UTILIZATION OF MICROCOMPUTERS IN THE DIVISION OF GRAVITY, GEOTHERMICS AND GEODYNAMICS

by

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Summary

The ad hoc committee on microcomputers was set up to develop a plan for exploiting microcomputer technology to improve the effectiveness of the scientific, technical and administrative activities of the Division of Gravity, Geothermics and Geodynamics.

Applications for microcomputers were ascertained by means of a questionnaire and by interviewing Section heads and secretarial staff.

The main applications for microcomputers are composing manuscripts, reports and letters and in the reduction, analysis and graphical display of data.

It is recommended that the following numbers of IBM PC microcomputers be purchased or rented with option to purchase: 8 in 1984/5; 8 in 1985/6 and 5 in 1986/7.

In deploying the microcomputers in the first year, at least one unit should be made available per section (including Divisional administration) in a common area so that staff members can acquaint themselves with the IBM PC.

Some on-going assessment of microcomputer utilization, particularly in the first year, is recommended.

We recommend, upon arrival of the first batch of microcomputers, a set of in-house demonstrations and lectures.

There is a need for a scientific programmer in the Division to support and develop scientific applications of all types of computers.

Introduction

An ad hoc committee was set up on Nov. 22, 1983 to "develop a plan for exploiting microcomputer technology to improve the effectiveness of the scientific, technical and administrative activities of the division". As a matter of interest, four out of five of the committee members already have their own microcomputers (micros) at home. Although their activities might be classified as mainly scientific in nature, the members have endeavoured to keep a balanced viewpoint with regard to the technical and administrative needs of the Gravity, Geothermics and Geodynamics Division. It became clear when considering possible applications and "care and feeding" of micros that there are larger aspects of Divisional computing needs that exist whether or not micros are available. These needs will be discussed to some extent later on, but they involve an apparent lack of well documented, main-line programs for scientific applications, and a need for a mid-level scientific programmer to write efficient programs. This would be a Division-wide service in much the same way as we have Branch-wide services such as photography, etc.

Although our study is not "machine-dependent", we have accepted the IBM PC as the micro designated for Branch use in the office. Given a particular application, this machine may not be the best choice. In fact, the COMPAQ, a portable machine,might also be useful since it can be carried around from one office to another or taken home. However, the IBM PC appears to be a safe choice. It must be recognized that the IBM PC will quickly be superceded, as any other machine will be, but, for consistency, it seems worthwhile to stick with it for the next few years.

We have maintained a fairly narrow viewpoint in our study, feeling that the main purpose of the committee is to identify, in conjunction with staff members, applications for micros and to suggest ways to ensure an orderly development of their acquisition and use. We have not considered the merits of diverting existing computing to micros but we have considered means of linking micros to larger computers and to the existing WANG word processor. We do not think that an influx of micros will unduly increase the workload of any particular individual and have tried to present a fairly simple plan.

Methodology of Investigation

It was decided to canvass the members of the Division by means of a questionnaire, supplemented by interviews of section heads and secretaries. The questionnaire is given in Appendix 1. In retrospect, it is probably weak in determining suitable technical applications for microcomputers but the Division already seems to be well equipped in this respect (Hewlett-Packard units for Global Dynamics and Geothermics and a DEC unit for Geodynamics). Discussions were also held with Mike Bone, Dave Seemann and Herb Dragert of PGC since they have already made a similar study for their division. A few staff members attended a demonstration of an IBM PC, a COMPAQ and a HYPERION computer at the Blackburn Laboratory. One of the committee members (Ron Buck) now has an IBM PC for use in the Data Center in Building 5 and the field group is using a HYPERION in Building 2.

Description of Applications

A detailed summary of the results of the questionnaire is given in Appendix 1. However, it is somewhat tedious to go through, so a general summary is given in Table 1. A little over half of the Division responded to the questionnaire. Of these about two-thirds have already used a micro-computer and think a micro would be useful for their work at the office.

