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Report for 1971

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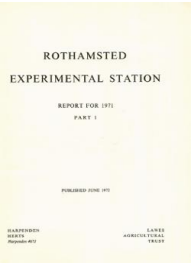
ROTHAMSTED
EXPERIMENTAL STATION

REPORT FOR 1971
PART 1

PUBLISHED JUNE 1972

HARPENDEN HERTS September 1972

LAWES AGRICULTURAL TRUST

Computer Department

D. H. Rees

D. H. Rees (1972) *Computer Department ;* Report For 1971, pp 238 - 245 **- DOI: https://doi.org/10.23637/ERADOC-1-126**

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COMPUTER DEPARTMENT

D. H. REES

The multiaccess computing service was further developed and by the end of the year was beginning to satisfy the initial computing needs of more than 200 registered users at 16 research institutes. The Orion and the terminal link to the Edinburgh Regional Computing Centre (E.R.C.C.) continued in service but with a shrinking work load.

Computing services

4–70. The multiaccess service was provided at Rothamsted on 15 February following the first two-day Multijob course. This course was repeated at 12 other research institutes over the next two months and again at Rothamsted in December. A total of 268 people from 16 institutes attended and there are now 201 registered users on the service. (Gledhill, Christine Lessells, Christine Shelley, and Clarke)

Performance. For the first eight months the users were justifiably dissatisfied with the service but over the last four months it has improved greatly. A brief account of this difficult year together with performance statistics is appropriate to this Report.

The Multijob operating system is supplied by the computer manufacturers, ICL, as a series of releases identified as M600, M650, etc. Version M600 had been in use for several months in 1970 and was known to be troublesome. The introductory service was planned on M650 (due for release in April 1971) because ICL had predicted that it would be more reliable. This was not fulfilled and the service was unsatisfactory until

TABLE 1

4-70 *performance (% total service hours)*

	M600/650 1.1.71–31.8.71	M700 25.10.71	M720 31.12.71	Overall 1.1.71–31.12.71
Multiaccess (M)	47·5	41·1	52·6	47·4
Batch	10·0	11·1	18·1	11·6
System support	29·9	38·4	18·3	29·3
Engineering				
(1) Scheduled	7·6	4·7	7·3	7·0
(2) Unscheduled	4·7	3·6	3·5	4·3
Idle	0·3	1·1	0·2	0·4
	100·0	100·0	100·0	100·0
Hours				
Total service (T)	1987	533	547	3067
Additional				
(1) Engineering	119	59	92	270
(2) ICL	490	—	—	490
Total power on	2596	592	639	3827
Incidents				
(1) Hardware	78	21	40	139
(2) Software (S)	440	169	49	658
(M) × (T)/(S)	2·1	1·3	5·9	2·2
% availability	94·9	96·3	96·3	95·4

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M700 was set up in September. Table 1 suggests that M700 was an even greater disaster, but in fact most difficulties arose from a new console WATFOR Fortran facility, which fortunately had not been released for general use. To the users M700 was a great improvement, which was maintained under M720 with the WATFOR facility now corrected and in general use. Releases of Multijob have been restricted to those System 4 sites prepared to accept the risks of using incompletely validated software. Thus at some cost to ourselves we have contributed to the speedier development of Multijob and hence towards an earlier reliable service. The first general release of Multijob, M750, will be set up in 1972.

Meaningful statistics that would quantify users satisfaction, performance and throughput in a multiaccess service are very difficult to obtain because of the problems of collecting and analysing appropriate data. These problems are being studied in the hope that their solution will also help us to make the system more efficient for our type of work. (Teather) For 1971 we can only provide an analysis of manually recorded data.

The 1970 format has been condensed slightly to the following categories:

Multiaccess—work is submitted from the consoles, or local card readers and paper-tape readers. This is the most sensitive operational condition directly involving the users.

Batch—consoles inactive and work submitted from local card reader, and paper tape readers. Since M720, work requested in a multiaccess session can be transferred to a batch session. Under batch there is more core store available for larger programs and work can be scheduled.

System support—this measures the cost in machine time of the effort necessary to set up, to maintain and to expand the service.

Scheduled engineering—this applies to routine maintenance, hardware modification and fitting new equipment. Users know in advance about scheduled engineering work, e.g. when the 64 k byte of core store, two disc drives and a second disc controller were to be fitted during 1971.

Unscheduled engineering—fault repair time interfering with useful operation of the system.

Additional engineering—engineering activities not interfering with useful operation of the system, e.g. late-night or weekend working.

ICL—time provided to ICL under the terms of contract.

