

A STUDY OF 650 COMPUTOR COSTS,
ALTERNATIVE METHODS
AND NEW APPLICATIONS

OEL - 628





REDA ENGINES LIMITED

TO: THE MANAGEMENT COMMITTEE

A STUDY OF 650 COMPUTER COSTS, ALTERNATIVE METHODS
AND NEW APPLICATIONS

ISSUED BY:


Systems Accountant
Finance


Sr. Computations Supr.
Engineering

PREFACE

This report comprises essential and economical I.B.M. applications. It is set out within divisions listed below. All other applications surveyed were discarded, as being unsuitable at this time.

1. General Section
2. Cost Comparison
3. New Applications: Purchasing
Production Control
Industrial Engineering
Accounting
Quality Control
General

GENERAL SECTION

QUALIFICATIONS TO STUDY

1. In the time allowed only a cursory examination could be made of the suggested applications, and all processing problems may not have come to light.
2. Estimates of load given by the departments concerned may vary to the actual.
3. The offer of data processing to these departments created report requirements, the concepts of which changed during the survey and will probably change in the future.
4. The Finance Division Key Punch, Verifier, and Tabulating machines are loaded, and the additional conventional applications would utilize comparable machines available in the Engineering area.
5. Computer time is available at the I.B.M. Service Bureau, and in all probability this will be on a 704. The I.B.M. Representative informs us that the cost per application is compatible with 650 Service Bureau Rental, since the 704 is 5 times faster when used to simulate a 650. This could be improved by programming directly for the 704.
6. Stationery costs have not been included, since the differences between existing and the mechanical applications in this report are considered negligible.

ALTERNATE EQUIPMENT

There are machines which have come on the market recently for both data processing and engineering work. Among these are the 1401 for data processing and the 1602 for engineering work.

The writers believe that the use of such machines might be of great benefit to the Company in the future, and strongly recommend that this be studied. Unfortunately, the delivery on these machines is from fourteen to eighteen months.

I.B.M. 650 COMPUTER GROUP

Statement of utilization required to break even with costs
of Rental at I.B.M. Bureau.

Monthly cost of 650 Computer Group \$ 5,739.

A similar expenditure on rental at I.B.M. Bureau will allow

17 hrs. 30 mins.	@ \$102. per hour	\$ 1,785.
15 hrs.	- @ 89. " "	1,335.
9 hrs. 48 mins.	@ 83. " "	813.
16 hrs.	- @ 70. " "	<u>1,120.</u>
Total	58 hrs. 18 mins.	\$ 5,053.
Add: Programmer's travelling time and mileage estimated 13.5% of rental cost		<u>686.</u>
		<u>\$ 5,739.</u>

Utilization hours required of O.E.L. 650 Computer
Group to break even 58.3

Utilization Percentage of available hrs. required 38.61%

COST COMPARISON

COST COMPARISON OF 650 COMPUTER GROUP AND COST OF

RENTAL AT I.B.M. SERVICE BUREAU

The final analysis arrived at in this study has been influenced by 3 basic factors, namely the work load of the 650 Computer Group, the installation rental of the Group, and the rental rates at the I.B.M. Service Bureau.

It is felt the following amplifying notes regarding these factors should be brought to management's attention.

Work Load - The comparison is predicated on the actual work load for the period August 17/59 to February 26/60 taken from Mr. J. Duggan's reports, and on the assumption that Engineering requirements for the balance of the year would remain at this level.

Similarly the annual sale of computer time to outside organizations has been based on sales orders pertaining to 650 Sub Contracts for the period August 17/59 to February 26/60.

Proposed additional loads for the 650 Group do not include those applications which would be more economically processed on conventional I.B.M. equipment.

Mr. Duggan states, that the period August 17/59 to February 26/60, should not be used for estimating the Engineering load for the rest of the year. It contains not one of the periods of intense activity which are typical of an Engineering Division which puts out proposals from time to time. The recent Iroquois B58 proposal caused such a period. Again, the assumption that the Engineering requirement for the rest of the year would remain at a low level is valid only if the Engineering Division fails to make a successful attempt to increase its activity. Mr. Duggan states, that estimates based on the period August 17, 1959 to April 1, 1960 would be more realistic. Therefore, a cost comparison based on this extended period has been placed below that made by Mr. Rowan on the shorter period.

Mr. Rowan feels that the inclusion of the crash programme time will show a distorted picture. The base period used in this case covers a period of 32 weeks, and extension of the costs to cover a full year implies that heavy utilization of the 650 Computer Group will occur again within the year, only to a lesser degree. The effect of the crash programme on the cost comparison can be clearly appreciated when it is noted that it raised 95 hours 650 computer time in the space of two weeks, while time on all O.E.L. Engineering problems for the previous 28 weeks totalled only 191 hours.