In our view the main applications of micro-computers in the GGG Division are (more or less in order of importance):

(1) composing manuscripts, reports and letters, etc.
(2) data reduction and analysis
(3) graphical display of data

Three additional applications which we think can be handled well by micros are:

(a) filing, program planning and management, etc.
(b) modelling of gravity and magnetic anomalies
(c) acting as "intelligent" front ends for larger copmputers

but there was no across-the-board support for these in the questionnaires.

It may seem surprising that so called "word processing" has first place in the list but some 90% of Chris Lacasse's time and some 30% of Micheline's time is spent typing straight-forward letters and memos (many of these are for internal distribution only). The point here is that the originator of the memo, etc. has to write it down on paper and the secretary has to transcribe it. It would be much more efficient to have the originator type his or her document directly into a micro and then transfer it to a main word processor (or another micro with a letter-quality printer in the secretary's office) for final preparation and printing. Perhaps more importantly, a word processing package allows one to "cut and paste" and correct errors easily and promotes getting ideas into written form. This is a great advantage not only in writing letters and memos but also in the preparation of scientific manuscripts.

Although at the present time letters, memos, reports (this one for example) etc. can readily be done with micros, we believe manuscripts requiring mathematical notation in camera-ready form can not yet be properly done on micros and these should be a subject of separate study. For the time being, scientific manuscripts can be roughed out and dumped into the WANG (we hope!) for final processing with mathematical equations entered by the secretary.

Recommendations

(1) Acquisition of hardware

Table 2 provides a capital acquisition plan for micros for the Division for the next 3 years. The first year (1984/5) has been made in consultation with section heads; the second and third years are based mainly on the responses to the questionnaire and are designed to give those interested in micros a chance to have greater access to them.

It is our view that the micros should be acquired as quickly as possible because they will rapidly get out of date and after 5 years (or whatever time span is designated under the CARP plan) they can be replaced in one or two groups. In this way the incompatibility of the old and new units will have an effect for the shortest possible length of time. We are proposing 8 units plus some printers and a few colour monitors in 1984/5, 8 units plus two printers in 1985/6 and 5 units plus one printer in 1986/7.

It is understood that all of these units are to be capital purchases but rental with option to buy from CSC is an alternative, especially for the second and third years when we see how further usage develops. We believe that all the units purchased in the first year will be used full-time given proper deployment.

(2) Deployment of microcomputers

For the first year each section should make at least one micro available in a common area so that the staff has easy access to it. This will enable people to use a micro for composing letters, manuscripts, etc. and to gain experience with a micro and see what further applications may develop. Some form of booking arrangement can be made, if necessary, to give equal opportunity for access. An inherent difficulty with micros that they will be regarded as "personal" property and sharing, although desirable in principle, may be difficult to achieve. Most members of the Crustal Dynamics section who already have experience with the LSI 11 indicated on the questionnaire that they have sufficient applications for a micro that they do not want to share a unit. This is probably not selfishness as much as a realization that sharing will disrupt their work. At least one staff member will need to monitor and evaluate the actual utilization of the microcomputers.

For the second year it may be necessary to go to a more formal method of allocation where personnel who wished to use one of the units would be required to submit a utilization plan. This plan would outline the application in detail, including the time, cost, personnel and software required for development, implementation and continuing hardware and software support. A two or three page form could be designed to facilitate the process. This method of allocation may seem overly bureaucratic but it provides a mechanism for review by the Division director and section heads to control the utilization of micros and to make the applicant aware of all of the factors that are involved in using a microcomputer system.

The third year could be administered in the same fashion. By this time prospective users should have a firm idea of how they will use a micro-computer.

