SYSTEM DEVELOPMENT CORPORATION

2500 COLORADO AVENUE · SANTA MONICA, CALIFORNIA

EXBROOK 3-9411

DATE 2-28-63

1. Digital Equipment Corporation
146 Main Street
Maynard, Massachusetts

Attention: Mr. Harlan E. Anderson
Vice President

2.

3.

REQUEST FOR QUOTATION ONLY

NOT AN ORDER

NOTE:
ACKNOWLEDGMENT COPY MUST BE PROPERLY FILLED OUT AND RETURNED TO US ~~WITHIN~~ ~~DAYS~~ by March 11, 1963

In Reply Refer To Mr. E. Vernon Johnson

ITEM	QUANTITY	DESCRIPTION	REQ'D, DATE *	PRICE
		Page 1 of 2 pages		
		You are requested to submit a proposal on System Development Corporation requirements for a Display System as generally outlined in the attachment hereto, entitled "Display Specifications" dated 2-28-63, and addendum attached. Drawings, sketches, specifications, or other detailed descriptions of your proposals are solicited with your bid package.	*Approximately 90 days on 1st unit.	
		Technical inquiries regarding this request for quotation should be referred to our Mr. Lou Gallenson, telephone extension 7172; contractual inquiries to Mr. E. Vernon Johnson, telephone extension 203.		
		The contemplated value of offers received indicate that a price analysis be made in support of prices quoted. Therefore, consistent with your normal accounting procedures, a detailed cost breakdown is solicited with your proposal. The successful bidder will be required to submit certification as follows:		
		"The Contractor hereby certifies to the best of its knowledge and belief that in the preparation of the _____ (job name) submitted herewith to SDC, all pricing data available as of _____ (date) has been considered in preparing the price estimate, and has been made known to SDC purchasing representative for use in evaluating the estimate."		

This quotation subject to terms and conditions appearing on reverse side.

All negotiations for purchase of the above requirements will be conducted through Purchasing Dept. without exceptions.

No charges allowed for packing and cartage unless specifically stated.

SYSTEM DEVELOPMENT CORPORATION

BY _____ NAME E. Vernon Johnson TITLE

WE QUOTE YOU AS ABOVE, F.O.B. _____

SHIPMENT WILL BE MADE VIA _____

_____ IN _____ DAYS AFTER RECEIPT OF ORDER.

TERMS _____ DATE _____

FIRM NAME _____

BY _____ NAME TITLE

Vendor's Copy

Form A-1203 (Rev. 3/61) SMP

SYSTEM DEVELOPMENT CORPORATION

2500 COLORADO AVENUE · SANTA MONICA, CALIFORNIA

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REQUEST FOR QUOTATION ONLY

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In Reply Refer To Mr. _____

ITEM	QUANTITY	DESCRIPTION	REQ'D, DATE	PRICE
		Page 2 of 2 pages		

Please specify if your quotation is based on rent-free use of Government Facilities: Yes_____ No_____

Indicate Small Business status: Large_____ Small_____

Proposals received will be handled in confidence and no disclosures will be made to unauthorized persons.

This quotation subject to terms and conditions appearing on reverse side.

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SYSTEM DEVELOPMENT CORPORATION

BY _____ NAME E. Vernon Johnson TITLE

WE QUOTE YOU AS ABOVE, F.O.B. _____

SHIPMENT WILL BE MADE VIA _____

_____ IN _____ DAYS AFTER RECEIPT OF ORDER.

TERMS _____ DATE _____

FIRM NAME _____

BY _____ NAME TITLE

Vendor's Copy

Form A-1203 (Rev. 3/61) SMP

DISPLAY SPECIFICATIONS

A display system is required to operate with the AN/FSQ-32 Computer currently installed and operating at the System Development Corporation. These consoles will be part of the Command Research Laboratory (CRL) and will be used for general man/machine communications with the computer. The specification may imply a specific design and packaging, but such is not the intent. The suggested techniques in the specification are only to help in defining the functional capabilities desired of the display system.

In general, the requirements are for six (6) displays operating, and in synchronizm, with one of the computer drums (DATOR Drum) to display alphanumeric symbols, at least 64, and to provide a light pencil capability for interrogation of the display. Delivery time of this equipment is important and a goal of three months for the first unit is desirable. Checkout and acceptance of the displays must be performed at SDC operating with the computer.

System Configuration Figure 1.

The computer outputs, from the DATOR Drum, are 48 bits of data, drum timing pulses and a drum origin pulse. These signals will be used to control and gate the proper data to the prescribed console. The drum word will contain sufficient information to randomly position one of the 64 selected characters on the selected display console. The computer inputs shall come from a 24-bit register in the display console, 13 bits of which are controlled by the light pencil which specifies the drum address of the data activating the light pencil. The display system will be required to count the drum timing pulses, and reset the counter with the drum origin pulse in order to provide this information to the light pencil input register. The remaining bits of the input request shall be available for inputs from other sources--pushbuttons, etc.

Functional Goals (subject to modification at the suggestion of the vendor and on written approval from SDC)

Display Console

1) Minimum of 10" x 10" display area.

2) Approximately 500 characters per display field.

3) D/A converters and amplifiers to position beam at any of 1024 x 1024 places on tube face

4) Deflection yoke currents or deflection plate voltage linear to better than 0.5%.

5) Contrast ratio variable from 4:1 to 12:1 black to white.

6) Intensity variable from 1/10 to 10 ft.-lamberts

7) Light pencil (as specified) and 24-bit data register. Cable capacity & card rack for an additional 24 bits.

8) Enclosed controls for positioning, contrast, brightness, linearity, etc. available at the front of console.

9) Desk surface available adjacent to CRT display area.

Light Pencil

1) Size--the light pencil shall be comparable in size to a standard pen or pencil. Electrical cable or fiber optics bundle connecting to console shall be no more than 1/8" diameter with flexibility & length such as to allow maximum freedom of action.

2) Field of View--the field of view of the light pencil shall be approximately 3/32" in diameter.

3) Aiming Light--the light pencil shall have an aiming light which indicates the field of view and point of best focus of the light pencil. A desirable pattern is an open circle.

4) Operate Switch--the light pencil shall have a switch to be operated by the index finger or thumb when the pencil is held in a natural position. The protuberance and travel of the switch shall be minimized--this switch may be electrical or optical. In either case, the aiming light shall be on in either position of the switch. A desirable arrangement of the switch would move an optical filter in the pencil so that the aiming light would change from, say, red to white as the switch is operated.

5) Controls--the light pencil sensitivity control shall be accessible to the operator at the front of the console.

Control Unit (Alternative arrangement may not designate this as a separate unit)

1) Count drum timing pulse - 8096 pulses - 2.75us between pulses. Drum Speed 45 cps.

2) Reset counter with drum origin pulse, desirable to generate error signal if counter is not equal to zero at time of reset pulse.

3) Transmit contents of counter to light pencil computer input register when light pencil has been activated. If a counter is provided for

each display, the counter may be stopped with light pencil return and held until computer reads counter register. Counter can then be reset and started with next available drum origin pulse. Alternative technique may be suggested by vendor.

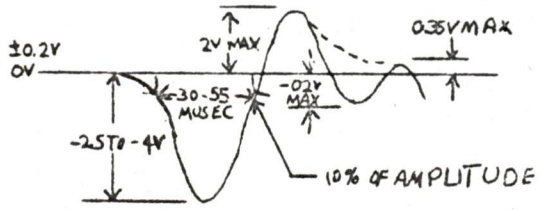
4) Use counter to properly distribute data to the six (6) display consoles. Each console will receive data continuously from the same set of drum registers. Writing a word on a drum register automatically routes the data via the control unit to a specific console.

Interface with Computer--Output

1) 48 data bits per word, at a 2.75us rate can be provided. Display system can use as many of these data bits as required to perform display functions. Minimum of 26 bits required--10 for x position, 10 for y position and 6 to designate character.

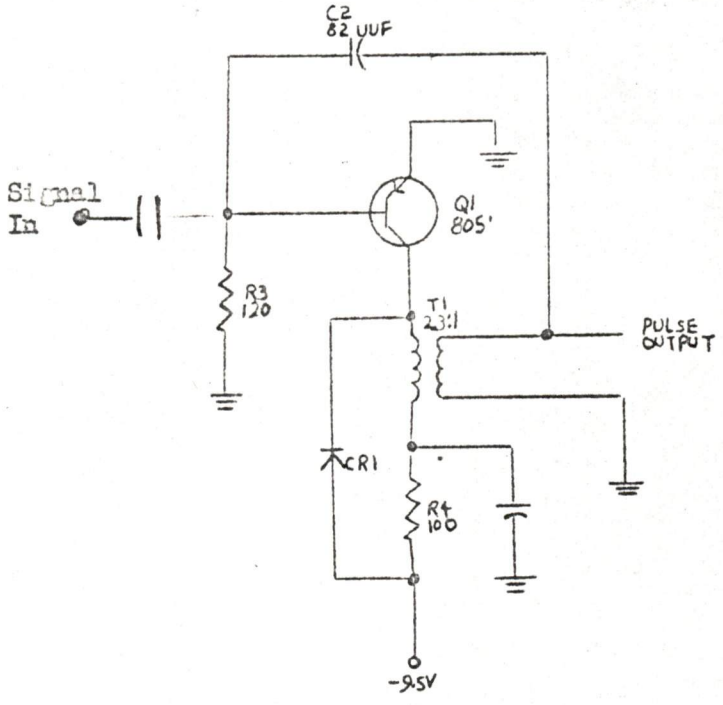
2) Timing and drum origin signals available on a 49th and 50th line.

3) Standard signal data, or timing,



4) A blanking bit--display/do not display is a desirable addition to the output word. This bit would allow the computer programmer to inhibit the displaying of a character without requiring that the word be erased from the drum.

5) Output driving circuit (from computer)



6) Output cables required: 120 ft. with Burndy-Hyfer MS50 type connectors. Two cables required to handle all required data. (Input cables identical.)

Interface with Computer--Inputs

1) 24 bits + 1 bit odd parity generated within console are required for data register. Additional parity bit required--will be a constant "1" to satisfy parity for unused portion of word.

2) 15-bit address register (toggles switches) per display to provide address in core memory of data being transferred. All console inputs will enter computer via a core memory. To initiate a data transfer the memory address must be provided.

3) Input cycle, control

   a) Display ready signal sent to computer by light pen return or push-button switch.

b) Computer requests transfer of memory address information 2.5 to 20us after display ready signal.

c) Computer request transfer of data .15us after (b).

d) Display control must reset light pen data register

4) The gates that feed to the computer must be two input AND circuits. One input to each gate is the data bit. The other signal is the computer output pulses 3b and 3c above.

5) Standard signals are required. (see Outputs (3)) The Control signals, Request Address, and Request Data are standard signals.

6) Drive circuits must be capable of handling a 120' cable and provide a standard signal to computer.

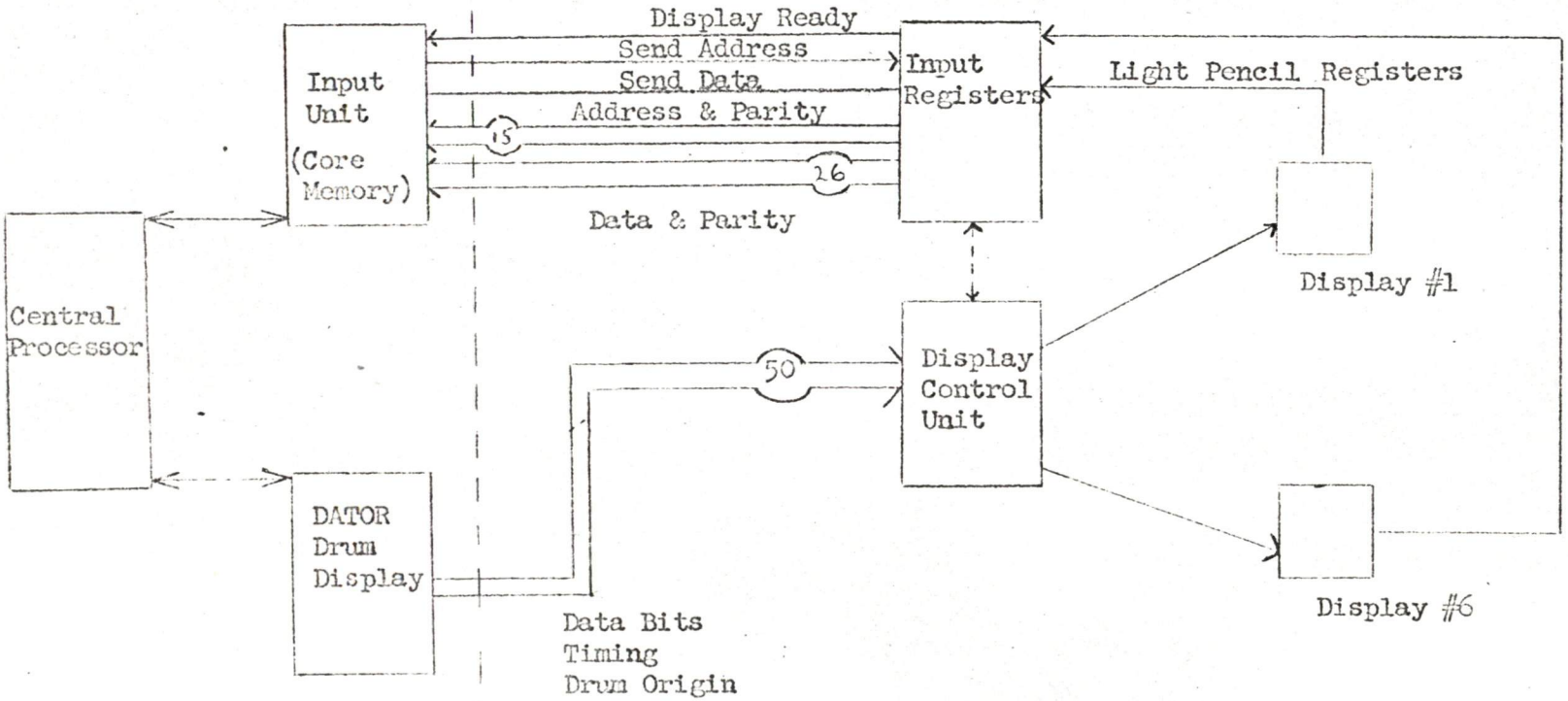
Miscellaneous Requirements

1) Display system required to operate at least 120' from computer--.25 volts of maximum induced crosstalk within any line in the cable using standard pulses and worst bit configuration.

2) Vendor must supply all cables for signal and power ready for connection to receptacles.

3) Vendor to supply at least four sets of logical drawing and operating instructions (commercial standards).

4) Vendor to supply engineering assistance to install and check-out display system at SDC.



DISPLAY SYSTEM--BLOCK DIAGRAM

Figure 1.

ADDENDUM

To "Interface with Computer--Output" add the following:

7) Signals will be transmitted on a single line, i.e. only ONE bits will be transmitted. Therefore, all input storage flip-flops, including the decoders, must be cleared between each data word or complementary signals must be generated locally to set these storage flip-flops.

dec INTEROFFICE MEMORANDUM

DATE February 28, 1963

SUBJECT General Radio Computer

TO Ken Olsen
Harlan Anderson
Stan Olsen

FROM R. Mills

While talking today with Ed Hurlbut, Controller, of General Radio, concerning their operation in Canada, the conversation worked around to the use of computers and he stated as follows:

1. They have ordered an IBM 1440 but feel that there is a restriction in this unit for them to combine engineering use with business use due to the 4 K memory in the central processor. This means to them, that they have to decide whether they should spend the extra money to get 8 K which capacity he apparently feels is a minimum.
2. They are especially interested in disc storage, due to information retrievial problems for inventories.
3. He commented that the General Radio people were very interested in out approach to the use of our computer for business and engineering but the implication was given that he was totally commited to the IBM 1440. They received an eighteen month delivery schedule from IBM and when we get our business programming to a point where there are saleable packages, I think we should go after them again.

# # #

dec INTEROFFICE MEMORANDUM

DATE February 28, 1963

SUBJECT Establishment of Canadian Office in Ottawa

TO K. Olsen
H. Anderson
S. Olsen

FROM R. Mills

cc: G. O'Dea

Following is the estimated schedule for my trip to Canada to start March 5th through the 8th:

1. Coopers & Lybrand - Chartered Accountants: March 5, 2:00 p.m.

John Aldrich of Lybrand, Ross Bros. & Montgomery in Boston, wrote a letter to Coopers & Lybrand to introduce us and this afternoon, I talked with Donald Ross, partner of Coopers & Lybrand, who was most cooperative and is setting up the appointments for me with the Royal Bank of Canada, Department of Trade & Commerce and Corporation House Ltd. He stated that we could have spent several days with the Dept. of Trade & Commerce just finding out who was the right man to talk to.

My preliminary thoughts on the feasibility of setting up a corporation as against a branch, were confirmed by Donald Ross in that, contracts let by the government are given preferentially to Canadian Corporations. In addition, the corporation receives a more favorable tax treatment. The favorable tax treatment seems to revolve around the 15% withholding tax, but the final determination on this for DEC is still to be made.

The subjects tentatively planned for discussion with them are as follows:

1. Advantages of incorporating over a branch operation.
2. A recommendation as to legal representation.
3. Financial Reports necessary for filing incorporation papers.
4. A list of Government agencies normally dealt with on financial matters.
5. Accounting differences of a statutory Dominion nature vs. U.S.
6. Accounting records required as a corporation and a branch.
7. Auditing schedules.

-more-

8. Taxes on income, property, sales, etc.

9. Recommendations on tariff negotiations.

2. Royal Bank of Canada: March 6, 9:00 a.m.

The subject matter here will revolve around the following:

1. Available services.

2. Establishment of a regular checking account - forms, minimum balance, etc.

3. Correspondent United States Bank.

3. Department of Trade & Commerce: March 6, 10:00-3:00 p.m.

The Department of Trade & Commerce, Industrial Development Branch, appears to be a good source of information regarding conducting business in Canada, with detailed statistics of businesses, products and marketing problems being published by the DBS (Dominion Bureau of Statistics). The Dept. of Trade & Commerce publishes such things as business conditions, new developments of industry, incorporation problems and will make a canvass of approximately 1000 concerns, in their files, for demand of a company's products.

4. Corporation House Ltd.: March 7, 9:-12:00 p.m.

This organization has an excellent reputation in negotiating rates with the Customs Department and in applications of Federal Sales Taxes. I believe we should make an arrangement with these people to negotiate the product tariffs on our line with the Customs people.