Incidents—both hardware and software faults that halt operations. When these occur there is no easy way of advising remote users of the cause and duration of the fault, and the consequences can range from an annoying delay to complete loss of work. For this reason frequency of incidents is one of the most sensitive issues affecting users' confidence. All but one software fault occurred during the multiaccess sessions; hardware faults were spread over all activities. Some software faults were caused by transient hardware failures, but most were errors and once corrected, would not recur.

Referring to Table 1, the multiaccess session time was increased to meet demand and now runs from 10.00 h or earlier to 18.00 h daily. Batch working was largely to satisfy demand and was provided up to 22.00 h as required. Much of the system support has to be done by experienced programmers (Guthrie) often outside scheduled hours. Such support will become less but will never disappear because it includes regular procedures for securing the users current files against possible future system crashes. However, the decrease to 18·3% is a real benefit of M720. Similarly the mean time of 5·9 h between faults during multiaccess in M720 is a real gain. During December the position was

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even better when, for example, there were 14 days without a software incident, including one period of five consecutive working days without software trouble.

The second disc controller was fitted during M720 and this accounted for the many hardware incidents over this period. Referring to Table 1, the availability of the equipment is measured as the—

$$\frac{\text{Total Service} - \text{Unscheduled Engineering}}{\text{Total Service}}$$

and averaged 95·4%. This will still improve slightly—stabilising to about 97–98%. The distribution of hardware incidents is encouragingly skew in that half the working days are incident-free and, of these, more than half occur in sequences of five or more trouble-free days. That is, the incidents tend to be grouped, suggesting a fault condition that recurs over successive days. As the engineering staff gain experience and receive better diagnostic aids, these faults should be better handled. However, no system will ever be trouble-free and the support time, currently about 3 h per day, is necessary to guarantee the integrity of the system and to safeguard the users' files. As the system stabilises, this position will be reviewed and alternative arrangements, such as archiving during the multiaccess session, considered.

There are more studies to be made into the problem of performance measurement and analysis, and it seems we have an above average interest in this topic. It is a fact that there are few published results on the cost-effectiveness of computers. Too often the performance is below expectation for reasons that are rarely publicly analysed.

Amount of work. The total amount of work done by the computer in terms of numbers of jobs and resources used is unknown, but Table 2 gives the jobs and jobs/day on a manual count of those done during M700 and M720. The notion of a job here is simply the loading of a program and takes no account of the number of individuals who are sharing the program, and includes the system overheads. Table 2 shows that jobs/day increased under M720 and is another indication of growing confidence in Multijob. On these jobs alone, we have about trebled the equivalent Orion throughput per day.

TABLE 2

Throughput

	Multiaccess		Batch		Overall	
	Jobs	Jobs/day	Jobs	Jobs/day	Jobs	Jobs/day
M700	5649	131	898	21	6547	152
M720	7127	174	1182	29	8309	203
Overall	12776	150	2080	25	14856	177
Mean time per job (minutes)	2·4		4·6			

The mean time per job (Table 2) confirms that the batch sessions are handling the larger jobs. The ratio of 2 : 1 for the batch : multiaccess mean time is an underestimate, because the system overheads, which are included in all these data, are considerably greater during multiaccess sessions; the true ratio will be closer to 4 : 1. Throughput is critically dependent on the equipment, and the second disc controller in part accounts for the increased number of jobs under M720. The central processor still has spare capacity and with suitable additional equipment, such as extra core, and high speed drum, twice as many jobs could be run during multiaccess with the same standard of service. Put another way, the multiaccess service operates at present with an average of 10 consoles

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on line of which eight are from the institutes. With the additional equipment, a useful service could be maintained for an average of 24 consoles on line, of which 18 could be at other institutes.

Multijob. The previous sections described some of the operational aspects of achieving a stable service. Investigations and analysis of the software incidents are yet another costly part of this process. Most of the software incidents were first checked against published faults, of which there were several hundreds, then checked as a repetition of a new fault condition, then reported to ICL complete with evidence. This procedure applied to both systems and user faults, and more than 200 error reports were submitted to ICL. (Gledhill)

There are design defects in Multijob because it was not originally conceived for a remote multiaccess service. Much time was taken up with meetings, discussions, preparing proposals in an attempt to persuade ICL to make major changes. ICL have agreed to some improvements but more are needed. (Rees and Gledhill) Meantime we have set up our own programs to improve communications with remote users for transferring work from multiaccess to batch sessions and to simplify the running of routine paper tape jobs. (Guthrie)

Communications. Four telegraph, four Datel 200 and two Datel 2400 buffers were added and up to 21 consoles can be simultaneously connected to the system. Datel connections are made through a manual switchboard which is being replaced by an automatic switching unit that will also allow line monitoring. Six consoles are now in general use at Rothamsted.