(3) Staff training

(1) Immediately upon acquisition of the first batch of micros

In-house speakers, along with guest speakers from CSC and GSC (Resource Geophysics and Geochemistry Division), are recommended to provide the following training:

a) Hardware - This would be designed to acquaint the user with the capabilities of the keyboard, disk drives monitor, printer and communications

system of the IBM PC.

b) Languages and Operating System - This course would introduce users to the operating system of the IBM PC and the high-level languages available for it and suggest possible difficulties which might be inherent in their use to solve various types of problems. The high-level language will be biased towards IBM PC BASIC.

c) Software Packages - This course would present an overview of the software packages available for the IBM PC. It would include word processing systems, interpreters and compilers for programming languages, spread sheet packages and (small) data management systems.

One person in the Division should be allocated the task to draw up an outline of the lectures to be given and to coordinate the speakers. It is estimated that five 1-hour lectures/demonstrations would suffice. It is expected that the CSC will provide training in microcomputer operation; if so, the in-house training could be reduced somewhat.

(11) As time progresses

Almost all of the respondents to the questionnaire indicated that they would be willing to undertake any training needed to operate a micro. About half (15) indicated they might need a course in programming but only one-quarter (6) felt they would need typing lessons. These requirements can probably be met in a fairly low-level way with some in-house help with the programming and purchase of some "how to type" books. If in-house help is not available for programming instruction, the CSC will be offering suitable courses.

(4) Support for microcomputers

Hardware - About the only hardware item which will almost certainly require maintenance is the disk drive. At present, the standard charge by industry to inspect and adjust a drive is about 50 dollars. Although we have personnel within the Division capable of fixing disk drives, repairs might better be done outside. The disadvantage to this is that the disk drives are mounted in the IBM PC and the whole unit will be out of action while the drives are being adjusted or repaired.

Software - There is a lot of business software available for the IBM PC so it is not necessary to "re-invent the wheel" in this case. Initial cost of software would be about 600 dollars per unit (some software could be shared; different software could be ordered with different machines to obtain a spectrum of software). However, there do not seem to be many programs for scientific applications of interest in the Division that are ready to run on the IBM PC. Most of the people likely to use micros in the early stages of their appearance will be able to write or adapt their own programs. Incidentally, these programs should be written so as to run on both the IBM PC and IBM compatible machines. One person should be designated to maintain a catalog of available programs.

Later on there will be a need for a person to support those members of the Division who are either not able to program a microcomputer or do not perceive their job to include programming one. This lack of programming activity is a long-standing problem involving computers in general, not only micros. The need is most obvious in the field of gravity interpretation but a scientific programmer (at the CS2 level) would be of help throughout the Division. An occasional summer student is not sufficient to fill this requirement. The incumbent would provide programming services and advice and keep abreast of scientific programs and systems available from universities and other geophysical institutions. He or she would adapt existing programs to the mainframe, mini- and microcomputers available to the Division. In addition, the scientific programmer would , in conjunction with operational and scientific personnel, advise the Division administration of the feasibility of proposed applications and how they would best be implemented on the available facilities.

Table 1 Short summary of Questionnaire results

This table is broken down by Section within GGG Division

The letters at the tops of the columns indicate the following:

- S Applications which are mainly scientific in nature (such as data reduction and analysis)
- A Applications which are mainly administrative in nature (such as composing manuscripts on a word processor and filing)
- T Applications which are mainly of a technical nature (such as data logging and instrument control)

The following letters indicate a rough estimate of the amount of work to be done in a particular class of applications

- H A high proportion
- M A moderate proportion

the letter Y indicates a need for a technical function
and the letter x indicates the expected utilization time

The numbers indicate expected utilization time of microcomputer

- 1 Every day
- 2 A few times a week
- 3 Only occasionally

Divisional Administration

	S(cientific)	A(dministrative)	T(echnical)	1(daily)	2(weekly)	3(occ)
Boyd	H(igh)	M(oderate)	Y(es)		x	
Gibb	H	M		x		
Lacasse		M				

