until, in December 1958, CRADLE was run. The success of this program was considered sufficient proof that the machine could do what it was designed to do but a number of modifications were still considered necessary and its reliability over a long period had yet to be demonstrated.

5. During testing a large number of faults was found, which fell into three classes:

(a) non-recurring faults, such as dry joints, shorts from lumps of solder, missing wires, etc., were, in most cases, easily found and soon fixed;

(b) recurring faults from the failure of components, accidental damage, etc., were far fewer than was expected until the middle of April 1959. Since then the emission of a large number of valves has been found to have dropped below a safe level and these have been replaced. Faults from catostrophic failures of components are quickly found but intermittent faults, from deteriorating components or other reasons are more difficult to locate and waste a considerable amount of time;

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(c) some design faults showed up not so much when testing individual chassis but when running programs. Most of these have been rectified by slight circuit modifications but others are still with us. The worst, and the only one known to be incurable, is "gates in series"; (i.e. only 10, not 20, logical circuits can be connected in series). The output circuit has been troublesome but once again appears to have been fixed. The modular adders and shift registers are not as reliable as one would like: a careful study and possibly some redesign of the mod. adder circuit must be made soon if the units' reliability cannot be improved. Under certain conditions writing on the drum can interfere with reading but this difficulty can be overcome by programming.

Programming

6. The duties of the programmers include: the assessment of crypt problems as Infuse projects; the reduction of suitable problems to their simplest logical form; the preparation, for each problem, of a logical diagram showing the best method of calculation using Infuse units; the preparation from the logical diagram of a second diagram showing, in detail, how the Infuse chassis must be arranged and plugged; the actual plugging (or at least supervision of it) and debugging of the program as it goes on Infuse; the location and clearance of faults which occur during running; writing a description of the program in sufficient detail for it to be quickly comprehensible at a later date.

7. All this takes a long time. Obviously, some programs are easier to write than others but it is unlikely that one could be written and made to work in under two months: so far it has always taken longer. Logical diagrams can now be drawn up more quickly but experience has shown that earlier programs contained far too few checks. Almost every step in a program will have to be checked and checked in such a way that faults can be detected quickly. Such checks will sometimes greatly complicate the programming and will always mean programs that take longer to write and longer to run but the saving in time spent in fault finding should more than compensate.

8. The present programming/operating staff consists of 3 programmers (including DX), 1 assistant programmer and two trainee machine operators/tape preparers. This level of staffing has proved reasonably adequate under present conditions when new techniques are being developed, the machine is giving trouble, there is no plugboard and customers are few. As these conditions change in the future and in particular when plugboards make rapid program changes possible there may be a requirement for additional programmers.

9. Mr Grouse's departure for GCHQ later this year will leave a serious gap in the programming team; it is hoped to fill this gap, at least in part, with Mr D. Wright, a DO1 Science graduate who has recently joined DSB. Mr Wright is at present doing practical crypt training preparatory to learning programming.

10. It will be noted that two machine operators/tape preparers are at present being employed, instead of one originally planned. Up to now there has been more than enough work to keep both occupied, especially since, in addition to plain major

functions of tape production, plugging and operating, they have been able to relieve programmers of much of the semi-routine task of preparing diagrams.

Maintenance

11. The present duties of the maintenance staff are many and are not always concerned with maintenance: this is having a bad effect on the efficiency of the machine. There has been a shortage of technical staff since the beginning of installation and although the staff has recently been brought up to a strength of 1 professional engineer and 3 technicians, it seems clear that even this staff is inadequate to carry out the two necessary functions of systematic maintenance and of development.

12. Because of staff shortage, plans to train all maintenance staff in all aspects of their work have not been effected; Mr Robinson and Mr Grouse who have played a large part in the commissioning of Infuse and in the daily maintenance of chassis will not be here much longer, and their loss will be felt for some time.

13. Since Cradle was unplugged in December 1958 three programs have been run. Plugging and testing have taken 7 weeks, engineering modifications and tests 4 weeks and running time including intermittent fault-finding and testing 7 weeks. It can be seen that effective running time has been less than 40% of available time which is not very good. Certain improvements can be expected. The plugboard will reduce plugging time on the machine to a negligible amount; eliminate, it is hoped, a lot of faults which are attributed to handling of chassis during this rearrangement for each program change and simplify maintenance by making chassis accessible. Also, programmed checks should reduce the time spent on fault-finding after a program has been debugged.