Remote data terminal. The ICL 7020 remote data terminal can be operated under Multijob and provides a function similar to the E.R.C.C. link. The 7020 and E.R.C.C. terminal can be emulated on a new device—the Electronic Associates Ltd. (EAL) DCT 132, which is under test and has replaced the original E.R.C.C. terminal; it will shortly be tried as a 7020 system under Multijob. (Martin and Moore) Possibilities for developing the terminal network include using a small computer to link non-ICL terminals to the system 4-70, which promises to be a cheaper solution, to improve security and be easier to use. (Martin, Hurford and Moore)

Documentation, advisory and training. Two introductory documents on Multijob were prepared and presented at the courses; many other documents covering new programs, error notices, amendments and newsletters were circulated, and the volume o paper entering and leaving this section increases greatly as the demand for advisory services grows. This section is responsible for the central program library which now contains over 100 items and they check all programs and routines offered to the library and prepare the Abstracts and Guides. (Gledhill, Christine Lessels, Christine Shelley and Baylis)

Liaison with users. Two committees were set up—one of Rothamsted users and the other of the more numerous remote users, to ensure that their needs are met as the service develops.

Orion. This will be the last yearly report on the Orion, which will close down in March 1972. Its working life was extended to eight years because of the delays in preparing programs on the 4-70. The usual performance tables are included.

Since March there has been only one resident engineer but the serviceability (Table 3)

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was slightly better than in 1970. The Orion service has settled to a pattern but the work load diminished slower than expected (Table 4). Production work almost exactly equalled 1970 and the main decrease was in development (Table 4). Fewer experiments were analysed than last year's peak but the number of variates analysed per experiment, 8·8, was the largest ever (Table 5). Survey analyses accounted for only 4·8% of work compared with 6·8% in 1970. (Fearne)

TABLE 3

Orion performance 1970–71 (hours worked)

	Maintained		Unmaintained		Total		%	
	1970	1971	1970	1971	1970	1971	1970	1971
Useful time	1807	1662	388	415	2195	2077	83	90
Faults	316	167	10	30	326	197	13	8
Restarts	62	39	4	6	66	45	3	2
	2185	1868	402	451	2587	2319	100	100
Contracted useful time	90		173			263		
Faults	12		30			42		
Restarts	6		4			20		
Additional maintenance					804	543		
					3391	3187		

TABLE 4

Distribution of work 1970–71 (% total nominal value £000)

	1970 %		1971 %	
Rothamsted				
Development	8		2	
Production	26		30	
		34		32
Other institutes				
Development	6		3	
Production	30		33	
		36		36
Experiments		28		30
Systems		2		2
		100		100
Total work (£000)		314		287

TABLE 5

Replicated experiments and variates analysed 1970–71 (% totals)

	Experiments			Variates		
	1970		1971	1970		1971
Rothamsted Programs						
Data prepared at Rothamsted	69		74	67		69
Data prepared elsewhere	30		25	32		30
		99			99	
Other programs		1			1	
		100			100	
Totals		6494	5729		55984	50249
Variates/Experiment		8·6				8·8

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E.R.C.C. Work on the link diminished from an average of 44 jobs per day in 1970 to 16. The link provides back-up facilities for the developing of Rothamsted programs for the E.R.C.C. The IBM 2780 terminal was replaced by the EAL DCT 132 terminal, which as already said can emulate some commercial terminals. When emulating the IBM 2780 the input rate was increased by 30% and output by nearly 60% over the standard IBM equipment. (Martin)

General services. About 968 000 cards were handled, an increase of 72% over last year. With punched paper tape input on the 4-70, the demand for converting trace and graphical records into paper tape has increased. Also postal services greatly increased with more than 10 000 items handled by job reception. (Fearne)

Programming

The poor behaviour of Multijob made things difficult for the programmers. For much of their work they use advanced features of Multijob and thus tend to meet problems earlier than most users and have to investigate them. The larger programs, in particular, have been delayed.

General program and routines

Utilities. It is not necessary to provide a full list of new programs and routines because users receive details through the documentation services. The following is a selection from some more interesting additions. For the Fortran user, there are now routines for manipulating strings of characters and performing non-arithmetic (logical) operations on most types of Fortran data; system information about files, state of the program, etc. can also be recovered within a Fortran program. (Bicknell) The routine for the input and output of 'free' format data—that is data which do not conform to standard Fortran notation—was modified to include Multijob line files. (Clarke) The paper tape input program was substantially extended and an improved technique for identifying output produced. (Sharma) A special version of the print routines was completed, and a program for transferring punched cards to magnetic tapes. (Tan)

Scientific. A routine was developed for inverting unsymmetric matrices and solving linear equations by othogonal (Householder) transformations (Beasley); various random number generators were written or transferred from other systems (Beasley and Clarke) and were satisfactorily used in a Monte Carlo study on the behaviour of Tukey's one degree of freedom for non-additivity for non-normal data. (Yates)

Application packages. Work continued in transferring the following major packages to the 4-70 and developing a large plotter package.