5. Assaly Brothers: March 5, 1:00 p.m.

I called Mr. E. W. Assaly this afternoon to verify that we were signing the lease which he sent to us and I would be bringing it with me together with our check for the two and a half months rent in advance. This is the first "port-of-call".

6. Denzil Doyle: March 7, indefinite time

The time spent with Denzil Doyle will comprise settlement of questions being asked by several departments of DEC some of which are as follows:

1. A list of prospective customers should be generated after having visited the Dept. of Trade & Commerce and obtained their publications.

2. After #1, we will be able to determine which provinces we can expect to do business in as this will affect us in our incorporation.

-more-

3. We will obtain available technical publications in Canada not of U. S. origin.

4. Obtain lists of newspapers which will handle the announcement of our office.

5. Arrange for petty cash amount.

6. Determine Dominion filing requirements for employees of the branch as regards payroll.

7. Determine different employee benefits which are required by the Dominion or the province.

8. Determine stocking requirements for inventory items in order to obtain an estimated amount to be paid for customs in the event that a withholding basis is necessary here.

General Comments:

I would appreciate a brief meeting on Friday, March 1, in order to clear the air on these items so that as many of them as possible may be resolved next week:

1. Use of Coopers & Lybrand as auditors in the event that we become a corporation.

2. Some dollar amount commitment to the Royal Bank of Canada even if of a token nature in order to establish an account.

3. The use of Corporation House Ltd. in handling our negotiations with the Canadian Customs Dept. on tariffs and possibly Federal Sales Taxations.

4. Sales items to be resolved with D. Doyle

# # #

dec INTEROFFICE MEMORANDUM

DATE February 28, 1963

SUBJECT 26th Meeting of the Test Equipment Committee

TO Richard L. Best

FROM Russell Doane

Members of the Committee:

Robert Hughes, Chairman
Russell Doane, Secretary
Donald White
George Gerelds
Dave Dubay
Dick Tringale
Jim Cudmore
Larry White
Ken Wakeen

1. The new 567 sampling oscilloscope ordered by Ken Wakeen will be delivered about March 1st.

2. Our first Hewlett Packard all purpose oscilloscope has been ordered and will be delivered off the shelf presently. It was ordered specifically to meet the need for three oscilloscopes in the Special Systems area, of which only two could be found available within the company. This oscilloscope has 40 megacycle dual trace band width and will be provided with a delay sweep plug-in unit which will make it a useful general purpose oscilloscope, as well as being appropriate for production testing of 10 megacycle modules and possibly also for trouble-shooting serial systems of VHF logic. We have been assured by the local representative that the face of the tube of this scope will have 10% and 90% markings inscribed.

3. All of the test equipment manuals ordered as a result of last meeting's decision to provide a library shelf for engineering use have been ordered. Most of them have already been received by the library and are being catalogued.

4. We have received our .01% Fluke meter earlier than expected. It is now in use.

5. Dave Dubay, Ken Wakeen, and Russ Doane comprise a sub-committee which will meet before the next meeting of the committee for the purpose of considering our needs for high precision standards to satisfy requirements such as the increasing need for accuracy in calibrating analog to digital and digital to analog conversion equipment.

6. Requests to Test Equipment Hdqs. for small signal A-C VTVM's have always been answered with a suggestion to use one of the high-gain

plug-in units which we have available for our Tektronix oscilloscopes. The Test Equipment Committee has briefly considered the possibility of ordering an AC VTVM several times before, but the list of specific known requirements for such an instrument has grown:

Operational amplifier gain measurements.
Production testing of power supply ripple.
Zener diode impedance measuring.
Trouble shooting of Stenorettes.
Many of the applications in which our Hewlett Packard audio oscillator is used.

It is still possible to use plug-in units for oscilloscopes for any of these jobs. But it is usually more cumbersome to do so than to use an AC VTVM, and in addition it requires the tie up of approximately $1500 - $1600 worth of equipment for making a simple measurement. The committee asked Ken Wakeen and Russ Doane to agree on an AC VTVM to buy, and as a result of their investigation, we will order a Ballantine type 300H Logarithmic meter AC VTVM ($230.) The principal choice was between this and a Hewlett Packard 400D for five dollars less, and hinged on the somewhat greater accuracy and greater ease of use which is offered by the Ballantine. It will read the rms voltage (responds to the average) from 300 microvolts to 300 volts with an accuracy of 2% of the reading (not 2% of full scale) from low audio frequencies to 700 KC with an additional 1% error of reading at 1 megacycle. It will respond down to 30 microvolts with 5% accuracy. It has a 5" mirror scale calibrated in indicating logarithmically from 3 to 30. Weight is 10 lbs.

7. While our new F_t tester is in operation at 10, 30, or 50 megacycles, the committee still felt that it is advisable to buy a Dynatran F_t tester capable of the industry standard 100 megacycle measurement. This instrument will have less flexibility in bias conditions and frequency choice than in our home built F_t tester, but will probably be more compatible with production testing requirements. It offers a good fit to the needs of speed testing for all transistors used in the 10 megacycle line and in VHF modules, and it should be of some value for transistors used in 5 megacycle modules as well. There are few F_t testers available commercially and the Dynatran seems to offer enough flexibility without extreme cost.

8. We discussed the needs over the next several months for new oscilloscopes. We seem to have exhausted the possibilities of removing oscilloscopes from the production test area for use in engineering, because the increase in low volume special modules has effectively soaked up all of the testing capacity slack which has been produced by automatic testing of the high volume standard modules. Two circuit engineers have recently started work and the model shop has an immediate requirement for one additional scope which will suffice for the next year in the model shop. We also may have summer students who will be using oscilloscopes to some extent within a few months. We therefore

agreed that it is essential to order three oscilloscopes immediately, and in view of our good impression from the Hewlett Packard scope which we have had on loan for more than a month, we decided to order three more like it (in addition to the first one, which is already on order). All three of these will be ordered with one dual trace vertical plug-in unit, and two of them will have the standard horizontal plug-in while the third will be ordered with the delay sweep plug-in unit for horizontal. These instruments are supposedly off-the-shelf items which is a situation allowing us to put off ordering any equipment which may be required during the peak summer demand until later than we might ordinarily.

9. Steve Lambert has been asked to join the test equipment committee since he has contacts with computer checkout and maintenance areas with which the committee has not had sufficient contact. This makes the committee members ten. We will give some thought to a different organization of the committee to promote efficiency.

10. It was suggested by Al Blumenthal that some means of X-Y plotting at high frequencies would be a desirable ability to have in some piece of test equipment.

11. Barbera Stephenson suggested a reminder that a lot of frustration could be avoided if people borrowing equipment from an unattended set-up would leave a note telling Who Took It!

The next meeting of the Test Equipment Committee will be on Tuesday, March 12, at 1:30 in Bob Hughes' office.

cc: H. Anderson
B. Beckman
W. Hindle
N. Mazzarese
R. Mills
J. O'Connell
G. O'Dea
K. Olsen
S. Olsen
H. Painter
G. Rice
M. Sandler
All Engineers
All Technicians

dec INTEROFFICE MEMORANDUM

H/SC.

DATE February 28, 1963

SUBJECT ANNUAL REPORT SUPPORT

TO Ken Olsen
Harlan Anderson
Stan Olsen

FROM Jack Atwood

We had a quick briefing this morning on the problems involved in turning out an annual report in less than a week and on the procedures we hope will overcome the problems.

I explained to the group that it might involve a fair amount of work tonight, Friday night and Saturday. I asked them all to indicate on a sign-up sheet whether or not they would be available to work any of these three time segments if needed.

Out of a total of 21 "effectives" (two of the regular crew are out sick and one has a death in the family), 21 volunteered to work at least one segment, 5 volunteered for two, and 15 volunteered for all three. Three of the AID girls also volunteered their help.

I use the word "volunteered" because this was short notice given at a time when many of these folks have sickness at home, are heavily engaged in outside activities or depend on others for bad-weather transportation.

I hope the end product will reflect the spirit with which the group has accepted the challenge.

INTEROFFICE MEMORANDUM

#3.G.

SUBJECT: AMA's 9th Annual EDP Conference and Exhibits – Statler Hilton Hotel, New York City – Feb. 25-27, 1963

DATE: February 28, 1963

TO: Ken Olsen
Harlan Anderson

FROM: George O'Dea

cc: R. Mills

Detailed Proceedings of the Conference will be published shortly by AMA. Here are some of the Highlights:

1. The conference was attended by approximately 400 people representing perhaps 150 companies, most of whom are at least thinking about going to some degree of coordinated EDP or "Integrated Data Process." (IDP)

2. Of the 22 speakers, only 2 were from Computer Manufacturing Companies (IBM and RCA) and, to a man, the panel felt that the future of all large businesses lay in profit improvement arising out of greater understanding of company operations through IDP.

3. The keynote speaker estimated the coming year Computer market at six thousand machines representing 2 1/2 billion dollars! A large portion of this he felt would be for business purposes.

4. Both from the comments of the speakers and the remarks of various people met at the conference, by far the largest interest in the computer business application lay in the field of controlling inventories; first from the point of view of keeping the balance down by policing the house keeping and second, by attempting to determine needs through various mathematical techniques (exponential smoothing, Operations Research, several of the larger companies have hired full-time mathematicians to work in these areas).

5. From the business users point of view the consensus of opinion was that present hardware far outstripped the use to which it was being put. The panel of speakers, of course, represented those companies which were trying to upgrade their usage to the equipment capabilities. The bulk of the audience was less intent but seemed impressed.

6. Most of the speakers referred to business models as being the best way to simulate the consequences of alternative approaches to business problems.

7. A great deal of time was devoted to the organizational aspects of an Integrated Data Processing system. For the most part the speakers represented large companies where crossing of Divisional lines posed major problems. The office of the Controller was thought of as the best place in which to Centralize the function. Some of the Companies found that it proved better to have a special group reporting directly to the President. Here you felt it was a matter of personalities.

8. Comments were made on some of the consequences of going to IDP particularly that of obsolescence of middle management (since human judgement is thereafter exercised on a higher management level.

9. One of the speakers, from Olin Mathieson Chemical Corp., indicated that his company was presently evaluating Computers for Purchase in April. His name has been given to Stan for follow-up.

10. A number of competitors exhibited at the convention - chief among these were RCA with what they call their Videoscan (Optical reader for input into their 301), and GE with their new 3101 (data accumulation system).

In summary the Conference was intended to highlight the coming importance of the computer in business decisions. Based on the quantity and quality of the audience the point is already being well taken.

George O'Dea

GO'D:ncs

dec INTEROFFICE MEMORANDUM

DATE 2/25/63

SUBJECT PDP-1 Status at LRL, Berkeley

TO Harlan Anderson
Nick Mazzarese

FROM Ted Johnson

I am afraid there has been some confusion in the situation existing at LRL. I am not clear as to whether your contact with these people last week enabled you to determine what the actual considerations are and for whom these computers would be intended.

There are two entirely separate computer requirements at Berkeley. In my conversation with Jerry Russell today, it was made clear that he is intending to go ahead and propose to the Atomic Energy Commission that they acquire a Pepr system including a PDP-1. This group has the interest also in the new machine, although it would appear that this is more an interest of Art Rosenfeld and is interesting only if this machine is substantially better than the PDP-1, particularly in the area of index registers and improved I/O and if it can make use of the PDP-1 programming by including in its communication list a PDP-1 sub-set.

As differentiated from the bubble chamber application above, the experimental physicists in the spark chamber area have decided that they would like to have an SDS 920. These people investigated the ASI 910, the PDP-1&4 and the CDC 924. The CDC machine was most desirable for their application but too expensive. When Art Rosenfeld learned that these people were interested inan SDS 920 he apparently initiated activity to try to sway the spark chamber people toward a PDP-1, primarily because of a desire to have programming compatibility. We will make an effort to contact the people in the spark chamber area, namely Leroy Kerth, Bill Wenzel and Denver Keefe.

They will want delivery on the smaller spark chamber before July. It is hoped that the order for the Pepr system would be forthcoming in July and they might hopefully have a system installed in September or shortly thereafter.

I would like to be made aware of the nature of the communication with these people on the new computer prospects.

Ted

INTEROFFICE MEMORANDUM

H.S.G.

DATE 25 February 1963

SUBJECT

TO H. Anderson
R. Beckman
E. Harwood
S. Olsen
G. Rice
J. Shields
R. Wilson

FROM S. Mikulski

Movement of PDP-1 Computer From EAI, Princeton, New Jersey, to Princeton Research Center, Princeton, New Jersey

February 13, 1963 3:00 pm

Arrived at EAI, Princeton, New Jersey, with Cliff Pitz and Bill Vaillancourt. Preliminary inspection of the PDP-1 computer showed that it was in operating condition. The running hour meter had 918 hours of elapsed time. Earl Carson, who was responsible for the machine while at EAI indicated that there were no internal machine failures during the period of operation there. There was one reader failure, the punch leaked oil slightly and they did have typewriter bugs. He indicated that he had called in an IBM repair man for the typewriter but continued to have typewriter problems after that. Arrangements were made for the movers to move the machine out first thing Thursday morning. Earl Carson indicated that the original packing crates had been destroyed and the only piece of shipping equipment remaining was the skid for the central processor. This was left at Princeton.

A set of maintenance tapes were run on the machine and they indicated that the machine was in operating condition. Arrangements were made at Princeton for delivery of machine first thing in the morning.

February 14, 1963 8:00 am

Arrived at EAI and started removing plugs and special patching equipment from the central processor. EAI furnished a janitor to clean up the outward appearance of the computer. The only visual sign of deterioration was on the console table, which

was stained such that the stains could not be removed. The movers arrived at ten in the morning and had no difficulty in wheeling the computer into the van without putting it on a skid. Typewriter table, display, light pen, typewriter, central processor, were all loaded on the moving van. Everything was securely tied. At this time we did receive a set of prints for the computer, two or three trays of maintenance tapes and the leftover typewriter paper and paper tape. We arrived at the Princeton Research Center at 11:30 am and unloaded the machine. The people at Princeton under the supervision of DEC personnel, handled the movement of the machine into the computer room. Because the power connections at EAI had been cut due to the use of special connectors, an electrician was called who wired up the system to the existing 115 volt outlets at Princeton. I met the personnel at Princeton in the morning. Bob Schultz is actually purchasing the machine for his department. Dr. Jack Benoit will be in charge of the programming for their specific projects and Mrs. Dawson will be responsible for the program files, maintenance files and morning checkout of the machine. In the afternoon I had started teaching a group of about fifteen Princeton personnel in the methods of programming the PDP-1. During this time Cliff Pitz and Bill Vaillancourt checked the machine out, made modifications to the reader and the punch and the multiply/divide, and the machine was in operation by 2:00 pm Thursday afternoon. It might be noted that the sign bit of the I/O register was wired incorrectly to the display, therefore a zero appeared as a negative number and a one in the sign bit appeared as a positive number. This was corrected. At 4:30 in the afternoon I had completed the programming portion of the course; the instructions on the central processor and general programming. The people were familiar with Fortran. The other computer in the computer room was an IBM 1620, plus associated card sorting and listing equipment. We made sure that the power switch on the central processor controlled all of the equipment as far as power shut-down, put in a copy of space war and let the personnel become familiar with the computer (they indicated the following day they were there until 11:30 pm).

February 15, 1963

Friday morning was taken up with the discussion of programming use of expensive typewriter, Macro, and DDT. During this time a complete check of the computer was made, including margins on portions of the machine. The machine seemed in excellent condition. Friday afternoon the personnel in the programming

class were shown a demonstration of expensive typewriter, a Macro assembly, and a DDT debug. They indicated that they would send someone up for the standard one-week course in programming and also send a technician up for the two-week course in maintenance. I will take care of sending them literature as to what is covered in the course and the dates of the next convening courses.

General Comments

I feel that the typewriter should be worked over, specifically as far as the roller is concerned it should be replaced, and the tab has some sort of problem in it. The light pen on the display did not operate. The display worked properly, however, their specific application will require a squeezing of the display specs. Bob Schultz indicated to me, when discussing acceptance test procedures on their ultimate machine, that they would be interested in writing the acceptance test for the display. Their application for the display will be film reading. They might be interested in changing their display to something of grid printing in nature. Their system configuration will be the basic PDP-1, automatic multiply/divide, two extra memory modules for a total of twelve K, three magnetic tape transports of medium density (556 characters), 16 channel sequence break system, display and light pen. A verbal order for the equipment has been placed with George Rice. Their application for the system will be very similar to MIT's PEPR system. Dr. Benoit indicated to me that some discussion has been made with DEC as far as finishing programmers when they get into their specific application for the machine.

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dec INTEROFFICE MEMORANDUM

DATE February 25, 1963

SUBJECT Raytheon Area in Building #5

TO Harlan Anderson
Loren Prentice
Maynard Sandler
Stan Olsen
Dick Mills

FROM Kenneth H. Olsen

I had a call from Mr. William Livingston from the Lexington office of Raytheon on Monday, February 25th. They would like to move out of their area in Building #5 the first of March if they could find someone to take up their lease. They are now paying $997 per month and their lease is over April 30, 1963. They also have an option for another year.

They have put $60,000 in fixing up the place and this would be ours if we could work out a sub-lease. It would seem to me that their present landlord would like to start negotiations over again at a higher lease saying that they have now inherited the $60,000 worth of leasehold improvements. However, Raytheon has a one-year option. If we could work a deal where we take the option also, it might be well worth taking on this property.

We have a Works Committee Meeting on Tuesday morning and we ought to discuss this subject. Raytheon has a lease on one acre parking with Ledgard at $60 per month. I think they also have a year option on that. Raytheon would sub-lease both of these till April 30 at $1,000 per month total. We should immediately contact Ledgard and take an option ourselves on that parking space so that no-one else can take that. This would put us in a strong position to dicker with the plastic company if they want to raise the rent.

We have 28,000 square feet of space on the fourth floor of Building #5 which I think is somewhat less than half of the floor.

Mr. William Livingston's phone number is VO-2-6600, Ext. 363.

Kenneth H. Olsen

INTEROFFICE MEMORANDUM

DATE 2-25-63

SUBJECT Computer for Data Processing Automatic Chemical Analytical Units

TO Gordon Bell

FROM Ken Larsen, WCO

cc: Ken Olsen

The attached letter from Dr. D.S. Goldman, describes the problem and some of the steps that the Veteran's Administration is taking to speed up the processing of information from the clinical laboratories of the V.A. hospitals.