Installation Rental - The Orenda 650 Computer Group consists of the Power Pack, the Console Unit, the Float Point and the Read Punch Unit. Calendar month rentals are presently as follows:

Power Pack	\$ 980.
Console Unit	2,690.
Float Point	1,230.
Read Punch Unit	839.
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Total Monthly Rental	\$ 5,739.

I.B.M. Service Bureau Rental Rates

The rates quoted by the I.B.M. Representative did not include rental of a Float Point. At his suggestion these rates were therefore adjusted by us on a percentage basis of installation rental to include this type of equipment. The hourly rates per month, with and without Float Point, are as follows:

	<u>Without Float</u>	<u>With Float Point</u>
First 17 hrs. per month	\$ 80.	\$ 102.
Next 15 hrs. per month	70.	89.
Next 9 hrs. 48 mins. per month	65.	83.
All hours thereafter for the month	55.	70.

The prices are based on monthly usage, with the customer operating the equipment.

Having regard to the fluctuation in Engineering requirements, and the progressive reduction in hourly cost with increasing use, the annual Service Bureau costs in this study have been based on the actual monthly work load for the period August 17/59 to February 26/60, and not on an average month's load. Incidental expenses such as mileage to and from the Service Bureau, and the programmer's time lost in travelling have been added to the basic rental figures.

Proposed additional work loads have been rated at the maximum of \$102. per hour in view of the uneven flow of Engineering load.

COMPARATIVE COSTS BETWEEN ORENDA 650 GROUP INSTALLATION AND

USE OF I.B.M. SERVICE BUREAU

	<u>ORENDA</u>		<u>I.B.M. SERVICE BUREAU</u>		<u>ANNUAL SAVINGS</u>
	<u>HOURLY RATE</u>	<u>ANNUAL COST</u>	<u>HOURLY RATE</u>	<u>ANNUAL COST</u>	
* Existing load without sale of Sub Contract work	\$189.	\$68,868.	\$108.	\$36,945.	\$31,923.
* Existing load with sale of Sub Contract work	\$176.	\$64,529.	\$108.	\$36,945.	\$27,584.
Existing load without sale of Sub Contract work, but including proposed additional load	\$165.	\$68,868.	\$109.	\$45,267.	\$23,601.

- * -- The use of I.B.M. Service Bureau in these cases may effect further savings on the balance of the equipment in the Engineering area.

It is important to note that retaining the 650 Computer Group at O.E.L. provides at least two intangible benefits which are not reflected in the above analysis

1. The convenience of having the equipment close at hand for Engineers working on a trial and error basis.
2. Speed where time is limited.

The importance of these two intangible benefits was brought out in the recent investigation of the Uprated Iroquois for the Convair B58.

COST COMPARISON BASED ON THE PERIOD AUGUST 17/59 - APRIL 1/60

	<u>ORENDA</u>		<u>I.B.M. SERVICE BUREAU</u>		<u>ANNUAL SAVINGS</u>
	<u>HOURLY RATE</u>	<u>ANNUAL COST</u>	<u>HOURLY RATE</u>	<u>ANNUAL COST</u>	
Existing load without sale of Sub Contract work	\$136.	\$68,868.	\$ 98.	\$47,264.	\$21,604.
Existing load with sale of Sub Contract work	\$127.	\$64,384.	\$ 98.	\$47,264.	\$17,120.
Existing load without sale of Sub Contract work, but including proposed additional load	\$127.	\$68,868.	\$103.	\$55,586.	\$13,282.

NEW APPLICATIONS: PURCHASING

PURCHASING

Mr. R. Parish

A tooling report is supplied to Mr. C. A. Hore, D.D.P. Representative every second week. It embraces the purchase price and O.E.L. estimates in labour hours and dollars, material dollars, and total value.

The manual operation entails some calculation and sorting. Application by means of I.B.M. conventional equipment reflects a substantial annaul saving and also relieves one employee in the Purchasing Department for other urgent work.

Annual Cost Manual Application	\$4,300.00
Annual Cost by I.B.M. Application	\$ 372.50
Annual Saving by use of I.B.M.	\$3,927.50

This application is not recommended for the 650, and the above figures are based on the use of the 602A.

NEW APPLICATIONS: PRODUCTION CONTROL

FINISHED PARTS STORES RECEIPT SCHEDULE

This is an example of the job of producing an operating schedule, given a "unit engine schedule" or "family tree", and an engine delivery schedule.