14. In the last few weeks, however, a number of faults have appeared in chassis which, it was thought, would be reliable for months or even years to come. Some components have aged prematurely, unnoticed, and there are other signs of inadequate maintenance. Therefore, the development of Infuse should wait until the maintenance is organized and operating efficiently: there seems to be no point in pressing ahead with development at the expense of reliability.

15. All this sounds depressing but there doesn't appear to be anything which cannot be remedied by a competent and adequate maintenance staff. The original estimate of 1 professional engineer and 3 or 4 technicians seems to be the absolute minimum even if they are all trained in all aspects of Infuse, including program reading, and can devote all their time to maintenance. A larger staff such is found on other computers of similar size would be more successful.

Development

16. The present plan is to restrict development to those things which are needed to make the machine suitable for D.S.B. and which will, at the same time, simplify maintenance and increase effective running time, namely a plugboard and a core store. Some of the advantages of a plugboard have been mentioned. Its value and that of a core store and the importance of obtaining them quickly are indisputable: programs

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could be changed in a fraction of the time; chassis could be changed and maintained much more quickly; some programs could be run faster and others could be run which are not at present feasible.

17. At present, the construction of these things could be undertaken only at the expense of maintenance and even then the spare time available after daily maintenance has been completed would not be enough to get the job done in under 2 or 3 years.

18. In considering future developments for Infuse one must judge whether the cost of the additions would be justified by the increase in output. In the case of the plugboard, the expected increase should more than compensate for the relative high cost and this argument also applies, to a lesser extent, to a small core store. After these developments it appears that Infuse may have reached a point of diminishing returns and the expense of such additions as a large core store to allow a "general purpose computer" program and magnetic tape input and output would not be warranted. Therefore, should Infuse be unable to cope with current problems after a plugboard and small core store have been added consideration should be given to acquiring another machine incorporating the latest developments in the computer field.

19. The immediate requirement, however, is for staff to construct the plugboard: work could start at once.

Workshop Facilities

20. The maintenance and development of Infuse require certain workshop facilities (in particular for metal work). In the past, nearly all such jobs have been done by technicians at the expense of maintenance. This is unsatisfactory because the technicians are kept from their own work and because the jobs are not done as quickly and expertly as they should be. There is not enough work on Infuse to keep a man busy full-time; what is required is adequate workshop time at short notice.

Training

21. The two new ADO's are being trained in machine operation, tape preparation and program reading.

22. From the beginning of May there will be two 1-hour classes a week (conducted by Mr Bailey and Mr Singleton) on chassis circuits for the technicians and one 1-hour class (conducted by Mr Eastway) on program reading for the whole maintenance staff: these classes, of course, will be held only if Infuse is not in need of immediate attention.

Tape Processing Equipment

23. The present requirements have been assessed. About half the machines are here or are on order; the rest will be ordered as money becomes available. The matter will be reconsidered when the plugboard is operating.

Infuse Engineering Meeting

24. AT QE's suggestion a weekly meeting has recently been instituted between programming and engineering staffs to discuss current problems, allocate priorities to jobs in hand and ensure the closest possible co-ordination. Those attending are DX, DS, QE, QE2, Mr Grouse and Mr Singleton.

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Conclusion

25. The successful running of a few medium to large programs has proved that Infuse can do the type of work for which it was designed (para.4).

26. The size of the programming staff has proved reasonably adequate up to the present but may need to be increased in future (para.8).

27. The full potential of Infuse is not at present being realized, but immediate improvements could be expected if:

(a) the maintenance effort were strengthened (paras.11-15);

(b) additional staff were available for development and construction of plugboards and core storage (paras.16,17,19), and

(c) workshop facilities (in particular for metal work) were more readily available (para.20).

28. No further consideration should be given to developing Infuse beyond adding plugboards and a core store until it is running reliably in that form. If additional machine resources are then required, it might be preferable to buy another computer which would incorporate the latest developments and be easier to program (para.18).

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