The system, as envisioned by Dr. Goldman, would collect the data in a fashion that is patient centered, i.e., patient name, patient number, physician's name, ward or room number, date and sample number, speciman code and test required. This information would be entered into the computer at the time that the analysis was requested and when the speciman is delivered to the laboratory, the computer would operate on the information that is then speciman oriented. That is, associate the speciman with the tests required. The laboratory technicians would take samples of the speciman and channel them through the various testing stations as directed by the computer listings and the computer would monitor (on an "on-line" basis) the automatic testing devices. The automatic device is a Technicon Auto-Analyzer, which at the present time has a spectro-photometer controling a strip chart recorder for visual readout. The output information, in the form of an analog voltage converted to binary, would then be changed to medical terms on either a calculation basis or some sort of look-up table and stored until all testing of that speciman had been completed.

When all testing has been completed, the information is to be printed out associated with the patient name and number and also punched out for entry into a larger processor for record keeping and patient profile analysis.

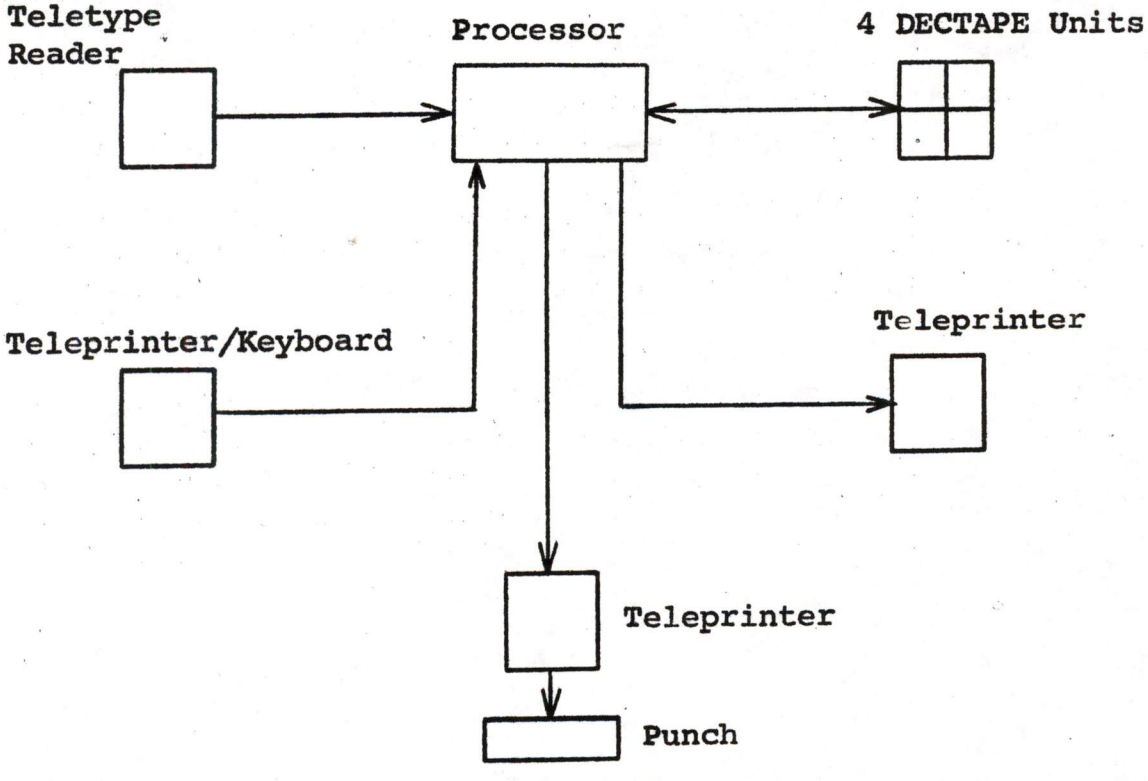
The storage required for assembling the pieces of data and for a look-up table was estimated to be equivalent to one reel of IBM tape. The present accuracy of clinical laboratory testing is on the order of $\pm$ 2 to 3 percent. To provide for future capability and improvement of automatic analytical devices, they would like to have the analog to digital converter be of an accuracy of $\pm$.2%. The data processor must be small enough to be a laboratory machine only, that is the exclusive property of the lab. The fear here is that if the machine has a greater capability, other people will want time on the machine and eventually squeeze out the lab people.

Their goal is to have a hard proposal by June 8th. Because delivery time is important, they want to use off-the-shelf equipment whenever

possible. The first system will be installed in the V.A. Hospital in New York City as an experimental device in their demonstration lab. If the feasibility can be proved, there will be a number of follow-on contracts for installation for every V.A. General hospital.

The system should be economical for any hospital having 500 beds or more. Other areas of the market would be clinical labs that do work on a job-shop basis for doctors in large medical centers and for small hospitals.

Another meeting has been arranged for Wednesday, February 27, 1963, and we will be going into greater detail at that time. It looks like the PDP-4 is too much computer for them, but we might propose as a special system Gordon Bell's ideas for a 10-bit computer with 1024 words of core memory; a 10-bit analog to digital converter, with the following Input/Output equipment: Teletype reader for program entry, a teletype printer keyboard for entry of information copied from the lab request form, a teletype printer for each test to be made on that speciman. A combination teleprinter and punch for outputting the hard copy of the analysis and a punched paper tape for input to a computer for updating patient profile analysis. Four DECTAPE units would be required for storage of information as collected by the system to be outputted when all tests of a given speciman have been made. A system diagram might be as follows:



Will keep you informed regarding the requirements as they are more clearly defined.

Ben Larsen

December 4, 1962

Dr. Reed Boswell
Systems Development Corp.
Santa Monica, California

Dear Dr. Boswell:

I enjoyed our brief conversation at the recent meeting in Cincinnati and now would like to go into more detail on the question of selection of equipment for our project on automatic data processing. I believe a brief history of this project is in order and I would like to fill you in on these details now. About a year ago Dr. Joe Meyer in Central Office set up a special committee to study the problem of automatic chemical analysis and, associated with this problem, the question of automatic data processing of the information from the automatic chemical analytical units. A prototype laboratory is now being established at VAH, Bronx. This laboratory is under the direction of Dr. Bernard Klein. Assisting Dr. Klein in this operation are Dr. Leonard Skeggs, of Cleveland, and myself. There is little doubt in anyone's mind at the moment that the automatic analytical equipment either is available or will shortly be available. Accordingly, I feel that our primary problem is the handling of the potentially massive amount of information coming from this automatic equipment. This is the section of the project which I am now working on.

I have tried to break the data processing system down into stages. At this time I would like to put these stages down in a reasonably logically sequence and use this as a basis for discussion.

Stage 1. This is the order form stage. We can assume that the order form will be a marked card having the patient's name and register number printed on it in some sort of a special print, perhaps with magnetic ink. This card will carry appropriate blanks for all the possible tests that can be requested. The appropriate blanks will be marked with a special pencil. The cards will pass into some device which will transfer the name and number and the test number to magnetic tape. The first question, therefore, is, does such a scanning device exist or is this a completely impractical approach?

Stage 2. The tape coming from Stage 1 is scanned repeatedly until all test requests are put in order by test name and number followed by a list of the patient's names and numbers.

Stage 3. The list of tests and orders is transferred to two locations. First, it is transferred to the computer section where it is stored until needed in Stage 7. Second, it is either transferred to the laboratory area by direct typewriter print-out or it is tabulated in a standard list and carried to the work area. In this stage the sample and standard solution positions are assigned.

Stage 4. The analytical work, programmed in Stage 3, is performed by the automatic equipment. The analog output of this equipment is converted by an appropriate device (in existance now) to a digital signal at this point.

Stage 5. The output digital signal is stored, temporarily, in some device which serves as the entry into the computer. This may be part of the computer or it may be a separate black box. Each analytical result from each channel of information will include a minimum of three pieces of information (a) channel number, (b) sample number, (c) digital value.

Stage 6. The stored information is wiped from a given location of Stage 5 and transferred to the computer. Wiping is at a frequency of, perhaps, 100 sweeps per minute. However, if a signal is just entering Stage 5 the wiping passes this point until the information transfer is complete and ready to be transferred at which time it is transferred to the computer on the next wipe.

Stage 7. This is the computer stage and it will have the following functions:

Item A, information from Stage 5 is transferred through Stage 6 to the appropriate storage portion of Stage 7, here it is to be matched up with the patient's name and number.

Item B, all information is stored until the last result of the last channel has entered the computer.

Item C, the memory unit is swept by the patient's name and number; tests, names and numbers relating to each patient are tabulated under the patient's name and number. The test value is converted to a

concentration based upon previous information permanently stored in Stage 7. This information includes standard dilutions as well as extinction coefficient which permit the final value to be expressed in the usual concentration terms.

Item D, as the concentration is calculated for a given test from the digital value of the test the concentration is corrected for base-line drift by comparison of standard values (see below).

Item E, all of this tabulated information is printed out and, simultaneously, it is to be transferred to tape for storage.

Item F, inquiries from an input station relating to work in progress are printed out on demand. This will permit us to inquire if a given test has been accomplished on a given patient to get a result back to the ward immediately.

It is somewhat difficult to anticipate, at this time, the final number of pieces of information that will be required. At the moment we may consider that each analytical test will be a separate channel of information. We can anticipate now that we will have about ten channels of information being handled simultaneously. Each channel will consist of the output of an automatic device, such as the Technicon Autoanalyzer. It is difficult at the present moment to know with any degree of certainty how many samples will be processed by each Autoanalyzer on a given run. However, we would anticipate that the turntable would contain approximately 100 samples. The rate of analyses would be approximately 1 or 2 per minute. If we use 2 per minute as the upper limit of the rate of analyses then we would anticipate some 20 samples per minute being handled by the complete system. Stage 5 would receive a signal from the analytical instrument at approximately 2 per minute.

We will have to consider the question of error correction and base-line shift. I do not have any firm opinions on this, by any means, and would appreciate comments from you on how this might be handled. As a starting point I could make the following suggestions. Suppose that on a given turntable, samples 1 10 20 30, etc are identical standards, then there should be some method of minimizing errors and base-line shift through the use of these standards. Suppose that the second standard to be run is compared to the first standard and an error correction is made. This would be expressed as a percentage of the first standard. Then let this error correction be made on samples 5 through 9 and 11 through 14.

Samples 15 through 19 and 21 through 24 would, accordingly, be corrected from the error correction made between standard number 3 and standard number 1. The system could continue to the end of the turntable making each error correction as it goes. Do you think that this is a possible method of handling the shift?

I would like to convey to you a certain sense of urgency in the working out of details of this problem. The prototype laboratory has already been established and should be in operation fairly soon. The question of data processing must be handled now; it cannot wait until a future time because the experimental laboratory will simply get too far ahead of us. I am also taking into account the difficulty of getting together people with sufficient specialized knowledge to make a system like this progress at any reasonable rate. My personal target date for installing the system is summer of 1963. There is not very much time.

Now that I have put this whole thing down on paper to the extent that I have thought it through I would like to ask you for your help and advice. What areas are there in this suggested setup that have not been thought through to any detail and I have overlooked? Is there standard equipment on the market that we can rent or buy, equipment that will make this system work the way we want? I am perfectly aware that if you ask a stupid question one is bound to get a stupid answer from a computer; I am therefore much concerned about the possibility that I am asking stupid questions. As I see it your role in this matter is to make certain that the questions that we pose to the equipment are rational and match the equipment to the question. At the moment we should leave budget considerations out of the discussion. As far as I know there will be sufficient money to rent or buy the equipment we need for the experimental laboratory. Central Office is greatly interested in this project and will do everything they can to supply the funds. We must come up with definite plans and suggestions before they will do anything about funding the problem. Once we get this set up in the experimental laboratory then will come the question of how far Central Office is willing to go in installing similar systems in the field. I do believe that there is a great potential for this equipment in the field and that in the next few years a great deal of stress will be placed upon this.

My plans call for me to be in La Jolla around the middle part of January, 1963. I plan on leaving here around the second of January. If it is at all possible, considering the move that you and your staff are

about to undertake, I would greatly appreciate hearing from you about this problem before I leave Madison. That would give me time to do some further checking before I go to California and then we can consider the problem person to person.

Sincerely yours,

Dexter S. Goldman, Ph. D.
Chief Biochemist
Tuberculosis Research Laboratory

Research Bio Chemist

La Jolla

Dr Dexter Goldman
Scripps Research Foundation
Prospect Street
La Jolla
(714) 454-6141
x-310
x-320
x-335

INTEROFFICE MEMORANDUM

DATE February 25, 1963

SUBJECT Type 57 Tape Control

TO
K. Olsen
H. Anderson
W. Hindle
R. Best
S. Olsen
N. Mazzarese
D. Morse
S. Grover
S. Lambert
R. Boisvert
R. Maxcy
All Sales Personnel

FROM Alan Titcomb

The purpose of this memorandum is to correct the Type 57 Tape Control Memo of February 20, as I am responsible for the $16,500 figure shown therein. The actual price quoted JPL was $16,800. This quote is the figure that Gordon Bell wishes to retain as the price for the Type 57 Tape Control.

AT/ll

Harlow E Anderson

INTEROFFICE MEMORANDUM

DATE February 22, 1963

SUBJECT New Computer Design

TO Ken Olsen

FROM Tom Stockebrand

My apologies for form and content of this memo, it is a rushed job. In particular it does not include enough evaluation of the competition nor enough filtering of the ideas presented. While I am on vacation, I will try to sketch out more of the machine design.

Commitments on delivery dates, price and so on should be to Ken Olsen and the company and not to customers.

This machine should be specifically designed to do the job as listed below superlatively well rather than to in any way "look like the competition" or be an answer for them.

This machine is to fill a vacuum we believe to exist at the present time in the computer market.

We must make no compromises in carrying out the ideas which are involved in its design. The implication of the above is that, as is usual with DEC effort, the ideas shall be limited to those which are eminently easy to do, general, straightforward extensions of the art..... In fact, "today's technology today." ------God.

The sources of the ideas presented in this note are indicated in an effort to provide "source data" while I'm gone. If the general ideas are agreed upon, future administration of the project will be vastly improved.

If we are to turn out machines regularly, we need some more official advanced development - that is answers to specific how-can-we-do-this-job questions. (Coax delays, micro-logic, serial, majority logic circuits, etc.)

THE IMPORTANT NOTIONS

It is time the Programmer was given real power in sub-routine writing ability so that no modifications of instructions are ordinarily necessary during program relocation.

Multi-programming, time sharing, fast break-in or what-you-will is necessary in the eyes of most users of our equipment and in fact necessary (though they don't know it) to many users who are comtemplating using our equipment.

Data words need to match today's data requirements in accuracy. The analog people are almost entirely concerned with 14 bit accuracy for what they call four significant digit precision.

Large memories are here. Index registers are here.

Some fair expansion of the machine should be planned for at the beginning though we understand that wholesale revisions of the machine are out of order.

The rest of this memo is a list of specifics pertaining to the generalities listed above.

Routine Relocation Power - The ability to operate routines wherever they may be located in memory after a dump from, say, the drum can be provided by the ability to (1) modify each memory reference by a constant while (2) checking that result against specified bounds and trapping to a particular memory location or executive program if the required location is outside of the bounded area. This feature can be achieved reasonably easily during the initial design of a machine by allowing the index adder, or its equivalent, to do the work. Dit says this feature would make programming "ten to a thousand times easier." Ed says that if you can use the arithmetic element more and memory less, you're way ahead and this feature would leap in that direction. (Dit, Shelley, Kotok, Ed and Ben.) This feature is considered by advanced type people to be crucial to the machine design. John McCarthy likes this.

Trapping - Trapping meaning to execute and instruction located at, for instance, the address indicated on the op code. This trapping would be done on non-used instructions or memory addresses outside of the bounds set by the executive routine in the relocation of power indicated above (Dit, Ben.)

Character Handling Power - The ability, in one form or another, to address characters stored in memory hopefully to deal with character strings in I/O transfers such as is done in the Lisp and Comet Programs. Dit, Ben and Ed are in favor of this, Ivan goes even further and says that bit addressing features are of great power. However, Len disagrees.

On Obsolescence - Trapping also allows optional expansion by do-it-now-with-program, later with wires. Also de-bugging and checking power is automatically incorporated. The machine should be built of modular parts of course like different memories and AE's and an extra bit or two should be assigned in the instruction word for future variations not thought of now when you absolutely have to have that bit!

Multi-Processing - Multi-Programming - First and foremost, a fast break - this means primarily no need for many accesses of a clean-up variety to store away stuff in preparation for operations in response to a break request. The most potent feature here seems to be an extra register in the AE to allow either exchanges with the AE for saving purposes, or as an address calculator (Dit) or as a multiply index by, or as an addend register, or as a carry register depending on your exact orientation. The second thing which would help this process out is probably a separate index adder though I believe a machine try should be made to use one adder for everything. Since it is reasonably certain that two groups of wide modules will be used, however, it is probably not unreasonable to suggest the index adder. In the future, that means perhaps with the development of another machine, separate program counters may be in order. For now, core program counters should certainly be enough if they are necessary. To hell with data gather. The idea here is to eliminate control problems from the channel and put them in the program where they belong.

Channels should be only high-speed data gathering devices. (Dit) System capability is an okay phrase. (Dit)

List Processing - This is a program technique which has general power which goes well together with our ideas of a processor with general power. It requires index registers and increment and decrement by more than one and, ideally, registers which can be packed with several addresses each (that is, word length equal to two times the address length.) However, I think a clever use of the relocation feature or of Dit's multiple indexing (1+ 2+ 4 scheme) will allow the shorter pack base address that this too short word machine will have. (Len) In general, this processing seems to be for the next machine though a small look into the future is probably in order. Similarly, floating point AE's will probably have to wait until the next machine or at the very best, be planned as a different kind of AE attachable to this memory.

Index Registers - These are clearly necessary. Dit feels that three register which could be added together in a micro-program fashion that is, any combination of the three according to MACRO programmed bits in the word, would be of more use than seven registers addressed directly by the same three bits though Kotok disagrees. I have no feelings. Whether the three could be added together and in fact the complete design of the index adder might depend crucially on the ability to build a simple circuit which would detect four out of seven to provide carry for carries. If this circuit were easily available I believe that five registers could be added together simultaneously and stored in a fifth and the sketch accompanying this memo shows the powerful use that could be made of this feature.