This method could be applied equally well to produce a schedule day by day for assembly, delivery to Finished Parts Stores, purchase and follow-up of bought-out finished parts, work in progress past chosen key operations in the shop, and purchase, follow-up and delivery of raw materials, for a given engine delivery schedule.

For this example consider a Finished Parts list of 3000 items, including parts and assemblies, and an engine delivery schedule by day for 3 years, or 750 days. Then a Finished Parts Receipt Schedule for 2 years or 500 days would contain 1,500,000 entries.

The "family tree" would be recorded on a deck of 3000 cards, one for each item in the Parts List, carrying part or assembly number, number of pieces per engine, and lead time in days to engine delivery. The engine delivery schedule would be stored on the magnetic drum of the 650; it would take less than 4 minutes to read this in from cards. The time covered by the engine delivery schedule would have to extend beyond the time for which the Finished Parts schedule was required by a time equal to the longest lead time in the family tree. In this example this longest lead time is taken to be 90 days.

The family tree deck would be run through the 650 and the complete Finished Parts Receipt Schedule would be punched out. This would best be in the form of a cumulative delivery requirement schedule, though a non-cumulative schedule could be produced if desired. It would be practical to punch several entries on each output card. Punching 20 entries on each output card, there would be 25 output cards for each item in the family tree. There would be 75,000 output cards, and the whole calculation would take $12\frac{1}{2}$ hours. This would be followed by $19\frac{1}{2}$ hours of sorting. The schedule could then be listed in 15 hours on the 407, though this need not be done all at once. It could be listed a few weeks at a time.

Mr. Rowan feels the card volume is understated as it may not be possible to punch 20 entries per card.

Thus the whole schedule would be available within 48 working hours, at a cost of \$2,280. (using the Orenda 650 rate in the cost comparison). This does not include the cost of putting the input data on cards; the engine delivery schedule would be about 20 minutes of key punching, and the family tree would be either 4 hours of key punching or the results of another 650 application.

The family tree could be extended to include key operations in the manufacturing process, purchase and delivery dates for purchased parts and raw material, etc. The data processing time would be increased in proportion to the increase in the family tree. Similarly the data processing time would be increased or decreased in proportion to the increase or decrease in the period which the schedule is required to cover.

Any calculation error would cause an error in the schedule. The self-checking features of the 650 would prevent this.

A very rough estimate for the time required to get this program into operation would be three weeks from starting. This is assuming that the engine delivery schedule and the "family tree" are available. The "family tree" is the only difficult one of these two items. It would either be supplied direct from Production Control and key punched directly, or compiled as a separate application on the basis of information supplied by Production Control. This application will be dealt with separately.

This job would be practically impossible on the 602A.

After the preceding was written it was stated that there are many items which are each used in several different places in the engine. If the "point" identification used in the "family tree" is increased by two digits denoting different "uses" of the item, then the detail schedule program can be made to cope with this. All the cards for the same item and event, but different uses, would read into the 650 together and one schedule by day or week would be put out for that item and event, taking into account the different lead times due to the different uses.

Spares present a nasty problem. It would be best to keep spares requirements separate, on paper, from requirements for engine delivery. These could be inserted into the schedule by hand if the number of different requirements is small, or by some automatic method if it is large. The latter would probably be the case. This would add some sorting time to the process, and an amount of calculating time in proportion to the number of different requirements.

Mr. Rowan disagrees that the latter would be the case. He understands the major portion of spares will be inserted into the schedule from the key punch and not from a further calculation.

Calculation and listing of a schedule for one year with a contingency for recalculation of a three month period quarterly, and the publishing of a weekly schedule showing the cumulative schedule requirements for the previous week, the cumulative receipts to Finished Parts Stores, and the cumulative requirements for the current week, has been estimated to cost \$2,865. The comparison to the manual method is shown on the Production and Material Records application.

PRODUCTION & MATERIAL RECORDS

Production and Material records were covered in a previous submission to Mr. J. May as a 650 computer application. Mr. Rowan pointed out that the 407, when making the listing for transfer post, would do the necessary addition and subtraction. It was agreed this was not a 650 job. In the submission to Mr. May the comparison of cost for both records and schedule was related to the additional equipment and operators required in I.B.M. and not the estimated costs of the complete process. A study has been made, in this light, reflecting an annual cost of \$5,909. for the records and an annual cost of \$2,865.*for the schedule, the total cost being \$8,774. The estimated annual cost of the manual operation \$12,079. shows a savings of \$3,306. by use of the I.B.M. method. Added to this are such intangible benefits as:

1. A more accurate and legible record
2. A more current record
3. The production of a status report within the time limits allowed

* - The use of Mr. Duggan's figures would reduce the 650 portion of this amount.