General Survey Program (GSP). The transfer of Part 1 of the Orion version of GSP to the IBM 360/50 is now complete and includes several new facilities for putting in initial data from punched cards; for example, non-numeric data including multi-punched columns can be properly translated. Printing facilities which are adequate for simple jobs are also provided. A flexible card editing program was written and a pre-edit program for editing Part 1 execution programs. With these additions writing Fortran programs for Part 1 execution is straightforward. Part 1 is now working on the IBM 360 and is under test on the 4-70. The more complex table and printing operations are done in Part 2 and much of this was successfully tested at Edinburgh. Draft user instructions for Parts 1 and 2 and the two edit programs were written. (Yates and Woodford)

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Fitcon and Fitquan. Both these Orion programs were transferred to the 4-70. The first stage of translating the Orion EMA into IBM Fortran using the E.R.C.C. translator was completed without error. The transfer of the IBM Fortran to the 4-70 Fortran proved difficult and brought to light new constraints in the latter's compiler. (Clarke). These programs are closely associated with GSP but have yet to be provided with input from GSP files.

Continuous System Modelling Program (CSMP). This is now working on the 4-70 and improvements are being sought to simplify its use and extend its facilities. (Bicknell and Janice Bending) Documentation was completed and circulated. (Bicknell and Beasley)

Synagraphic Mapping Program (SYMAP). This program takes spatially distributed data and produces, as output, a representation of the surface characterised by the data. The surface is produced as line printer output using different symbols with overprinting to indicate contours and boundaries. The user has several options on the techniques for grouping data and for estimating contour boundaries. This program is now working on the 4-70. (Clark)

Plotting package. Development was handicapped by difficulties in reading 4-70 magnetic tapes on the plotter equipment. At one stage, and after much laborious systematic testing of all the 4-70 magnetic tape drives, we proved that the plotter reading heads needed slight re-alignment. This improved things and, together with a more reliable Multijob system, the package is now beginning to be used. Documentation was prepared. (Thomson)

Sponsored programs. Programs used on the Orion and by the Plant Pathology and Biochemistry Departments were transferred and run on the 4-70. Other Orion programs for the Institute of Animal Physiology and the Meat Research Institute were also transferred. Some new features were added to each of their programs. The initial tabulation for the annual Barley and Wheat Disease Survey data was completed for the Plant Pathology Laboratory, MAFF. The Gleadthorpe and Great House Experimental Husbandry Farms were given a routine service use of Penman's natural evaporation program. (Bicknell and Clarke) A start was made with the input and editing phase of the Physics Department data logged paper tapes. (Beryl Hersom) Assistance was given to the Pedology Department in transferring to the 4-70 an Atlas Package to produce stereoscopic drawings of crystal structures. (Thomson)

System investigation. Programmers also studied in detail the following aspects of the Multijob system. The ICL mathematical package, both for its reliability and methodology (Beasley); the causes for the Fortran compiler failing to generate either reliable or efficient code (Beasley, Bicknell and Clarke); handling magnetic tapes, reading of paper tapes at consoles, running jobs as a controlled sequence of sub-jobs (Beryl Hersom); the sub-system for testing programs (Trials system), the organisation of Multijob and the operating performance of large programs using sequences of overlaid sections from disc store to core store (Sharma); the implementation of new job steps and other system procedures. (Guthrie)

Staff

D. J. Baylis, J. D. Beasley, D. Cockburn, C. H. Hurford, J. G. Jackson, W. J. Moore and D. Teather were appointed. Monica Raddon joined the department for one year

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as a Sandwich Course student. F. Yates contributed an invited paper to the 38th Session of the International Statistical Institute in Washington, U.S.A., and lectured on Survey Design and Analyses at the Civil Service College Seminar. D. H. Rees was elected Chairman of the System 4 Users Association and appointed to the Council of the ICL Computer Users Association; he attended a Civil Service College Seminar on Project Management and contributed to the first joint IEE/IERE/BSC summer school on Software for the Engineer. H. J. V. Gledhill and D. Teather were awarded the degree of M.Sc. of Dundee and London University respectively.

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