Addressable Registers - These would be very useful according to Len for much easy processing without complicated instruction and could perhaps be implemented to do the character addressing without using extra bits in the word by allowing certain kinds of character type transfers between registers. The most important addressable registers would perhaps be the in/out registers such as, for example, the scope buffer for use with the light pen -- especially if it were an incremental scope plus generator type. In this case too, the feature would allow sine, cosine and hyperbolic and parabolic function generation with no extra hardware. It would save on the IOT read-in bits but cost some address decoding.

Data Channel - Fast break SI, Data Channel SI, I/O Channel , no, - do it with program. (Dit)

Cute Instructions - Ben feels that load and deposit AC in push down list would be a useful instruction at least to the prospects of a clever turn of mind if not to real users. Instruction (Y+)AC)) $\longrightarrow$ AC is reasonably necessary for multi-dimensional matrices when indexing is not readily available and would implement easier list processing. Ben likes an instruction called execute effective address however, Len doesn't go along with him. Dit makes the comment that we should avoid doing things in little pieces.

Word Length - There are two criterion for word length, one is the data word that will usually be of necessity, and the other one is the number of bits that you need in your instruction. For floating point work, 48 bits seems to be a minimum and for graceful manipulation of the text

this also seems like an appropriate word length. I do not believe that it is necessary to have precisely a multiple of six though this may be, in some cases, graceful for character processing. Many people would just love to have an extra bit or two to indicate whether this set of characters is to be considered in the list and for other marking purposes, ask Dit for example. I, myself, have run into this problem many times when programming character strings. Len will also agree I think. As far as the packaging limitations go, I agree that it is essential to keep the packaging the same which means no more than 25 units in a rack panel wide; notice that if the address portion is 16 or 17 bits, even, there are 8 bits left over in the mounting panel supporting the "short-word" AE in which to provide extensions of the full register portion of the AE. Since the floating point people need 48 bits and we can't possibly take this much of a jump in the present machinery, we should either leave them out of consideration or consider two-word data accesses floating point words. To this end, Dit suggests a single bit in the data words to tell whether the word is to be interpreted as floating point or not. This might be an example of the use of a spare bit location in the word for use when a floating point processor might become available. How about word lengths for ordinary users of fixed point type calculations? The competition seems to feel that 24 bits is a reasonable length however, I submit that in many practical cases 14 or so bits is a reasonable length based on my discussions with various analog and hybrid types. This is because 14 bits represents four decimal digits which is the current okay number in that industry, though there as here okay numbers do not necessarily represent the best in engineering philosophy or power. Analog people further state that they need higher data rates than we can get and if we are to capitalize on our parallel computing and data handling power in order to try to overcome some of the taint of the current serial flap, we should consider, I think, 28 bits minimum so as to be able to pack two 14 bit words per register and thus, double our data output rate to digital to analog converters and the like - also to scopes.

Now on to word length as determined by the instructions. Certainly 16 bits represents a reasonable address length to address 65 kilowords of memory. Everyone agrees that this would be a desirable number. 3 bits for index register seems about right and one bit for deferring. 6 bits seems like a minimum for op code, 1 bit for a programmed operator - primarily to catch up to the competition of SDS. I insist on one spare bit and many people who feel character addressing is important would want to use my spare bit plus two others to do the character addressing in those instructions where it matters, and leave it for instruction modifications where it does not matter. This would give a total of 28 or 30 bits depending how you look at it. If you really believe that there should be a multiple of six, then I would recommend a 30 bit machine. However, 28 bits I think is my current recommendation. Incidentally, if you allow 7 bit characters for 128 character set, which is quite a reasonable number, and a "step forward",then this even meets the criterion that 2 bits of character addressing is enough and comes out even. In any case we have room for 33 bits and 17 address bits in the two mounting panels which have double trays so this gives us three extra slots for odds and ends.
I STRONGLY RECOMMEND A 28 OR A 30 BIT WORD.

Concurrent Programming - In this area I am not an expert but Dit seems to feel that the FORTRAN four language, which looks like the ALGOL language,is the language to use for all programming. I am not aware of the details of the character set required or like that.

He wants to do it all in ALGOL. I would have a good discussion with Dit on the subject. All agree that a full-time programmer should be working from the start of the project.

More Work - Very soon, more work should be done in the following areas before the design is completely hard.

1. A careful compilation and discussion of the competition's ideas and features, also of LINC and other semi-competitive machines.

2. Whether an analog input is a necessity - I believe it may be.

3. Whether serial methods of computation would give us any real advantage. It may be that in the shorter worded index adder, the multiple additions that will sometimes go on could be done very efficiently this way in the event that a majority logic circuit did not work out as a good idea. This would allow many additions in only the time to circulate one word plus N extra bit times. Furthermore, I am not sure of the best AE design. I am convinced that we should have one programmer (hopefully Lennie) working full time along with the design of this machine so that it is on cards or back panel wiring or like that right from the start. This, I think, will eliminate in the future bottle necks which we are certainly going to run into if we plan to turn out new type machines regularly.

Conclusions -

Relocation
Independence of AE and Memories
Trapping
Time Sharing or Multi-Processing or Addressable Register or Multi-Programming
Character Handling Power

I think a tentative example of the breakdown of parallel tasks in the developments of this machine would be somewhat as follows:

1. Programming with a good man such as Dit

2. Manual Design and Development along with the development of the machine with Stu Grover

3. AE design under Dit and Gordon

4. Machine design under Gordon and I

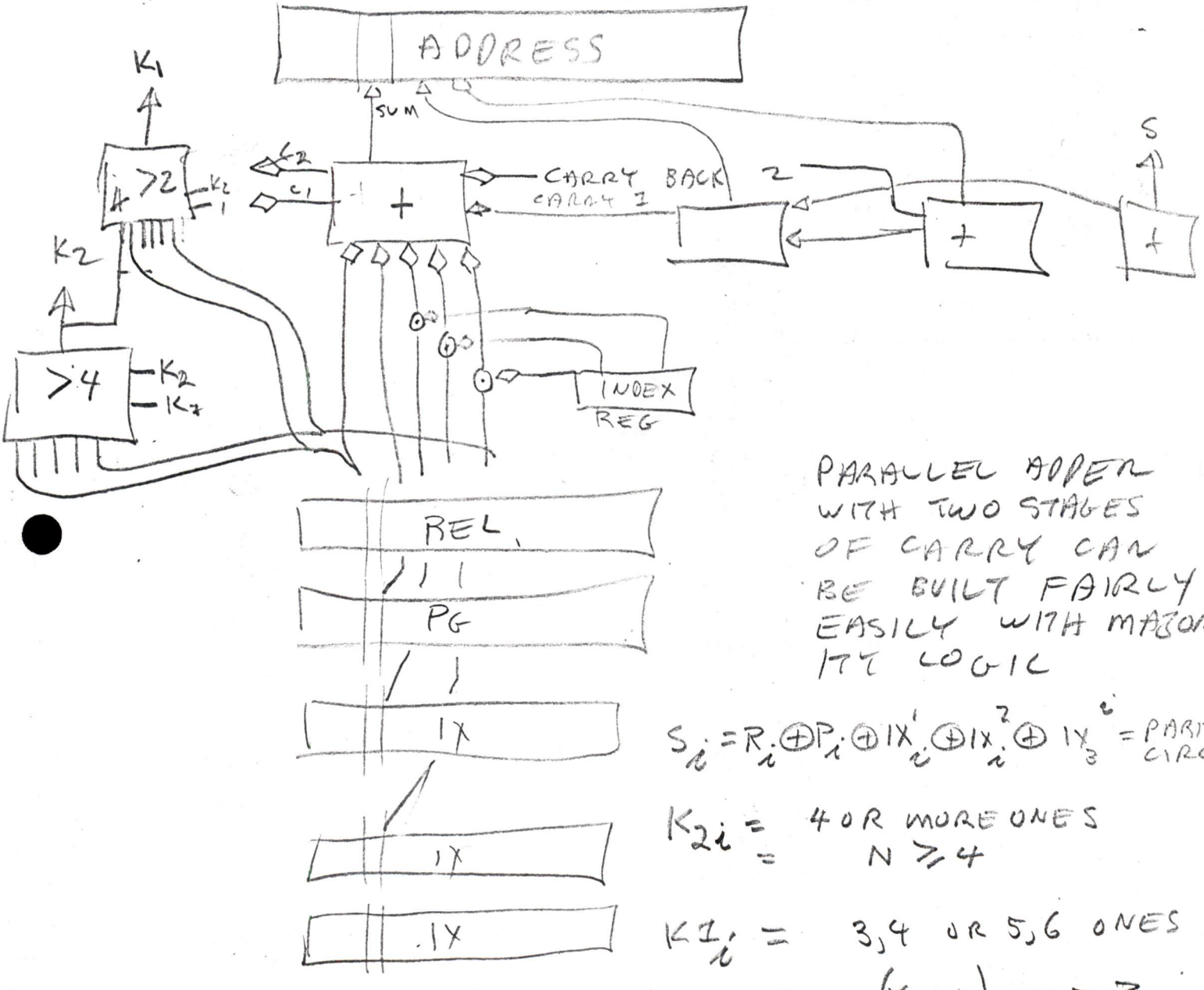
5. Programming toward aiding the design of the machine under Len

6. A small amount of research under Emile or Russ Doane in the form of coaxial serial parallel conversion and multi-plexing and majority logic circuitry.

7. I/O development under Roland Boisvert or perhaps even better Mel Arsenault.

PG

PARALLEL



PARALLEL ADDER WITH TWO STAGES OF CARRY CAN BE BUILT FAIRLY EASILY WITH MAJOR ITT LOGIC

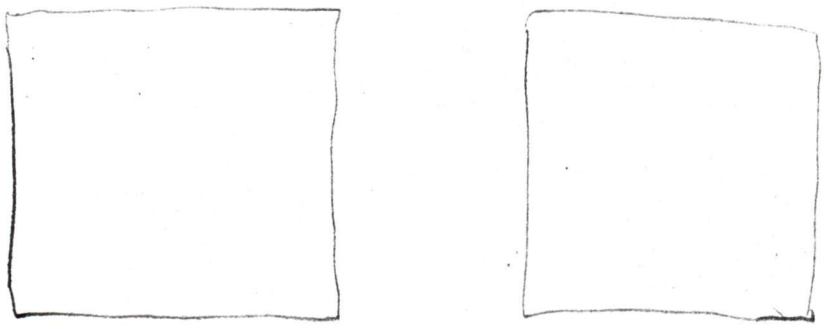
$S_i = R_i \oplus P_i \oplus 1X'_i \oplus 1X''_i \oplus 1X_3^{i}$ = PARITY CIRCUIT

K_{2i} = 4 OR MORE ONES
= $N \geq 4$

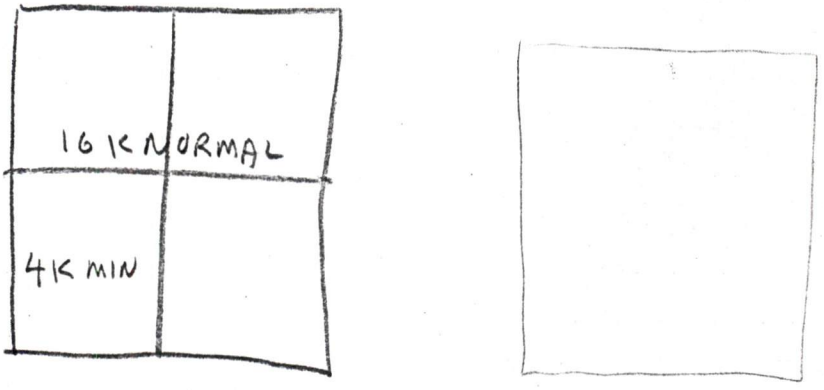
$K1_i$ = 3,4 OR 5,6 ONES
= $-\left(K_{2i}/2\right) + N \geq 3$.

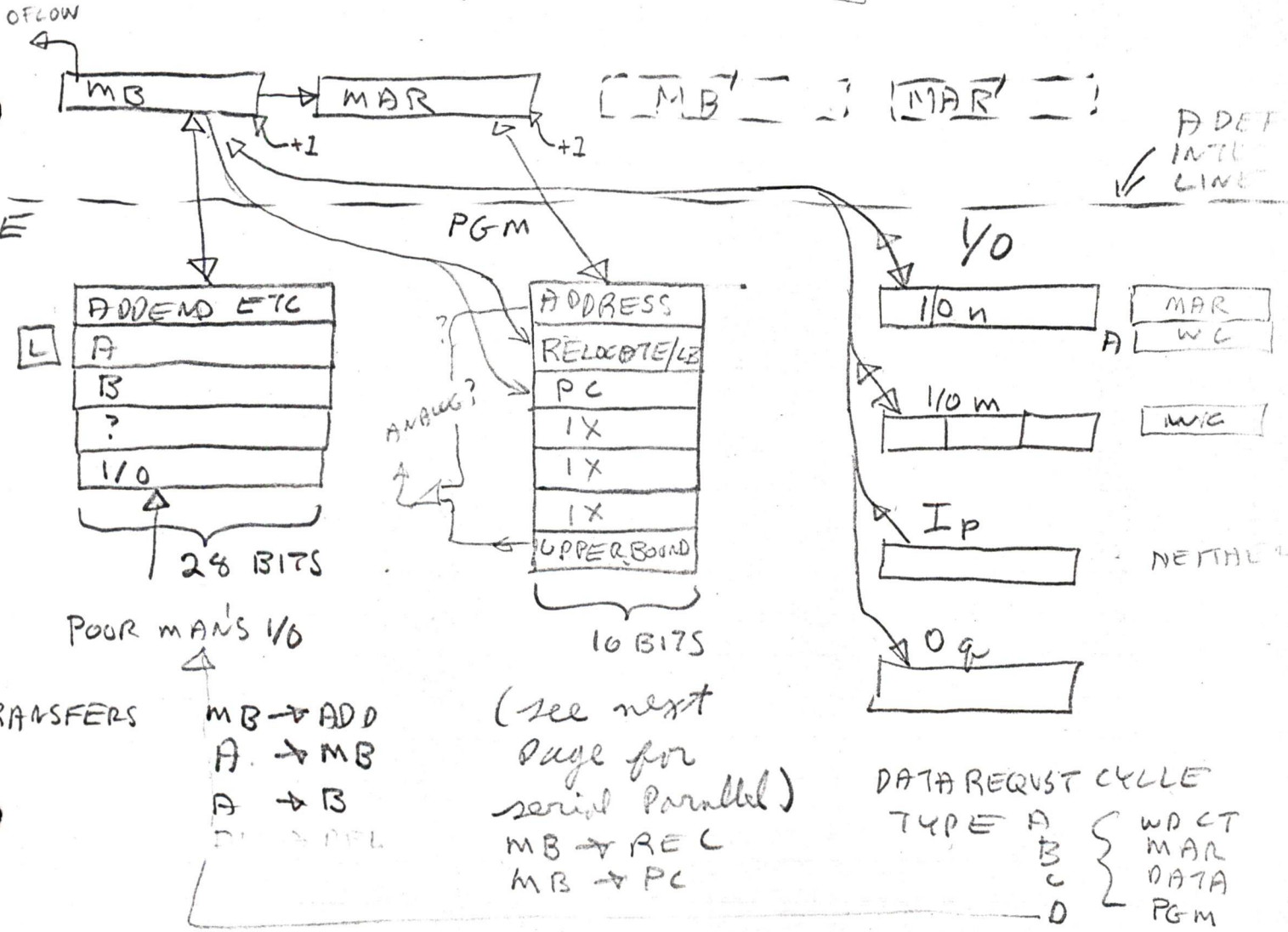
FLOW

MEM



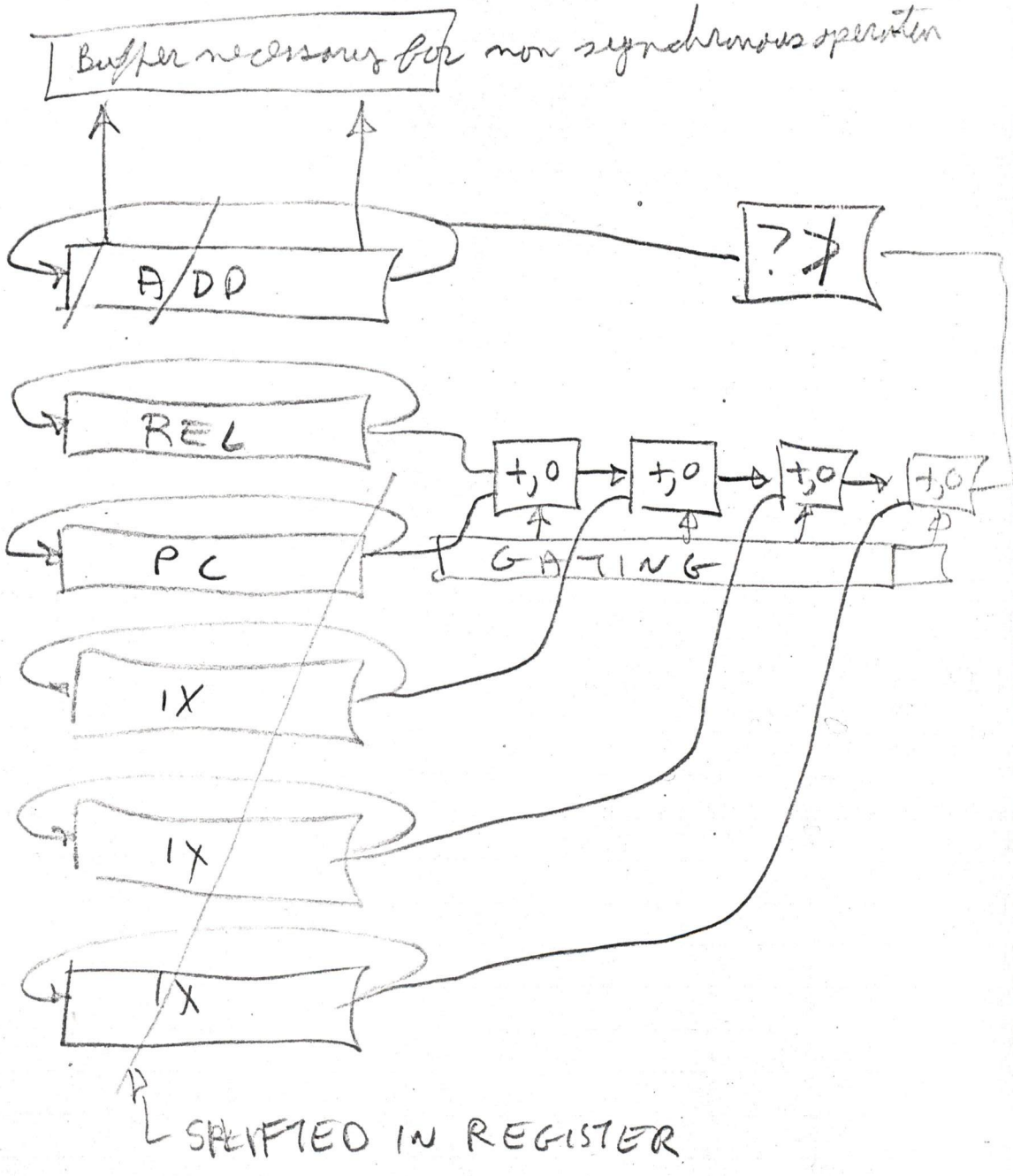
65K MAX





MAX'S NEXT MACHINE IS A
DES = DIFFERENTIA EQN SOLVER

SERIAL



dec INTEROFFICE MEMORANDUM

DATE February 22, 1963

SUBJECT

TO Arthur Hall

FROM Kenneth H. Olsen

Now that we are using computers for Control Application, our need for reliability is much more severe than anything we have faced up to before. I am now particularly concerned about our drums that we are using in Control. U. S. Steel uses a drum for some reason or another and it takes two months to replace it. They are likely to be very unhappy. I suggest that we carefully consider the possibility of buying and keeping on hand a spare drum. This might be a rotating inventory item so that one drum does not stay on the shelf too long.