NEW APPLICATIONS: INDUSTRIAL ENGINEERING

SHOP PERFORMANCE ANALYSIS

This is a job requested by the Industrial Engineer, Mr. Price. The object is to measure the performance of the Production Shop.

The daily requirement is for calculation of earned hours and elapsed hours for part and operation, summarized by cost centre and by man within the cost centre, to be delivered by 11 a.m. next day. The weekly requirement is for earned and elapsed hours summarized by cost centre and efficiency by cost centre. A man may report time against several cost centres during the day. It is considered unnecessary to lump these together, for the few cases in which this will occur.

For the job to be done by I.B.M. methods, additional information must be recorded on the job time cards, and the number of cards produced daily would increase. This would necessitate increased use of the Executone system. The Executone system has the required extra capacity, and Mr. Price has stated that he will make the necessary arrangements about staff.

The cost of handling this operation as an I.B.M. application will not be compared with that of doing it by hand, as Mr. Price has stated that it is impossible to produce the information needed quickly enough to be useful.

It was estimated that there would be a daily output of about 2000 cards, with 38 columns of key punching in each, for a working force of about 700 men, in 50 cost centres. There would be about 9000 part-operation combinations, recorded on a "rate" deck of 9000 cards, each carrying part number, operation, and earned hours per piece.

Job time cards would be brought from the Executone room to the I.B.M. room at intervals through the day, for key punching and verification. It is estimated that the last batch of cards from the day shift would be punched by 9.30 the following morning. It would be necessary for a man to call in when leaving a job, in order to report the number of pieces processed. This presents a major difficulty at the end of the shift. Mr. Price has undertaken to sort this one out.

It has been estimated that the job cards would be completely verified by 10.00 a.m. By use of the 650, the report would be ready by 11.45 a.m. Using the 602A, the job would take an hour longer. Allowing for lunch hour, the report would be out by 1.30 p.m.

There was a suggestion that the rate be called in by the employee, and key punched into the card. This has been dropped as it is necessary to get the G. E. part number from the rate card and the rate would be reproduced at the same time.

The self-checking feature of the 650 would not give it great advantage over the 602A, since a calculation error would not be carried forward from one day to the next.

The weekly summarizing operation has not been dealt with. It is almost trivial by 650 or by 602A.

Mr. Rowan has this comment to make regarding "The necessary arrangements about staff" in paragraph 2. Additional staff in the Executone area is a decision required from the Accounting Department. They have tentatively agreed this could be two people.

The estimated cost of this application is \$15,840. a year. Since it has been stated it would be impossible to carry out by hand, within the time limits, we have not shown a comparison.

Mr. Rowan does not feel this is an economical 650 application. Although the report is estimated to be issued at 11.45 A.M. on the 650 and 1.30 P.M. on the 602A, the comparison of costs between the two methods reflects an annual saving of \$3,450. * by use of the 602A.

* - The use of Mr. Duggan's figures would reduce the 650 portion of this amount.

NEW APPLICATIONS: ACCOUNTING

PAYROLL

This application was examined only with a view to producing the pay envelopes and cheques, the payroll listing, and the payroll summary by punched cards, laying out a rough routine for the 650 and pricing this out to compare with the displaced costs in the payroll department. It was found that on the basis there was no saving, the two sets of costs being very close in amount. Since this was a borderline case as far as economy was concerned, it was included in the study as an economical 650 operation, particularly as by-products might render the operation as a whole favourable to I.B.M. application. This is not to suggest that the 650 application would be the cheapest I.B.M. method. A successful payroll operation is carried on at Avro Aircraft by means of a 604 calculator renting at \$708. per month.

Annual Cost of 650 Application	\$5,944. *
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Annual Cost displaced in Payroll Dept.	\$5,434.
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* - The use of Mr. Duggan's figures would reduce the 650 portion of this amount.

NEW APPLICATIONS: QUALITY CONTROL

QUALITY CONTROL

It has not been possible to completely finalise the requirements of this department, but it appears likely they will be met by reports on rejections by:

- (1) Employee and Dept.
- (2) Part and Operation or Supplier
- (3) Defect Code

Each report will embrace the cumulative quantity to date in process and cumulative rejections. This is an application on conventional equipment.