Crustal Dynamics

	S	A	T	1	2	3
Beach	H	M	Y	x		
Bower	M	H	Y	x		
Courtier	H	H	Y	x		
Gagnon	H		Y		x	
Goodacre		M		x		
Jeudy	H			x		
Lambert		M		x		
Liard	H	M		x		
Valliant	H	H	Y	x		

Crustal Studies

	S	A	T	1	2	3
Allen	H		Y	x		
	(some applications already filled by HP micros)					
Drury	H	M			x	
Feininger		M				x
Jessop	M	H		x		
Judge	H	M	Y	x		
Robertson	H	M				x
Sobczak	H					x

Taylor	M	H			x	
Thomas	M	M			x	

Global Dynamics

S	A	T	1	2	3
Kouba	H	M	Y	x	
Paul	M	M		x	

Standards and Data Systems

S	A	T	1	2	3
Cooper	H		Y	x	
Halliday	H	M		x	
Halpenny	M	M		x	
Winter	M	M		x	

Table 2 Acquisition plan for micros

Note: The basic unit consists of an IBM PC with 256K of memory and two floppy disk drives (or a HYPERION in case of field use). Estimated cost of one basic unit is 6K; HYPERION is about 5K.

1984/5

Section	No. of units	Extras	Expected main users
Divisional Administration		1 Black box to interface PCs to WANG (2K)	
Crustal Dynamics	2	1 Printer (1.3K) 1 Colour monitor and associated board (1.3K)	Valliant, Courtier, Gagnon
Crustal Studies (one or two units might be purchased with Energy funds)	3	1 Colour monitor and associated board 1 Printer	Jessop, Judge, Thomas
Global Dynamics	1	1 Printer	Paul, Nagy
Standards and Data Systems	1 (field) 1	1 Colour monitor and associated board	Halliday Kane, Halpenny
Cost	47K	10K	

1985/6

Section	No. of units	Extras	Expected main users
Divisional Administration	1	1 Daisy wheel printer (2.5K)	Dence, Lacasse
Crustal Dynamics	2		Bower, Goodacre Lambert
Crustal Studies	2		Drury, Weber, Feininger, Robertson
Global Dynamics	1		Popelar, Kouba
Standards and Data Systems	2	1 Printer	McConnell, Cooper Winter
Cost	48K	3.8K	

1986/7

Section	No. of units	Extras	Expected main users
Divisional Administration	2	1 Printer	Gibb, Boyd
Crustal Dynamics	1		Liard
Crustal Studies	1		Taylor, Burgess
Global Dynamics			
Standards and Data Systems	1 (field)		
Cost	37K	1.3K	

Appendix

Questionnaire re micro computers for GGG

Name _____ Date _____

Part A

Have you used a micro computer? Y ____ N ____ (1)

If so, what kind? _____

Would you like to have further information and/or a demonstration of a micro computer? Y ___ N ___ (2)

Do you think a micro computer would be of use to you in your work? Y ___ N ___ (3)

What sorts of things would you use a micro computer for?

Data acquisition _____ (4)

Data reduction _____ (5)

Data storage _____ (6)

Data analysis _____ (7)

Composing letters and memos - preliminary versions for final processing by a secretary _____ (8)

or final versions _____ (9)

Composing manuscripts - preliminary versions for final processing by a secretary _____ (10)

or final versions _____ (11)

Controlling laboratory or field experiments _____ (12)

Keeping inventory _____ (13)

Filing _____ (14)

Data display e.g. Computer graphics _____ (15)

black and white _____ (16)

colour _____ (17)

other displays _____ (18)

Other uses you can visualize. Please list below.

Where would you use your micro computer? Office _____ Field _____ Both _____ (19)

Are you presently a user of the CSC CYBER computer? Y _____ N _____ (20)

Are you aware of the variety of science and business applications software that are presently available on the CYBER? Y _____ N _____ (21)

How many of the microcomputer applications you know about can be handled now (or in the foreseeable future) on the Departmental CYBER?