Kenneth H. Olsen

cc: Stan Olsen
Harlan Anderson
Gordon Bell

INTEROFFICE MEMORANDUM

DATE 2/22/63

SUBJECT

TO K. Olsen
H. Anderson
W. Hindle
R. Best
S. Olsen
N. Mazzarese
D. Morse
S. Grover
S. Lambert
R. Boisvert
All Sales Personnel

FROM B. Maxcy

The following prices are now in effect:

Ultra Precision Display	Type 31.	$41,200
Remote Computeriter and Control		7,730
Precision Display	Type 30C	19,460
Soroban Punch Including:	GP2-300.	26,600

Punch
Control
Cabinet
Echo Checking

INTEROFFICE MEMORANDUM

DATE February 21, 1963

SUBJECT Program Libraries; time delays in processing requests

TO Bob Beckwith
Elsa Newman
Joe Rutschman
Gordon Bell
Harlan Anderson
Sandy Moore
Nancy Hurley

FROM H. R. Morse

The following times to process written requests for Library materials should be assumed when requesting tapes and writeups:

No delay in processing of requests for single tapes and/or writeups which are on hand.

One day to process a batch request for on-hand materials.

One week to process a request for a larger number of a given tape than are normally kept on hand.

One week for a newly submitted program to become available for distribution.

Some of the above delays vary greatly depending upon the library workload. However, the above times should be taken into account when ordering library materials to assure that the materials are ready when needed.

Harlan Anderson

INTEROFFICE MEMORANDUM

DATE February 21, 1963

SUBJECT Random Notes on New Computer

TO Tom Stockebrand

FROM Kenneth H. Olsen

We received a quote from Amphenol on a 36 pin connector for use in large system plug-in units but this will not work out well because it has to be thicker and therefore will not fit in our standard construction. Loren Prentice is now making a model of a double width plug-in unit which will have two 22 pin connectors on it which will make a total of 44. This looks like a reasonable approach to a large plug-in unit.

Gordon Bell suggests that we do all our register transfers through one common register. This is the way the MTC Computer worked originally. This would cut down the number of gates and they might end up using the very high speed transistor gates.

I asked Bob Savell to consider repackaging the reader, punch and typewriter control panels to make them less expensive. We might put much of it on a very small number of large plug-in units. We might also include the micro-tape logic in the same place.

I told Bob Savell to start working on the new punch timing control for PDP-1 but to plan to have it in the new computer.

Dit Morse feels that the teletype typewriter is a satisfactory typewriter for computer use. He of course would like a more extensive character set but a typewriter that works has a very definite advantage. I can't see that we'll have time to evaluate any other typewriter in time.

Loren Prentice has been working on a new design for the PDP-1 and PDP-4 console fronts. I suggested that they drop all work on that and work on the console front for the new computer. This one should include space for punch, reader, LINC and control panel.

Some people like the idea of having an extra register to store the contents of the accumulator when it is not being used. This would allow the accumulator to be used for index adding and other things. The extra register could then be used as a carry register which would allow very fast multiply. If this carry register is used as an accumulator buffer, the accumulator might then be used as the register which transfers information between registers. Several people have told me they would like to have a pointer register.

We have to decide whether we want indicators on all flip-flops or not. I have asked Jack Smith to estimate what it would cost to add an indicator.

It is a real chore to change cabinet design. Our present mounting panels hold 25 plug-in units and if we move the marginal checking panel, it will hold 26. It would therefore be convenient to keep the digit length of the machine 26 or less bits long.

Gordon Bell

INTEROFFICE MEMORANDUM

DATE February 21, 1963

SUBJECT New Computer Design Philosophy

TO Tom Stockebrand FROM Kenneth H. Olsen

A new computer is long overdue at DEC but we have not been in a position to build one because we have been so long in winding up the details from our present computers. However, now we do have the techniques and the time and the money for a new computer, I think we should go ahead and make one in a reasonably fast time schedule.

The proposal is to do all aspects of the computer design in parallel. This means that at the end of the time schedule whether it is four or six months, the job should be done. Then after a rest of a month or two we could if we wanted to go off and make another computer. Here is a list of the items which should be carried on in parallel:

Design and Build Central Processor
Write FORTRAN with Assembler and Simulator
Design and Build Tape Control Unit
Write All Manuals

We have never looked at competition before but I think as a result we have lost out because we don't know the points in which our machines are significantly better than others. I think that we should consider doing this parallel effort sub-contracting a survey out to someone like I.I.I. to compare our machine in detail with others.

Kenneth H. Olsen

SALES CALL REPORT

FIRM: Herbert Gordon Co.	DATE: February 21, 1963
DIVISION	SALESMAN: Arthur H. Hall III
STREET	OFFICE
CITY: Harvard, Mass. STATE	NATURE OF CALL
PHONE NUMBER: 456-3548 AREA CODE	FOLLOW-UP DATE

CONTACTED

Herbert Gordon

SUBJECT: DC Power Supplies

REMARKS (CONTINUE ON BACK OF SHEET)

Herbert Gordon called for Dick Best this morning and (because he was on vacation) spoke to Jack O'Connell who thereupon spoke to me who in turn called Mr. Gordon.

Mr. Gordon is the head of a small company once known as Weston Labs which manufactures radar power measuring equipment.

He says that a company which asked to remain anonymous told him that they were buying computers without power supplies from us and wanted him to bid on DC power supplies which would remain "up" for 50 ms. The only company he could have gotten this figure from is Foxboro who calls it out in their spec. (Two of the voltages he mentioned are 26.6 VDC & 15 VDC)

This man had the brass to suggest that as we had solved the problem of making our power supplies "hole up" for 50 msec. and as he had little experience with solid state power supplies, maybe we would tell him how we do it.

I suggested that it was unlikely that we would give up our competitive advantage so that he could underbid us on power supplies.

I said that Dick Best or I would call him up on Monday or Tuesday of next week.

(continued overleaf)

PROMISED: R. Best would call back February 25 or February 26.

HOW TO LOCATE PLANT

I called Mr. Gordon on February 25, 1963 and confirmed his suspicion that we use saturatable reactors, solid state rectification and lots of capacitance on the output. I further told him after consulting with Dick Best and others in the company that we did not wish to discuss this particular project further because of the rather secretive nature of the negotiations. I also mentioned in response to his idea that we are supplying customers computers without power supplies, that while I might be mistaken, I didn't know of any such case.

Ken Olsen

dec INTEROFFICE MEMORANDUM

DATE February 21, 1963

SUBJECT Random Notes on New Computer

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dec INTEROFFICE MEMORANDUM

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Kenneth H. Olsen

dec INTEROFFICE MEMORANDUM

DATE February 22, 1963

SUBJECT New Computer Design

TO Ken Olsen

FROM Tom Stockebrand

My apologies for form and content of this memo, it is a rushed job. In particular it does not include enough evaluation of the competition nor enough filtering of the ideas presented. While I am on vacation, I will try to sketch out more of the machine design.

Commitments on delivery dates, price and so on should be to Ken Olsen and the company and not to customers.

This machine should be specifically designed to do the job as listed below superlatively well rather than to in any way "look like the competition" or be an answer for them.

This machine is to fill a vacuum we believe to exist at the present time in the computer market.

We must make no compromises in carrying out the ideas which are involved in its design. The implication of the above is that, as is usual with DEC effort, the ideas shall be limited to those which are eminently easy to do, general, straightforward extensions of the art..... In fact, "today's technology today." ------God.

The sources of the ideas presented in this note are indicated in an effort to provide "source data" while I'm gone. If the general ideas are agreed upon, future administration of the project will be vastly improved.

If we are to turn out machines regularly, we need some more official advanced development - that is answers to specific how-can-we-do-this-job questions. (Coax delays, micro-logic, serial, majority logic circuits, etc.)

THE IMPORTANT NOTIONS

It is time the Programmer was given real power in sub-routine writing ability so that no modifications of instructions are ordinarily necessary during program relocation.

Multi-programming, time sharing, fast break-in or what-you-will is necessary in the eyes of most users of our equipment and in fact necessary (though they don't know it) to many users who are comtemplating using our equipment.

Data words need to match today's data requirements in accuracy. The analog people are almost entirely concerned with 14 bit accuracy for what they call four significant digit precision.

Large memories are here. Index registers are here.

Some fair expansion of the machine should be planned for at the beginning though we understand that wholesale revisions of the machine are out of order.

The rest of this memo is a list of specifics pertaining to the generalities listed above.

Routine Relocation Power - The ability to operate routines wherever they may be located in memory after a dump from, say, the drum can be provided by the ability to (1) modify each memory reference by a constant while (2) checking that result against specified bounds and trapping to a particular memory location or executive program if the required location is outside of the bounded area. This feature can be achieved reasonably easily during the initial design of a machine by allowing the index adder, or its equivalent, to do the work. Dit says this feature would make programming "ten to a thousand times easier." Ed says that if you can use the arithmetic element more and memory less, you're way ahead and this feature would leap in that direction. (Dit, Shelley, Kotok, Ed and Ben.) This feature is considered by advanced type people to be crucial to the machine design.

Trapping - Trapping meaning to execute and instruction located at, for instance, the address indicated on the op code. This trapping would be done on non-used instructions or memory addresses outside of the bounds set by the executive routine in the relocation of power indicated above (Dit, Ben.)

Character Handling Power - The ability, in one form or another, to address characters stored in memory hopefully to deal with character strings in I/O transfers such as is done in the Lisp and Comet Programs. Dit, Ben and Ed are in favor of this, Ivan goes even further and says that bit addressing features are of great power. However, Len disagrees.

On Obsolescence - Trapping also allows optional expansion by do-it-now-with-program, later with wires. Also de-bugging and checking power is automatically incorporated. The machine should be built of modular parts of course like different memories and AE's and an extra bit or two should be assigned in the instruction word for future variations not thought of now when you absolutely have to have that bit!

Multi-Processing - Multi-Programming - First and foremost, a fast break - this means primarily no need for many accesses of a clean-up variety to store away stuff in preparation for operations in response to a break request. The most potent feature here seems to be an extra register in the AE to allow either exchanges with the AE for saving purposes, or as an address calculator (Dit) or as a multiply index by, or as an addend register, or as a carry register depending on your exact orientation. The second thing which would help this process out is probably a separate index adder though I believe a machine try should be made to use one adder for everything. Since it is reasonably certain that two groups of wide modules will be used, however, it is probably not unreasonable to suggest the index adder. In the future, that means perhaps with the development of another machine, separate program counters may be in order. For now, core program counters should certainly be enough if they are necessary. To hell with data gather. The idea here is to eliminate control problems from the channel and put them in the program where they belong.

Channels should be only high-speed data gathering devices. (Dit) System capability is an okay phrase. (Dit)

List Processing - This is a program technique which has general power which goes well together with our ideas of a processor with general power. It requires index registers and increment and decrement by more than one and, ideally, registers which can be packed with several addresses each (that is, word length equal to two times the address length.) However, I think a clever use of the relocation feature or of Dit's multiple indexing (1+ 2+ 4 scheme) will allow the shorter pack base address that this too short word machine will have. (Len) In general, this processing seems to be for the next machine though a small look into the future is probably in order. Similarly, floating point AE's will probably have to wait until the next machine or at the very best, be planned as a different kind of AE attachable to this memory.

Index Registers - These are clearly necessary. Dit feels that three register which could be added together in a micro-program fashion that is, any combination of the three according to MACRO programmed bits in the word, would be of more use than seven registers addressed directly by the same three bits though Kotok disagrees. I have no feelings. Whether the three could be added together and in fact the complete design of the index adder might depend crucially on the ability to build a simple circuit which would detect four out of seven to provide carry for carries. If this circuit were easily available I believe that five registers could be added together simultaneously and stored in a fifth and the sketch accompanying this memo shows the powerful use that could be made of this feature.

Addressable Registers - These would be very useful according to Len for much easy processing without complicated instruction and could perhaps be implemented to do the character addressing without using extra bits in the word by allowing certain kinds of character type transfers between registers. The most important addressable registers would perhaps be the in/out registers such as, for example, the scope buffer for use with the light pen -- especially if it were an incremental scope plus generator type. In this case too, the feature would allow sine, cosine and hyperbolic and parabolic function generation with no extra hardware. It would save on the IOT read-in bits but cost some address decoding.

Data Channel - Fast break SI, Data Channel SI, I/O Channel , no, - do it with program. (Dit)

Cute Instructions - Ben feels that load and deposit AC in push down list would be a useful instruction at least to the prospects of a clever turn of mind if not to real users. Instruction (Y+)AC)) $\longrightarrow$ AC is reasonably necessary for multi-dimensional matrices when indexing is not readily available and would implement easier list processing. Ben likes an instruction called execute effective address however, Len doesn't go along with him. Dit makes the comment that we should avoid doing things in little pieces.

Word Length - There are two criterion for word length, one is the data word that will usually be of necessity, and the other one is the number of bits that you need in your instruction. For floating point work, 48 bits seems to be a minimum and for graceful manipulation of the text

this also seems like an appropriate word length. I do not believe that it is necessary to have precisely a multiple of six though this may be, in some cases, graceful for character processing. Many people would just love to have an extra bit or two to indicate whether this set of characters is to be considered in the list and for other marking purposes, ask Dit for example. I, myself, have run into this problem many times when programming character strings. Len will also agree I think. As far as the packaging limitations go, I agree that it is essential to keep the packaging the same which means no more than 25 units in a rack panel wide; notice that if the address portion is 16 or 17 bits, even, there are 8 bits left over in the mounting panel supporting the "short-word" AE in which to provide extensions of the full register portion of the AE. Since the floating point people need 48 bits and we can't possibly take this much of a jump in the present machinery, we should either leave them out of consideration or consider two-word data accesses floating point words. To this end, Dit suggests a single bit in the data words to tell whether the word is to be interpreted as floating point or not. This might be an example of the use of a spare bit location in the word for use when a floating point processor might become available. How about word lengths for ordinary users of fixed point type calculations? The competition seems to feel that 24 bits is a reasonable length however, I submit that in many practical cases 14 or so bits is a reasonable length based on my discussions with various analog and hybrid types. This is because 14 bits represents four decimal digits which is the current okay number in that industry, though there as here okay numbers do not necessarily represent the best in engineering philosophy or power. Analog people further state that they need higher data rates than we can get and if we are to capitalize on our parallel computing and data handling power in order to try to overcome some of the taint of the current serial flap, we should consider, I think, 28 bits minimum so as to be able to pack two 14 bit words per register and thus, double our data output rate to digital to analog converters and the like - also to scopes.

Now on to word length as determined by the instructions. Certainly 16 bits represents a reasonable address length to address 65 kilowords of memory. Everyone agrees that this would be a desirable number. 3 bits for index register seems about right and one bit for deferring. 6 bits seems like a minimum for op code, 1 bit for a programmed operator - primarily to catch up to the competition of SDS. I insist on one spare bit and many people who feel character addressing is important would want to use my spare bit plus two others to do the character addressing in those instructions where it matters, and leave it for instruction modifications where it does not matter. This would give a total of 28 or 30 bits depending how you look at it. If you really believe that there should be a multiple of six, then I would recommend a 30 bit machine. However, 28 bits I think is my current recommendation. Incidentally, if you allow 7 bit characters for 128 character set, which is quite a reasonable number, and a "step forward",then this even meets the criterion that 2 bits of character addressing is enough and comes out even. In any case we have room for 33 bits and 17 address bits in the two mounting panels which have double trays so this gives us three extra slots for odds and ends.
I STRONGLY RECOMMEND A 28 OR A 30 BIT WORD.

Concurrent Programming - In this area I am not an expert but Dit seems to feel that the FORTRAN four language, which looks like the ALGOL language,is the language to use for all programming. I am not aware of the details of the character set required or like that.

He wants to do it all in ALGOL. I would have a good discussion with Dit on the subject. All agree that a full-time programmer should be working from the start of the project.

More Work - Very soon, more work should be done in the following areas before the design is completely hard.

1. A careful compilation and discussion of the competition's ideas and features, also of LINC and other semi-competitive machines.

2. Whether an analog input is a necessity - I believe it may be.

3. Whether serial methods of computation would give us any real advantage. It may be that in the shorter worded index adder, the multiple additions that will sometimes go on could be done very efficiently this way in the event that a majority logic circuit did not work out as a good idea. This would allow many additions in only the time to circulate one word plus N extra bit times. Furthermore, I am not sure of the best AE design. I am convinced that we should have one programmer (hopefully Lennie) working full time along with the design of this machine so that it is on cards or back panel wiring or like that right from the start. This, I think, will eliminate in the future bottle necks which we are certainly going to run into if we plan to turn out new type machines regularly.