Annual Cost	\$2,303.50
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STATISTICAL ANALYSIS OF INSPECTION SAMPLES
FOR THE QUALITY CONTROL DEPARTMENT

The quality of incoming shipments of bought-out Finished Parts or Raw Materials is estimated from the results of Inspecting samples from these shipments. Mr. Foskett, Quality Control Specialist, is about to recommend the use of standardized statistical methods in the analysis of the inspection data. It is not within the terms of reference of those writing this report to recommend for or against this proposal. If, however, the proposal is accepted, there would be a considerable amount of tedious computation, which could well be performed by the 650.

There were 140 receipts during March. This is 7 per day. It has been estimated that there will be 12 to 13 daily during April, and that the daily figure will rise to 15. There are, on the average, about 4 characteristics per item to be measured.

Working by hand, it takes 4 minutes to analyze the data for one characteristic. At 15 receipts per day, and 4 characteristics per item, this would take an average of 4 hours per day. The number of receipts per day, and the number of characteristics to be inspected and analyzed, can vary widely. It is important, however, to produce the results of the analysis as quickly as possible, no matter what might be the variations in flow.

To process the inspection data by calculator it would be punched into cards and run through the calculator, and then the result cards would be listed on the 407 tabulator.

A generous estimate would be about 20 cards per item (not per characteristic), punched in about 20 columns. At 15 different items received daily, this would involve 38 minutes of key punching and 38 of verifying.

Four or more characteristics, all of the same item, would be processed simultaneously in the calculator. It is estimated that the 650 would cope with one item, of up to 10 or 15 characteristics, in about 15 seconds. Thus the 15 items per day would be dealt with in 4 minutes.

There would probably be 6 or 7 result cards per item. These would require no further processing but could be listed immediately. These would be listed on the 407 in less than one minute.

These results, already on cards, might be used further in the assembly of weekly vendor efficiency reports, but that will not be further dealt with here.

If Mr. Foskett's proposal is accepted and put into practice, his methods could be extended to analysis of inspection of work in the various shops. This would increase the I.B.M. work load in proportion, and would similarly increase in proportion the benefits to be obtained from systematic statistical analysis.

Annual Cost of Manual Application	\$3,615.
Annual Cost of I.B.M. Application	\$3,299. ★
Annual Savings by use of I.B.M.	\$ 316.

Since this particular application was submitted subsequent to the completion of the cost comparisons and is not an established requirement approved by a Department Head, its appearance in this report is in the form of a memorandum only.

It should be noted that if the proposal is accepted the annual savings by use of the I.B.M. Service Bureau would be reduced by approximately \$1,632.

★ - The use of Mr. Duggan's figures would reduce the 650 portion of this amount.

NEW APPLICATIONS: GENERAL

LABOUR BUDGET

This is a small job which has been already set up on the 650 and run for the Engineering Division.

In the preliminary stages of putting out the semi-annual budget, there is often a considerable amount of calculation and re-calculation of labour requirements. The final labour requirements must all be produced within a comparatively short time.

In its present state, the Labour Budget calculation program can deal with a department of up to five sections. The input consists of a list of the numbers of employees in the various sections and their wage rates, for the first month, and all changes in wage rate or numbers of employees for the following months. The calculation can be run for as many months as desired. The output consists of a card for each month, carrying number of employees and total wage for the month for each section, total wage for the month for the whole department, and cumulative total wage for the department.

The program takes account of statutory holidays, varying number of days in a month, annual holidays, an extra week of holidays for 10 year employees, and allowed for an "efficiency" to take absenteeism into account. Since it was concerned with J 79 work only, it also allowed for partial employment of personnel.

This program has already been used in the calculation of the J 79 Engineering Labour Budget. To calculate the budget by months for 5 sections for a period of 36 months took about 4 minutes. The results were listed on the 407, on a standard pre-wired control panel, in less than a minute.

This program may not seem very useful the first time it is used, but its advantages become obvious the first time a change is contemplated in the Labour Budget and a re-calculation becomes necessary. When this happens it is necessary only to key punch the changes in input and rerun the program.

This program would be of great help to all department heads who have to produce a labour forecast twice a year. The main advantage would be in saving their valuable time and in speeding up the preparation of the main budget.

The cost and 650 time are negligible and the amount of supervision time saved is not known. Therefore, no comparison has been shown. This job in itself, cannot have a real effect on the study of uses for the 650.

It has been included because it is typical of a class of small jobs which might be found in widely different areas of the Company's operations. Each in itself would be insignificant, but taken together they might make a contribution. This contribution would be difficult to estimate in advance, but should be kept in mind.