How many are better handled by a micro computer?

Part B

Branch policy is to purchase IBM PC's for office use and IBM "compatible" micro computers for field use. Is this satisfactory for your purposes? Y _____ (22)

N _____

If not what micro computer will satisfy your requirement? _____ (23)

Why? _____

What are your hardware requirements? Please list below.
some examples: memory size, number and type of disk drives,communications capability, joystick and/or mouse for cursor control, printer, etc.)

Please indicate maximum file size in characters needed
for your applications (24) ~~~~~~~~~~~~

How often would you need to have access to a micro computer?
every day (25) ~~~~~~~~~~
a few times a week (26) ~~~~~~~~~~
only occasionally (27) ~~~~~~~~~~

Do you need to have your micro computer hooked up to:
other micro computers Y ~~~ N ~~~ (28)
a larger system Y ~~~ N ~~~ (29)please specify ~~~~~~~~~~~~~~~

Would you be willing to undertake any necessary training to help you use a micro computer efficiently? Y ~~~ N ~~~ .(30)

For example: how to program ~~~~~~~~ (31)
how to type ~~~~~~~~ (32)

Would you be willing to share a micro computer with one or more other people?
Y ~~~~ N ~~~~ (33)

What are your software requirements? Interpretation packages (specify) (34)
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~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
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Mathematical packages (specify) (35)
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~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

(15)

Statistical packages (specify) (36)

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(15)

Word processing systems (specify) (37)

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Filing systems (specify) (38)

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Languages (specify) (39)

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Other (e.g. communications, cost estimates, accounting) (specify) (40)

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Will you need programming assistance? Y~~~~ N~~~~ (41)

Will you need help to implement various software packages? Y~~~~ N~~~~ (42)

Please list any other comments or queries below.

Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Allen	Y	Y	Y	✓	✓	✓	✓					✓	✓	✓	✓	✓			B	N	N
Beach	Y	N	Y	✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓		O	N	N
Bower	Y	N	Y						✓	✓	✓	✓	✓	✓*	✓	✓	✓		O	Y	Y
→ Boyd	N	Y	Y	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓	✓	B	Y	Y
Cooper	Y	N	Y		✓	✓	✓	✓				✓			✓	✓	✓		B	Y	N
Courteier	Y	N	Y*	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	?					O	N	
Drury	N		Y	*	✓	✓	✓	✓		✓	✓				✓	✓			O	Y	Y
Feinager	N	Y	Y		✓														O	Y	N
Fogarasi	Y	Y	Y	✓	✓	✓	✓		✓			✓			✓	✓			B	Y	Y
Gagnon	Y	N	Y									✓	✓	✓	✓	✓			O	N	N
Gibb	Y	Y	Y		✓	✓	✓	✓		✓				✓	✓	✓	✓		O	Y	½
Goddard	N	Y	Y		✓		✓			✓	✓			✓	✓	✓	✓		O	Y	Y
Halliday	Y	N	Y		✓	✓	✓	✓	✓				✓			✓			B	Y	Y
Halpenny	Y	N	Y	✓					✓		✓						✓		B	Y	Y
Jessop	Y	N	Y		✓		✓	✓	✓	✓	✓								O	Y	N
Jendy	Y	N	Y		✓		✓								✓	✓	✓		O	Y	Y
Judge	Y	N	Y	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓		O	Y	Y
Konta	Y	N	Y	✓	✓	✓	✓		✓		✓	✓				✓	✓		B	✓	✓
Liard	Y	N	Y	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓		O	✓	✓
Paul	Y	Y	Y				✓			✓					✓		✓	✓	O	Y	Y
Robertson	N	Y	?		✓	✓	✓			✓				✓		✓			O	N	N
Sobcyak	N	Y	?				✓										✓		O	Y	N
Taylor	Y	N	Y				✓	✓	✓	✓						✓			O	Y	Y
Thomas	N	Y	Y		✓	✓	✓	✓		✓				✓	✓	✓	✓				
Valliant	Y	N	Y	✓	✓	✓	✓	✓	✓	✓	?	✓	✓	✓	✓	✓	?		B	N	N
Winter	N	Y	Y	✓	✓	✓	✓	✓		✓				✓					O	Y	Y
→ Chernis	N	Y	Y		✓	✓	✓	✓		✓				✓	✓	✓		✓	O	Y	?
Lambert	Y						✓	✓		✓									o	Y	Y
Larnas		Y												✓					o		
	Y	Y	Y	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	Y	Y
	18	12	25	11	21	17	13	14	11	16	9	12	7	14	17	17	14	3	18 B 8	20	15