Conclusions -

Relocation
Independence of AE and Memories
Trapping
Time Sharing or Multi-Processing or Addressable Register or Multi-Programming
Character Handling Power

I think a tentative example of the breakdown of parallel tasks in the developments of this machine would be somewhat as follows:

1. Programming with a good man such as Dit

2. Manual Design and Development along with the development of the machine with Stu Grover

3. AE design under Dit and Gordon

4. Machine design under Gordon and I

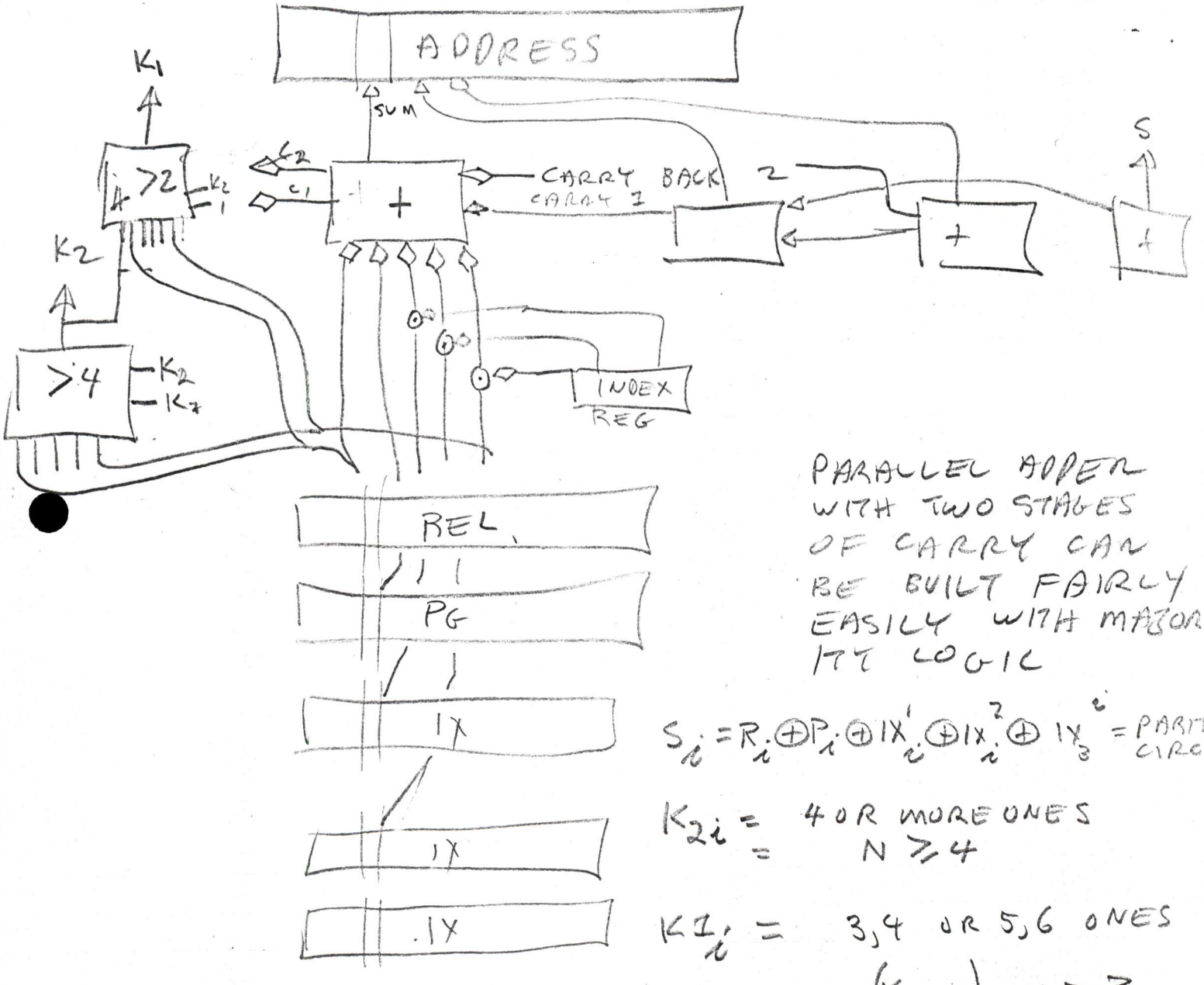
5. Programming toward aiding the design of the machine under Len

6. A small amount of research under Emile or Russ Doane in the form of coaxial serial parallel conversion and multi-plexing and majority logic circuitry.

7. I/O development under Roland Boisvert or perhaps even better Mel Arsenault.

PG

PARALLEL



PARALLEL ADDER WITH TWO STAGES OF CARRY CAN BE BUILT FAIRLY EASILY WITH MAJOR ITT LOGIC

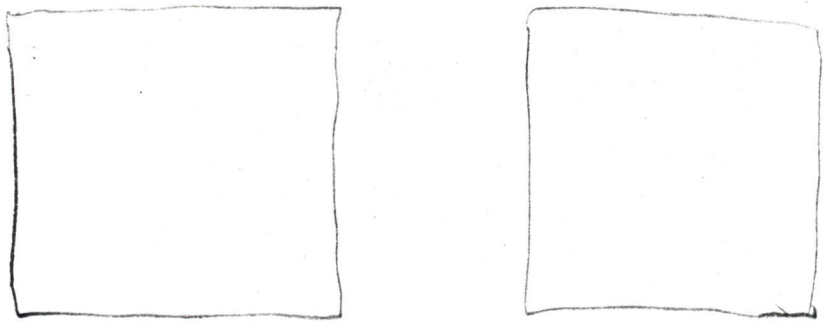
$S_i = R_i \oplus P_i \oplus 1X'_i \oplus 1X^2_i \oplus 1X^4_3$ = PARITY CIRCUIT

K_{2i} = 4 OR MORE ONES
= $N \geq 4$

$K1_i$ = 3,4 OR 5,6 ONES
= $-\left(K_{2i}/2\right) + N \geq 3$

DATA FLOW

MEM



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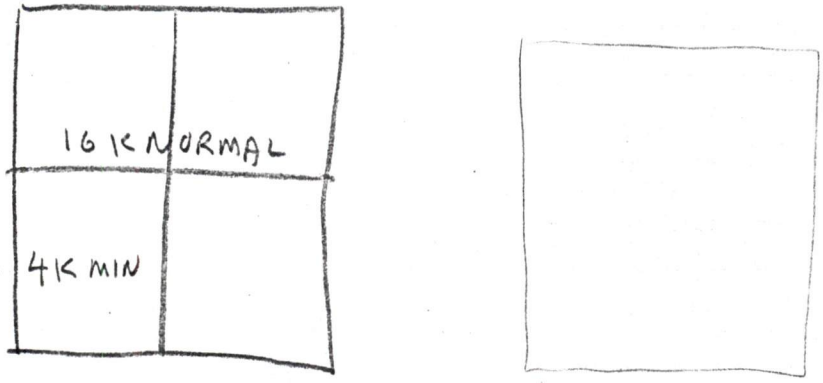
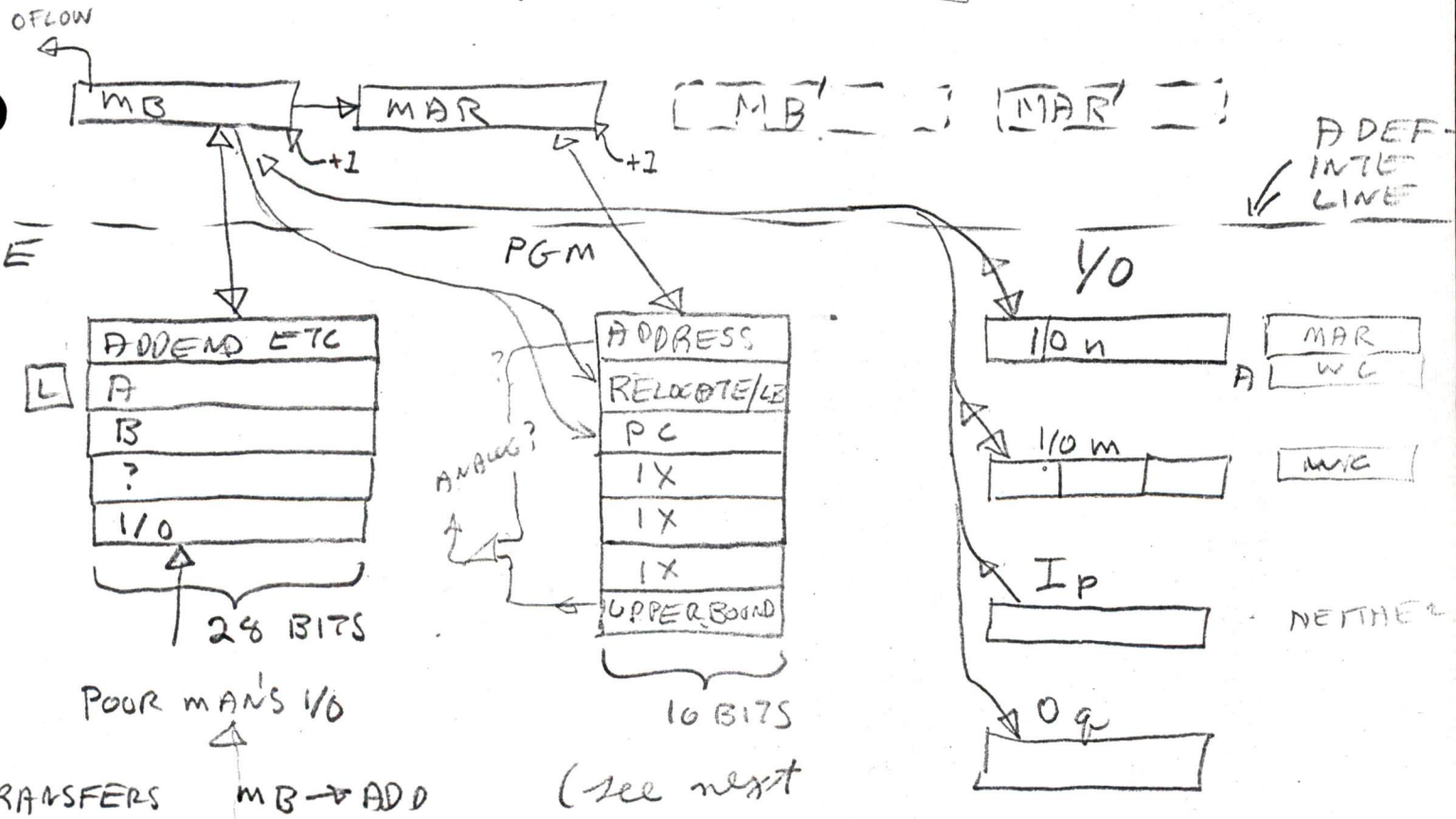




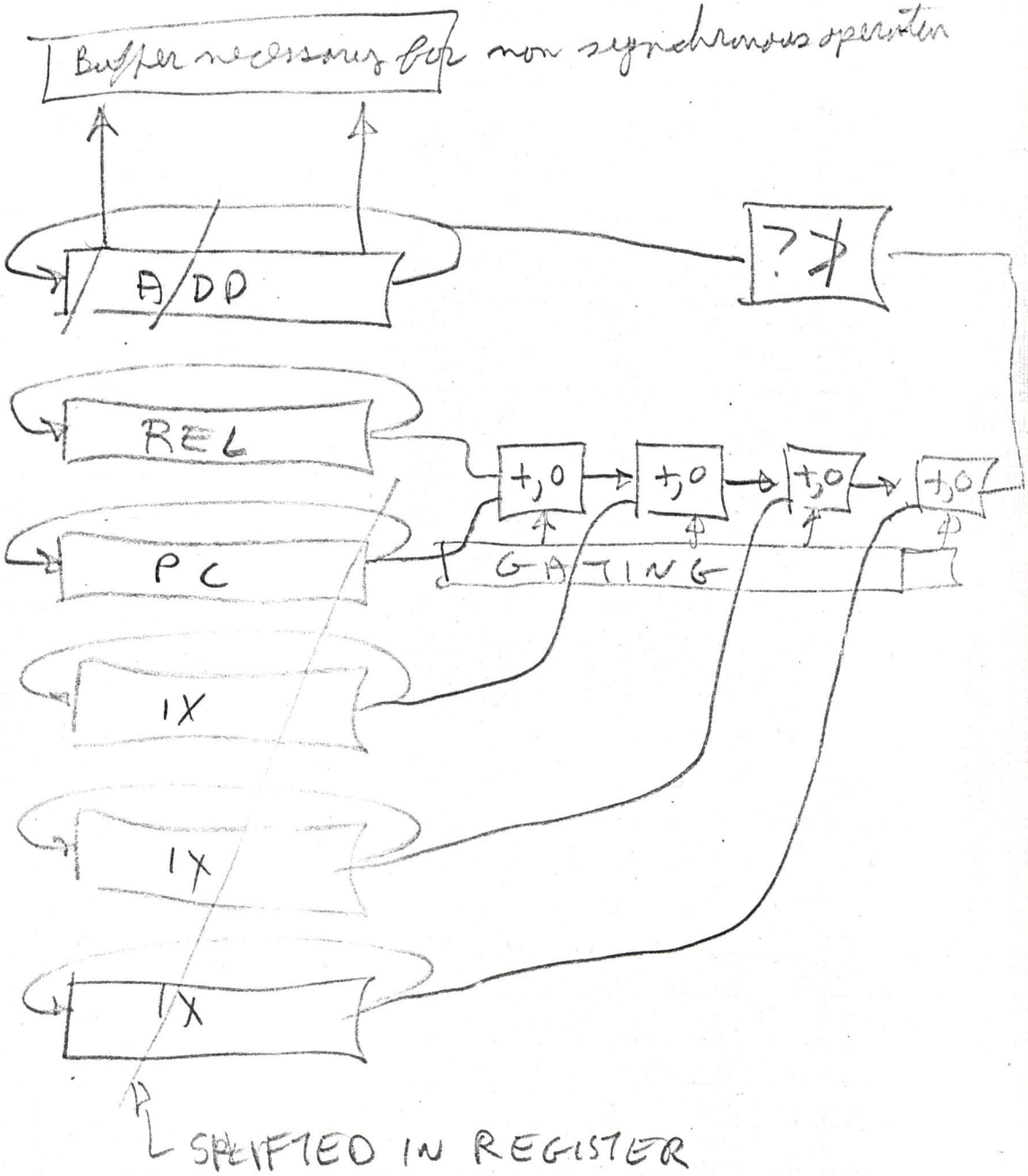
TRANSFERS
MB → ADD
A → MB
A → B

(see next page for serial Parallel)
MB → REC
MB → PC

DATA REQUST CYCLE
TYPE A, B, C, D → WD CT, MAR, DATA, PGM

MAX'S NEXT MACHINE IS A
DES = DIFFERENTIA EQN SOLVER

SERIAL



dec INTEROFFICE MEMORANDUM

DATE February 21, 1963

SUBJECT Status of Renegotiation Board - Exemption Filing

TO Ken Olsen
H. Anderson ✓
R. Best
G. O'Dea

FROM R. Mills

Yesterday I called Matt Chick in an effort to determine the status of our Module Exemption Filing with the Renegotiation Board. Matt told me he had talked with Alex Watt, who is on the staff of the Renegotiation Board and Watt stated that they expected to get to our filing within two (2) weeks, with an answer to DEC in about a month, which will bring us to the middle of March.

After we receive an answer from the Renegotiation Board, as to the allowance or disallowance of the exemption, we will have about thirty (30) days within which to make our regular filing, whether it be on a Statement of Non-Applicability, i.e., without the detailed Profit and Loss information or on an RB-1 form, i.e., including detailed information.

# # # #

INTEROFFICE MEMORANDUM

DATE Arthur Hall

SUBJECT

TO Bob Beckman

FROM Bob Savell

Ken Olsen
Harlan Anderson
Stan Olsen
Dick Best
Gordon Bell
Nick Mazzarese

Would it be possible for us to supply to our computer users some sort of a log or service form which would make it very easy for customers who service their own machines to send us a copy of all their field service reports? I have the feeling that many troubles on IO equipment, typewriters in particular, are occurring of which I have no knowledge. The only way in which we will be able to accurately determine how well our perhipheral equipment is behaving is to have a formal reporting scheme set up so that each and every trouble that occurs will come to our attention.

I feel that it is very important that a system of this sort be instituted as soon as possible so that we no longer have to rely on rumors and the grapevine to keep informed about equipment other than that which we service ourselves. The status of the units we service ourselves is well reported by our field service people.

RS/ll

INTEROFFICE MEMORANDUM

DATE February 20, 1963

SUBJECT

TO Bob Savell

FROM Kenneth H. Olsen

cc: Nick Mazzarese
Harlan Anderson
Jon Fadiman

David Caldwell called on Monday, February 18 to say that he was having visitors from University of Michigan on Friday and that he would like to bring them out here to show our Precision Display and our PDP-1 Computer. They are interested in reading spark chamber photographs and Professor Caldwell has told them that ours is obviously the only machine to get. The man's name will be Professor Harry Jones and he will have two others with him. I am not sure whether David Caldwell will be out here or not.

You might call the day before to see if we can help in any way in bringing them out.

Kenneth H. Olsen

H.E.C.

3rd Draft: For Presentation at
Works Committee Meeting
February 19, 1963

THE DIGITAL EQUIPMENT CORPORATION

Statement of Inventory Policies

I. Inventory Mechanism

Our stated goal is to keep finished goods (Modules) inventory as an aid to customers and as a buffer against demand fluctuations. We plan to provide stock quantities of each module type to cover all orders (external and internal) AND to cover all expected orders; the company's aim is to fill any order "off-the-shelf".

Our goal is to maintain adequate Raw Material Inventory and Work-In-Process Inventory to meet demand on Finished Goods Inventory without excessive inventory build-up.

We maintain a stock list of approximately 250 module types. The addition of new module types is a continuing result of our design improvements and our expanding markets. The raw material components in stock number approximately 1300, and manufactured parts in stock total approximately 1500.

A. Raw Material Inventory includes material, equipment, and components used directly in our products. We maintain Kardex perpetual inventory records for each part, recording receipts and issues of material. Raw material parts are classified and coded into categories which enable us to analyze the structure of this inventory. (See Appendix I for details).

B. Manufactured Parts Inventory includes parts and subassemblies manufactured and stocked by DEC. Kardex perpetual inventory records are maintained for these parts and the parts are classified and coded for analysis. (See Appendix I for details).

C. Open Jobs Work-In-Process Inventory includes Module Job Orders in process, Manufactured Parts Job Orders in process, and Special Systems and Computer Jobs Orders in process.

D. Finished Goods Inventory is modules in stock at manufacturing cost. Normally there will not be any Special Systems or Computers finished goods inventory.

II. Inventory Delineations

Modules	Systems and Computers
Raw Material (Class 10-18)	Raw Material (Class 30-36)
Mfd. Parts in Stock (Classes 50-54)	Mfd. Parts in Stock (Classes 70-74)
Work-In-Process (Open Jobs)	Work-In-Process (EN Open Jobs)
(In Test)	---
Finished Goods (Stock Room)	---

See Appendix I

Inventories are planned in response to actual and anticipated demand. Inventory levels and demand flows are both conditions of and determinants of procurement and production activities.

Inventory values flow from purchase orders, to receipts into Raw Material Inventory, to issues of Raw Material and Labor and Overhead to Work-In-Process Inventory, to completion of WIP Inventory to Finished Goods Inventory, to shipment or Cost of Goods Sold.

The determination of what to produce and what to buy flows in the opposite direction. Usage and sale of modules determine need to restock, orders written into Work-In-Process determine the need to procure Raw Material and Manufactured Parts Inventory.

III. Mechanics of Determination

A. Modules - Finished Goods: At least once each month the determination of the coming Month's Module Production Starts is made according to the following procedure.

We maintain both an Actual Balance and an Available Balance record for each module type.

The Balance on Hand and Manufacturing Lots In-Process being known, Customer Orders and Internal (Computer and System) Orders are posted as a deduction to Available Balance for each module type.

Manufacturing Orders are written to correct minus availability and, upon issue, are an addition to Available Balance.

We now must plan for that amount of each module type to provide for expected orders. Usage records are maintained for each module type, one-month supply being the quantity ordered during the past three months adjusted by past historical records. Future order information is entered into the availability determination when available. It must be noted that demand for each module type varies an average of 50% over or under in any given month.

The One-Month Usage is deducted from Available Balance as a requirement, and Manufacturing Orders are written (Planned) to the level of one-month usage.

Planned Issues are submitted to Sales for approval or change.

For example see Appendix II.

B. Module - Raw Material and Manufactured Parts:

The need for Components is determined by a similar basic availability mechanism and is calculated in conjunction with the Modules requirements procedure described above.

Actual module Manufacturing Orders not yet issued and expected future Module Manufacturing Orders are exploded into required types and quantities of components. We use the PDP-4 Computer to process the data:

1. A complete, current listing of all Raw Material and Manufactured Parts Components is maintained on punched cards and tape.

2. Complete, current Parts Lists for each module type is maintained on punched cards and tape.

3. The actual to-be-issued Manufacturing Lot for a module type is an "order". An expected future planned issue Manufacturing Lot is an "order". Module "order" quantities are then

exploded into the required quantities of each component specified in the parts list for those required module quantities. This will be the current Need for each component.

4. We maintain perpetual inventory record cards for each component. This card indicates On-Hand Balance, Purchase Order Open Balance, and Module types in which component is used.

5. Need for each component is deducted from On-Hand Balance to give Available Balance.

6. Purchase Order quantities are added to Available Balance to give a To-Be-Available Balance. A minus here will be the initial determinant to place a Purchase Order.

7. Minimum Available levels of stock for each component are determined by exploding the desired level of total monthly module unit production, the quantity for each module type being calculated by ratio of the One-Month Usage mix. The unpredictable mix of types in module orders urges us to add a safety factor to the minimum level of availability of each component. This factor is usually 25%.

Example

Component	Balance On-Hand	-Need	=Available Balance	+Open P.O.	=To-Be Available	Minimum Usage	To-Be Placed
1.5K Res.	10,000	13,200	-3,200	5,000	+1,800	10,000	8,000

8. Orders to be Placed are determined as above. The value of these orders is then calculated to give a prediction of Raw Material Receipts in dollars.

9. If actual total module usage is lower than minimum production level, the level of module unit production will determine the minimum required available stock for each module type and each component.

C. Computers and Systems:

Finished Modules are a large part of the Bill of Materials for each computer or Special System, and the procurement of these Modules is a requirement

input to Modules Finished Goods Inventory and Availability.

Raw Material and Manufactured Parts Components unique to Computers and Systems are maintained on perpetual inventory record cards and the levels for each component are calculated on an availability balance. The historical background, however, has not been sufficiently repetitive and the final designs of each computer and System are still in a condition of change. Basically, we try to insure that material be available for production of actual order machines, and for those built for inventory as approved by the Works Committee.

Peripheral Equipment (Readers, Punches, etc.) is expensive, and delivery is long. Need is determined on the basis of customer orders, but quantity ordered is usually determined by committee on the basis of discount and vendor consideration and appraisal of potential customer orders.

IV. General Determinations

Input rate of new orders, production capacity, and inventory levels are periodically reviewed to determine what production starts are to be undertaken.

If required production starts are higher than present capacity, we seek to increase our labor capacity by subcontracting operations to close the gap. If the increased demand is deemed to be a new level rather than merely a fluctuation, we seek to add people and alert to increase individual productivity by better planning and methods changes.

If required production starts are lower than present capacity, we seek to loan people to other departments and to manufacture those units and subassemblies which will use the least amount of materials.

V. Future Plans

Component lists and product parts lists are being handled by our PDP-4 Computer. We plan to process our receipts and issues and procurement orders through the Computer to give us instantaneous Availability information. We plan to program usage calculations to give us fast, accurate trend data.

Our components explosions now are in quantities; we will next add standard costs and prices to this calculation.

Standard labor hours and dollars are now available, and we plan to program this data to give us scheduling and definitive inventory value predictions.

It will be noted that we have not specifically introduced the time or timing dimension into the above discussion. Several time factors are available however, and are in use:

A. Lead times for individual component procurement are known and are a consideration in the determination of minimum availability levels.

B. Assembly time and production progress data for computers are available and are being used in the determination of Module Availability planning.

C. Standard labor times are being tabulated monthly. Production and productivity rates will thus be operational or process times rather than gross, generalized production rates.

The above data is not as yet completely formalized. Faced with sharply increasing demand, we issue Manufacturing Orders and Purchase Orders to meet that increasing demand, often at a rate greater than our current labor capacity will absorb. Faced with sharply decreasing demand, we issue fewer orders. Reaction to demand fluctuations is thus subject to time lag. Certain computer programs are being studied in an attempt to time our reactions. We will then consider labor capacity to absorb inventory as well as demand need for inventory.

VI. Inventory Valuations

It is the Company's intention to evaluate each commodity in its inventory at actual cost, consistent with the "lower of Cost or Market" concept and to include in inventory only commodities for which current usage is indicated.

VII. Obsolescence

Consistent with the Company's desire to produce a current quality Product, Engineering changes are to be expected and as a direct consequence thereof a certain amount of obsolescence is inevitable.

To minimize the obsolescence factor it shall be the responsibility of the Chief Engineer to consult with the Production Manager before authorizing changes in design in order that the phasing out of old commodities can be realized to the fullest extent possible.

It shall be the responsibility of the Production Manager to advise the Chief Engineer of the Probable obsolescence cost of any proposed Engineering change.

Obsolescence shall call for the removal of the commodity from Inventory and instigate efforts to recover such salvage value as can be realized.

VIII. Purchase Commitments

A detail file is maintained on all open Purchase Orders affecting Raw Material Inventory. This file spells out the Vendor, Commodity Class, Cost, and estimated delivery date of each Inventory Order. The purpose of this file is to anticipate cash disbursements and to provide an expediting tool to the Purchasing Department in those instances in which deliveries prove faulty.

APPENDIX I.

Inventory Class Codes

	Code Number	Description
Raw Material		
Modules	130-10	Capacitors
	-11	Diodes
	-12	Mechanical Components (Lamps Knobs, Connectors, etc.)
	-13	Resistors (Potentiometers, etc.)
	-14	Board and Panel Stock
	-15	Transistors
	-16	Transformers
	-17	Sheet Metal Stock
	-18	Miscellaneous
Computers and Systems	130-30	Peripheral Equipment (Readers, Punches, Typewriters)
	-31	Mag. Tape (Potters, etc.)
	-32	Printers
	-33	Display
	-34	Mechanical Components
	-35	Cabinets
	-36	Miscellaneous
Manufactured Parts (W-I-P)		
Modules	131-50	Etched Boards
	-51	Phenolic Panels
	-52	Transformers
	-53	Fabricated Metal (Chassis, etc.)
	-54	Sub-Assemblies
Computers and Systems	131-70	Sub-Assemblies (Wired)
	-71	Mag. Tape
	-72	Display
	-73	Memory
	-74	Fabricated Metals
Finished Goods	132-Model Number	

Appendix II

MODULE AVAILABILITY PLANNING SHEET (Example)

Module Type	Balance On Hand	In-Process		-Current Orders	=Available Balance	+ Jobs To be Issued	= To Be Available	Requirements		= Future Available	Proposed Issues	=Proposed Available	Sales Plan Available
		Test	Work					Future Orders	Usage				
1201	60	30	30	54	+ 66	30	+ 96	24	110	- 14	120	+106	
1204	20	90	30	79	+ 61	60	+121		65	+ 56	30	+ 86	
1209	10	90		49	+ 51	60	+111	35	70	+ 41	40	+ 81	
1538		60	90	92	+ 58	90	+148	36	70	+ 78		+ 78	
1981	22				+ 22	20	+ 42		25	+ 17	15	+ 32	
3201	12	20	60	135	- 43	60	+ 17		20	- 3	20	+ 17	
3410	11	20		15	+ 16		+ 16		5	+ 11		+ 11	
4105	353	50	150	197	+356		+356	83	220	+136	90	+226	
4110	54	50		29	+ 75	40	+115	42	90	+ 25	90	+115	
4201	65	30	60	58	+ 97	210	+307	320	200	- 13	220	+207	
Total		3400	2400			5500					4500		

Appendix II

Module Availability Planning Sheet

The Planning Sheet is used to indicate the status of each module type and serves as a basis for inventory and production capacity planning.

The To Be Available column is that quantity of each module type expected in Finished Goods Stock within 3 - 4 weeks and the Proposed Available column is that quantity of each module type planned to be in Finished Goods Stock within 7 - 8 weeks. The Sales Department may indicate in the Sales Plan Available column that quantity of each module type which should be available based on their expectation and predictions of future demand. Differences in Sales Plan and Proposed Availability will then be corrected by issue of additional manufacturing orders or cancellation of open manufacturing orders.

The In-Process (Test and Work) columns and the Jobs to be Issued column and the Proposed Issues column are totaled in quantity of module units. These totals are translated into labor capacity hours:

Standard Labor Hours per Module is 1.70 hours plus .30 hours for test.

In-Process (Test) = .30 Hours/Unit.

In-Process (Work) = .85 Hours/Unit.
(In-Process lots are assumed at 50% operation status)

Jobs to be Issued and Proposed Issues = 1.70 + .30 Hours/Unit.

Man Hours/Month = 172 Hours.

In-Process (Test and Work) plus Jobs to be Issued are due in first or current month; Proposed Issues are due in second month.

To Determine Test Load vs. Capacity:

Current Month

In-Process (Test) = 3400 Units
In-Process (Work) = 2400 Units
Jobs to be Issued = 5500 Units

11,300 Units

11,300 Units x .30 Hrs./Unit = 3390 Hours ÷ 172 Hrs./Man/Month= 19.7 Men

Match 19.7 Men against current labor force to determine over- or under-load.

Next Month

Proposed Issues = 4500 Units
4500 x .30 Hrs./Unit = 1350 Hrs. ÷ 172 Hrs./Man/Month =
8.0 Men

Match 8.0 Men against current labor force to determine over- or under-load.

To Determine Module Assembly Load vs. Capacity:

Current Month

In-Process (Work) =
2400 Units x .85 Hrs./Unit = 2040 Hrs. ÷ 172 Hrs./Man/Month =
12.0 Men

Jobs to be Issued =
5500 Units x 1.70 Hrs./Unit = 9350 Hrs. ÷ 172 Hrs./Man/Month =
54.0 Men
66.0 Men

Match 66.0 Men against current labor force to determine over- or under-capacity.

Next Month

4500 Units x 1.70 Hrs./Unit = 7650 Hrs. ÷ 172 Hrs./Man/Month =
44.0 Men

Match 44.0 men against current labor capacity to determine over- or under-load.

INTEROFFICE MEMORANDUM

DATE February 19, 1963

SUBJECT Fortran Status Report

TO Ken Olsen
Harlan Anderson
Stan Olsen
Nick Mazzarese
Gordon Bell
Steve Piner
Ted Johnson, West Coast Office
Ken Larsen, West Coast Office
Ron Coleman, West Coast Office
Dave MacAvin, Foxboro Co.

FROM Dit Morse

Work on Fortran began in earnest during the first week of February. At the present time Steve Piner and myself are working essentially three-quarters time on it.

The work on Fortran can be divided into three portions:

1) The Fortran compiler which accepts a Fortran program as input and produces a symbolic assembly language as output.
2) The routines and subroutines which form the operating system.
3) Modifications to the assembler to permit relocation and linking.

The parts of the program which we now have written are as follows: The floating point arithmetic routines have been written and debugged along with the floating point input and output routines. Steve Piner has written the routines which handle the compiler's symbol tables and punch out the constant and variable data storage and array storage at the termination of compilation.

In the process of being coded are the following routines: Examine the input string and separate pseudo instructions and operators. Symbols and floating point constants are distinguished from fixed point constants and stored in a table for punching out at the end of compilation. Also in process are the routines which move pointers up and down the stack. The algorithm for processing algebraic statements and most of the other statements in Fortran has been flow charted but not coded.

A very rough schedule for the generation of the PDP-4 Fortran is:

The next two weeks will be used to get the basic input and output portions of the compiler and a simple form of the algorithm working. At the end of this stage we will have a program which will accept as input algebraic statements and produce assembly language output. Barring unforeseen disasters, a version should be ready for the March IRE show.

The month following this will be spent incorporating the other features of Fortran into the compiler and in writing the operating system (which includes the floating point subroutines, the floating point interpreter, and routines to permit the calling of Fortran subroutines and the use of subscript variables). At the end of this period we should have a complete Fortran compiler and operating system.

Not included in this particular operating system are facilities to permit assembly of subroutines separately from main programs. This feature requires rather extensive additions to the PDP-4 assembler which will not be undertaken until late in the Spring.

The other area which will be considered later in the Spring is the Fortran in-out facility. We cannot possibly hope to reproduce the system used in 7090 Fortran, but may possibly use a subset of that system. Otherwise we will have to define an independent in-out system for use on the PDP-4.

dec INTEROFFICE MEMORANDUM

DATE February 19, 1963

SUBJECT

TO K. Olsen
H. Anderson

FROM J. Smith

It is my suggestion that the (2) 50 Tape Units and (1) Tape Control 51 for MIT contain (2) blue Potter units. This will enable us to keep (2) gray Potter units on hand in the event a customer order has to be filled on short notice. If I do not receive a negative reply, I will continue along this line.

INTEROFFICE MEMORANDUM

DATE February 18, 1963

SUBJECT Munich Office - Next Steps

TO Ken Olsen
Harlan Anderson ✓

FROM George O'Dea

cc: Stan Olsen
Win Hindle
Dick Mills

To bring the problems of opening the Munich office more sharply into focus it might be desirable to spell out the way we'd like to see things going after they have been in operation for a while in order to point out the gaps in reaching these goals.

For purposes of this memo let's assume Stan and Harlan have worked out all of the marketing matters (foreign list price, GmbH discount structure, Duty, Sales Policies, objectives, etc.) We will only concern ourselves here with fiscal matters.

To begin with let's agree to treat Digital Equipment GmbH as a separate entity on our General Ledger. Their operations can be consolidated into our own on a work-sheet basis after the fact. If we attempt to consolidate in our regular closing it will lead to pointless delays.

Consistent with this policy the DEC General Ledger need only be expanded to include an Investment Account (subject to Valuation reserve) and an Inter-Company account for current transactions.

As regards the latter it would at least include:

Debits for: Billings to GmbH for direct shipments to customers (list less 20%)
Billings to GmbH for direct shipments to them (list less 20% if consignment treat)
Billings to GmbH for services rendered (at cost.)

Credits for: Money received from GmbH
Commissions earned on Billings direct to end user.

Shipments to the GmbH would net out at list price less 20%, minus job cost to leave a residual gross profit on the DEC statements.

So much for the Books at Maynard.

We would then look to the GmbH for monthly reports in much the same detail as the present DEC reports. (Balance Sheet, P&L and Statistical Info.)

As a first requirement the Capital and Inter Company Accounts on the GmbH Statements would have to carry reciprocal balances with the same items on the DEC books. This assures that they have picked up all transactions originating in Maynard.

The GmbH could have an inventory balance if Maynard ships to them directly. This they would price from our billing to them. Cost of Sales on their billings to customers would either come out of their inventory or come directly from our billing to them (if the shipment to the end customer went directly from Maynard.)

Gross Income for the GmbH would, of course, arise from their billings to customers plus commission credits from Maynard for shipments directly to customers by Maynard. Independent Income would probably be generated by Service billings (as long as the staff is only two people it probably would not be worth trying to strike an individual cost of Sales on such service billings).

The G.m.b.H. would have to effect their own collections so we would expect them to carry a Receivables Balance.

While the operation is small, expenses could pretty much be on a cash basis. Payroll would have to be modified to comply with West German regulations as would the calculation of turnover tax and all of the other Foreign Taxes. Presumably the Secretary can be coached to comply with local requirements but the Books of the G.m.b.H. must be set up to tell us what's happening in the American concept of Profit and Loss.

Obvious expenses such as travel, rent, supplies, etc. should be fit into our chart of accounts on their books. No doubt the chart of accounts will have to be expanded to include transactions peculiar to the West German Economy.

To accommodate the setting up of the Books of the GmbH we will work with Coopers and Lybrand to guarantee compliance with German regulations.

As to cash - we will make the original capital investment out of funds in the DEC Bank Accounts in Munich. (These will no doubt have to be replenished for money spent in the interim. This replenishment may be taken up on the DEC books).

From that day on, the GmbH is expected to live on its 20% (or such other rate schedule as may be evolved) commission. As the GmbH collects from customers it will remit the 80% portion to Maynard. (sole exception - billings for services rendered out of Munich; here they keep it all)

If the GmbH cannot live on its commissions additional capitalization may be pumped in by DEC. There will be no loans made, either in Munich or out of Maynard.