Name	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Allen	N	HP		✓			[illegible]	N	Y	✓		Y		✓	✓				[illegible]	N	N
Beach	Y		100KB	✓			Y	Y	Y			N			✓	✓	✓	✓	✓	N	N
Bower	Y			✓			Y	Y	Y			Y(A)	✓		✓	✓	✓	✓	✓	Y	Y
→ Boyd	Y		graphics ?		✓		N		Y	Y		Y			✓	✓	✓		✓	Y	Y
Cooper	Y		10^6	✓			Y	Y	Y	✓	✓	Y	✓		✓	✓		✓		Y	Y
Courteier	Y/N			✓			Y/N	Y/N	Y	Y	Y	Y*				✓		✓			
Drury	Y				✓			Y	Y	✓		Y								Y	Y
Feinager						✓	N	N	Y			Y						✓		Y	Y
Fogarasi	Y		256K	✓			✓	✓	✓	✓		Y								N	Y
Gagnon	Y		0?	*	✓			✓	✓							✓	✓	✓	✓	N	N
Gibb	Y				✓		N	N	Y	✓	✓	Y	✓		✓	✓					
Goddard	Y?				✓			Y	Y	✓		Y					✓	✓		N	
Halliday	Y		40K		✓		N	Y	Y	✓		Y	✓	✓	✓	✓	✓	✓	✓	N	N
Halpenny			30K	✓			N	Y	Y			Y				✓		✓		N	N
Jessop	N		60K ?	✓			N	N	Y	✓	✓	Y			✓	✓		✓		N	N
Jendy	Y			✓				Y	M			N		✓						N	N
Judge	N*			✓			Y	Y	Y	✓	✓	Y	✓	✓	✓	✓	✓	✓	✓	N	N
Konta	Y			✓			Y	Y	Y			Y	✓			✓		✓		N	Y
Liard	Y		750K	✓			Y	Y	Y			N								?	?
Paul	N		Bytes		✓		N		Y			Y		✓		✓		✓		N	N
Robertson	?			*		✓	N	N	Y	✓	✓	Y								Y	Y
Sobcyak	Y					✓	N	N	Y	✓		Y								Y	Y
Taylor	N		128K		✓		N	Y	Y			Y				✓		✓		N	Y
Thomas					✓		N	N/Y	Y	✓		Y	✓	✓		✓				Y	Y
Valliant	Y			✓			Y	Y	N*			N			✓	✓	✓	✓		Y	Y
Winter	Y			✓				Y	Y	✓		Y	✓						✓	Y	Y
→ Chernis	Y		165K		✓		N	N	Y			Y	✓		✓	✓	✓	✓		N	
Lambert	Y		[illegible]	✓				Y	Y			Y/N				✓				N	Y
Larnas									Y	✓		Y									
	Y		Check bytes or bits	✓	✓	✓	Y	Y	Y	✓	✓	Y	✓	✓	✓	✓	✓	✓	✓	Y	Y
	18			14	10	3	9	17	25	15	6	22 N 4	8	6	11	17	9	17	7	10	13

Scientific

Software

27

(16)