As to the supporting detail we might ask of the GmbH, I would think we'd at least want the following:

1. Copy of all billings - to tie in with net sales per P&L
2. Receivables detail at close of each month - to tie in with Balance Sheet
3. Inventory detail at close of each month - to tie in with Balance Sheet
4. Short term cash forecast at close of each month.

The last thing any of us want to see is Guenter burdened down by a bunch of accounting. On the other hand, he will be commiting the Company on a daily basis and there are minimum requirements from our point of view.

Now for a timetable to achieve these goals:

1. Obtain charter as G.m.b.H.

   We're all pretty much agreed that Dr. Strobl should represent us here. The Board of Directors has approved a capitalization of 160 shares, DM500 = DM80,000 (initial paid in of 25%) and a charter calling for Marketing, Servicing, and Manufacturing Capabilities. As soon as we have Fadiman's opinion on the man, and the estimate of his fees I'll write and authorize him to proceed with the incorporation. No doubt this will involve some exchange of correspondence so the sooner we get this going the quicker we will be done.

2. Establish set of Books consistent with German Legal Requirements and DEC minimum requirements. Mr. Herbert Schueller of the International Division of Lybrands has given us the names of two of his colleagues in Frankfurt with the recommendation that we work through them. I'll write them and explain what we have in mind and get this going (once the company is set up the Munich office of Lybrands can take over – but Schueller specifically recommended that we do the setting up through Frankfurt). The hope here would be that they can devise a system which can be run by the Secretary. The question of whether or not we wish a year end audit can be left open for now.

3. Learn about German Taxation - particularly turnover tax. The same gentlemen referred to us for setting up the Books of Digital Equipment G.m.b.H. are reportedly keen in this area. Will explore the subject in letter regarding Books.

Any suggestions as to other matters to be scheduled at this time will be appreciated.

George T. O'Dea

GTO'D:ncs

INTEROFFICE MEMORANDUM

DATE February 18, 1963

SUBJECT

TO Gordon Bell
Arthur Hall
Harlan Anderson ✓
Stan Olsen
Nick Mazzarese

FROM Kenneth H. Olsen

I had a call from Dick Sonnenfeldt at Foxboro on Friday, February 15. He called mainly to continue to show interest in us and to be friendly. He said that U. S. Steel is very enthusiastic about our computer and that there is a big future here. He also said that things look good in one of the bids but he mentioned that we did lose out on Boston Edison because Westinghouse took part in severe price cutting.

I told him about our new 10 bit computer which Gordon is suggesting we consider building.

They have need for a small low prowess computer. They are now talking with four people who need this and I think they are seriously thinking of using the Monroe Drum Computer for this. Gardner Hendrie and Sol Dinman are the two people who are deeply involved in this. They need 10 bit accuracy but because of round-off errors they need a 12 bit computer. They need 16K words of storage. I told them that we would informally talk with Gardner Hendrie this week and let him know what our plans are.

Kenneth H. Olsen

INTEROFFICE MEMORANDUM

DATE February 18, 1963

SUBJECT Job Allocation, Mechanical Design

TO All Engineers
Ken Olsen
Stan Olsen
Harlan Anderson
N. Mazzarese
M. Sandler
J. Smith
R. Maxcy
B. Maroni
K. Peirce
H. Crouse
W. Brackett
W. Hindle

FROM Loren Prentice

To better acquaint all Engineers and Management with Job Responsibility within the Mechanical Design Department, a memo will be issued periodically as required.

Engineer	Job Number or EN Number	Description		% Complete
Scott Miller	1062	PDP-4	New Operator Control End	75%
	1020	PDP-1	Operator Control End	25-35%
			New Table Configuration	25%
	2477	M.B.2010 Trailer	Modify Top, 50 pin Panel	95%
	1136	Mag Tape 555	Over All	95%
			Rack Mtg. (1 & 2 Bat)	95%
			Hub Label (New)	25%
			Reel Package	25%
	1026	Mag Tape (New)	Controls	0-5%
	1064	Display 31	Shroud	100%
	-	Remote Typewriter	Table	15%
	1027	Display 30	Shroud, Casting	98%
	1036	Light Pen	Holder	25%

Scott Miller	1058	H. S. Printer	Cabinets - etc.	100%
	1095	PDP-4 Sales	Colors, Paint JPL Foxboro	75% 95%
Ron Cajolet	2320	31 Display	Finish DEC Display (some rework)	99%
	1064	31 Display	Casting adj. mechanism Better shock mounts	10%
	1157	Automatic Module Tester	Layout front end	60%
	1097	Dynasent board aligner	Finish sketches - design control switches	60% (hold)
	1136	Tape unit 555	Small cabinet - spare reel holder	95%
	1025	PDP-1 Punch	Retrofit kit & instructions for installation	75%
	2432	Honeywell System	Front end layout	60%
	1026	Burroughs tape	Cabinet layout & indicator panel	20% (hold)
	1156	Incremental Platter	Ind. Panel - attach cabinet and table	80%
	2454	Remote typewriter table	Fit equipment into table. Bring remote table up to date.	90%

Loren Prentice	1136	555 Tape Unit	50%
	1097	Mod. development	75%
	1065	Large display	10%

Jobs Pending Unassigned	Assigned Electronic Eng.
1. Memory mounting redesign	A. Blumenthal
2. Continuous recording tape unit	T. Stockebrand
3. Large storage tape unit	T. Stockebrand
4. Necessary redesign production model 555 tape unit	J. Hamilton
5. L & M cabinet modification	G. Rice
6. F. A. A. Memory Buffer	F. Gould
7. Model 555 stepper and keyboard unit	T. Stockebrand
8. Paper tape authentication catchers	A. Blumenthal
9. Light Pen	B. Savell
10. Camera mount for 30A Drafting	B. Savell

Ken FitzGerald — 1023 — Assembly procedures for Standard 1901 Type Mounting Panels. — 50%

a. A jig for assembling mounting panels has been devised which will hold the amphenol plugs in correct alignment as well as spacing the side plates during the assembly operation.

b. This jig is also designed to incorporate either stick screws for assembly, or nut feeders and drivers to be used on the studs of the new plug.

c. When this jig is completed, it will be used for experiments to try to determine the best possible methods for assembly of mounting panels, (nut driven on a stud or a screw driven into a threaded hole).

Ken FitzGerald

d. I have a stick screw gun and sample screws on hand now and have made arrangements with Bebo Assoc. to bring in and demonstrate a screw feeder and driver; and Battles and Joy Company to come in and demonstrate an Automatic Screw Driver.

e. This jig is about 80% complete and will be finished as soon as spare time in the Machine Shop can be found; probably within the next two week period.

1000 Paint adhesion on our steel components 30%

a. The paint adhesion on end panels, doors, and cabinets leaves something to be desired. Zinc phosphate is one possibility of increasing adhesion. Different types from different companies should be tried to find which is the best and easiest to apply.

b. Preliminary samples of zinc phosphated steel have been made in the Sheet Metal Shop using American Chemical Corp. products. Samples from other companies have been requested but not received as yet.

c. A dimple test machine has been built and is ready for use.

d. A mandrael bend machine is still to be constructed.

e. This project will be continued as soon as the mandrael bend machine is completed and time is found in the chromacote area to run more samples.

1053 Cabinet Welding Jig 90%

a. A welding fixture for assembling and welding standard DEC computer cabinets has been made. A trial run of five cabinets has been made and they have all passed inspection. It looks as if this jig can be used for our next order on cabinets.

b. Drill jigs for putting in all holes in a completed cabinet are being designed and built to go with the welding fixture.

Ken FitzGerald	1000	Shipping and Crating	?

a. I feel a better method of packing our equipment for shipping should be devised. Crates designed and built by specialists in the field are a possibility. One quotation is available. However, we can not do much more until clearance is received from Sales.

1051	Drill Jig for Classroom Modules	5%

a. A jig for drilling classroom modules was designed and built but proved to be unsatisfactory as the overall tolerance of the board itself caused the hole locations to vary.

b. A new jig will have to be designed but will locate from one end and one adjacent edge.

c. Type of jig has been decided, all that remains is drawing it up and initiating work order to the shop for construction.

1000	False floor for PDP-4 System, 1st flr. Bldg. 12	95%

a. I have been requested to give cost estimates for constructing a sectional false floor, 1st flr. Bldg. 12.

b. Before estimating cost, a design had to be decided upon which has been done.

c. All that remains is to add up the total number of board feet and price it out.

d. Cost seems to be approximately $2.00/sq. ft.

100-00	Stroke Sander	10%

a. It is desirous and necessary to have a stroke sander in the Sheet Metal Shop for brush finishing large aluminum trims and extrusions, end panels, blank plenum door panels, blank front panels, and plenum door power supplies, etc.

Ken FitzGerald

b. Catalog information for drive and idler end is available. Design of the machine itself is in sketch stage. Method of raising and lowering table is still not been decided upon. Waiting for catalog information from "Joyce Jacks" to see about possibility of incorporating their products in table.

1000 Personnel infinite

a. Personnel is one of my biggest problems at this time. I feel there is excessive amount of sickness in my group which I cannot control, plus personal matters and shortage of people in the Sheet Metal and Cabinet Assembly Shop.

b. I have outstanding requisitions for one sheet metal worker, to work as additional skilled help in the Sheet Metal Shop.

I feel that there are only two qualified sheet metal workers in the Sheet Metal Shop at this time. An additional sheet metal worker would be a valuable asset.

c. I have an outstanding requisition for a sheet metal worker "B" to replace John Armour and another sheet metal trainee to replace Barry Heinenon who was transferred to the paint booth when Robert Budden left. There is also an outstanding requisition for a machine operator in the Sheet Metal Shop. In the Cabinet Shop I have not permanently replaced John Mancini as yet, but we have temporarily used our machine operator Bob Corsman from the Sheet Metal Shop to fill this vacancy.

d. I also feel that there is a possibility we may have to add an additional machinist in the Machine Shop since the load in the Machine Shop for the past three months has been keeping the shop filled right up with no slack time. If things should pick up and more orders are received in that area an additional man will be needed.

Ken FitzGerald 1000 Shop Supervision

a. This includes shops layout for expansion, insuring work accepted is completed correctly and on time. Trying to keep abreast of the personnel problems and insuring foreman and all workers are performing their duties adequately.

# # # # #

bbn

dec INTEROFFICE MEMORANDUM

H.B.G.

DATE February 15, 1963

SUBJECT MAGNETIC TAPE PACKAGE

TO Ken Olsen
Harlan Anderson

FROM Jack Atwood

Scotty has made a good start on this particular package. His treatment is restrained, avoiding the common pitfall of overdesign. And his idea for the sliding tape mount is most ingenious.

There are a few practical design considerations which should be taken into account in the final version. There is also an opportunity to carry the mount concept a step or two nearer optimum utilization.

We suggest these alterations, some of which are covered in Ted's rough sketches:

1. The dominant package design element, relating the container and its contents to the equipment, should reflect a major physical design feature of the equipment not a minor element of panel graphics.

   In the LINC, the obvious design departure is the incorporation of two tape units side by side in a compact housing with the four tape reels showing through a window door.

   These four reels or circles are the key to product identification.

2. The other package graphics should bear some resemblance to the graphics of related items - unless there is a definite reason for a complete departure from established standards.

   The tape package is part of our family of PDP auxiliary materials - PDP programming manuals, PDP program binders, PDP program write-ups, MAINDEC manuals, and PDP log books.

   These have all been styled to provide a basic family resemblance. We have used a good blue and a good red, and our typography has a strong, masculine, mechanical flavor. You can tell at a glance that this material is all PDP-related.

I would not favor introducing two entirely new colors or a new styling concept into this family without due consideration.

3. The basic function of any package is to provide the maximum practical protection for the product during storage and shipment. Design for reuse has to be a secondary consideration.

   To satisfy this requirement, the outer portion of the tape package should completely enclose the inner portion, shutting out dust, dirt and other contaminants.

   A tuck-in end flap and two short side tabs would be enough to keep the contents clean and prevent the inner portion from sliding out accidentally during the many possible handlings which can occur between the original supplier and the ultimate user. The package could be adapted for reuse as a storage container by having the flap and tabs perforated for easy removal.

Expanding somewhat on Scotty's tape mount concept, it might be feasible to have the entire insert made of formed plastic. The inserts could then be used as vertical "file drawers" in an economical plastic cabinet.

The front and back panels of the insert would serve to center it between sets of low ridges running from front to back on the inside of the top and bottom panels of the cabinet.

This would permit magnetic tape users the same opportunity for organized storage and handy portability that our present fanfold tape storage trays provide for paper tape users.

The plastic for the insert could have a matte finish so that the user would be able to label his tapes with ball pen or pencil. Or we could supply pressure-sensitive labels for this purpose. Either method would make both original labeling and any necessary relabeling relatively simple.

INTEROFFICE MEMORANDUM

DATE February 14, 1963

SUBJECT Doing Business in Japan - First Impressions

TO Ken Olsen
Harlan Anderson

FROM George O'Dea

cc: Stan Olsen, Win Hindle
and Dick Mills

As a result of a meeting with Dr. James Abegglen of Arthur D. Little we have the following first impressions of where we would stand if we went into Japan and began doing business.

A. As a Branch of DEC - Without a Place of Business in Japan:

To us this may seem incongruous - doing business in Japan without an office in that country. To the Japanese Tax Authorities, not necessarily so. We were shown correspondence surrounding an ADL contract with a Japanese client whereby they first became aware of the Japanese Tax Authorities views on the matter when the Japanese client withheld 15% of the bill as payment of the Japanese income tax due! In this case, the Japanese position was predicated on the fact that the ADL consultant spent time with the client in Japan and therefore the income was earned in Japan and subject to withholding tax. (To make matters even worse, the ADL billing had been cost plus a fee- while the Tax was 15% of the total bill; and there was no guarantee that IRS would agree with the Japanese that indeed this was foreign income hence subject to special credit on the ADL domestic tax return.)

To prevent this revolting development we would have to make certain that any orders taken in Japan were accepted here - and probably backed up by letter of credit for the gross amount. This of course makes the selling job more difficult.

B. As a Branch of DEC with a Place of Business in Japan: We did not explore this avenue extensively as Dr. Abegglen felt our chances of staffing such a "temporary" entity with competent Japanese Nationals would be poor at best.

He felt strongly that, as a minimum, we would need a Japanese National as a number two man (preferably number one) and he suspected that as an American Branch in Japan we would run into discrimination particularly in the areas of Tax assessment and obtaining government approval of various actions. (He particularly mentioned the position of a Neisei in Japan. It would be more difficult than that of an American).

C. As a Japanese Corporation owned Wholly or Otherwise by DEC:

Virtually anyone can obtain a license to open a business venture as a Japanese Corporation. With the exception of a few industries there is no legal discrimination against foreigners.

The big problem arises when you try to get your money out of the country. If you wish to withdraw funds from Japan you petition the government (each time) and may or may not be granted the license to proceed depending on how they happen to feel about things at that particular moment.

If you are not willing to run for luck you can take certain steps in advance of your investing and be granted varying degrees of security depending largely on what you have to offer to the Japanese economy. These degrees of security are:

1. Validation: This is tantamount to an unconditional guarantee on the part of the Japanese Government that dividends earned on Japanese stocks purchased with American currency, will be payable in American currency whenever declared; and that the basic principal investment may be withdrawn in three equal yearly installments any time after the investment has become two years of age.

   Since the guarantee is "unconditional" the Japanese Government will only grant it if they need you badly.

2. Conditional Validation: Differs from full Validation only to the extent that one condition is not guaranteed - namely Japan's foreign exchange position. If in the Government's opinion they are in dire need of Yen, they may defer payments.

3. Recognition: Similar to Conditional Validation in that the guarantee is subject to the Japanese foreign exchange position at the time of petition for withdrawal. Differs from Validation in that Recognition is granted more from the point of view of its influence on the Japanese foreign exchange position than from the broader effect on economy position. (Granted under a different Law than Validation.)

There was no question as to Dr. Abegglen's recommendations. In our particular field there would only be a handful of potential customers. Make the first contact by an American to sample interest. Follow up with correspondence then a second call some four months later. At this point decide whether or not the Japanese market is worth pursuing. If the answer is yes, form a Japanese Corporation - preferably with a Japanese National as partner; even better, go into an existing Japanese Corporation as partner. If the DEC interest is in the area of 1/3rd, Validation is highly likely. As it approaches 1/2 the likelihood goes down.

As to Taxation, we have already seen that Americans doing business in Japan (in the opinion of the Japanese Tax Officials) are subject to a 15% withholding tax on all billings. This tax is final - there are no returns to be filed or expenses to be argued. The rate is simply 15% of gross. It is entitled to full special credit on a U.S. Tax return if the IRS agrees the income belonged in Japan (seems unlikely).

As a Japanese Corporation with place of business in Japan the basic Corporation would be subject to regular Japanese Tax provisions (basically same rate as here - no haven. Special credit applicable in U.S.) Monies taken out of the Corporation however are subject to some interesting differential treatments.

Dividends: carry a special 25% extra tax credit in U.S.

Interest on Loans: 15% Japanese Surtax - full special credit in U.S.

Royalties: same as interest.

In contrast to our conversations about a Munich Office one has the feeling that there are a great deal more imponderables surrounding the Japanese office.

Dr. Abegglen's suggestion makes good sense. Give it a try with a Travelling American. If the interest is there and its worth pursuing, Incorporate. If not, write the trip off with no obligation to the Japanese Government.

George T. O'Dea

GTO'D:ncs

1. What Taxes will we run into?

2. On What are they based?

3. What are their rates?

4. In what respect do they affect the DEC Corporate tax return (U.S.)?

5. Do they differ if we are a Branch vs. a GmbH?

6. What is the Turnover Tax - The equalization turnover tax - how does the doctrine of Organschaft effect these?

7. Could shipments from Maynard to Munich be subject to either turnover, or equalization turnover tax? Would Branch status vs. GmbH make a difference?

1. Import Duty — Arrange

2. Turnover Tax — Basic rate

Incentive for shipping thru certain ports.
Establish

need a customs broker —

Should we operate it as a commission or principal basis.

Charter changes are difficult

Accountant + Lawyers raise their prices for Americans

Do not rely on accountants or lawyers for business decisions.
They ~~are~~ regard themselves as professionals.

$250 — fee for incorporating as a GMBH
2½ % tax on issued capital.

Debt financing is repaid with after tax profit.

Pay in minimum capitalization

---

use a part time accountant —

Equalization tax

Box privilege — Companies are treated as all being in the same box.

Refund of turnover tax for export

Common Market has recommended

8. How are Tariff's negotiated?

As to Commodity Class?

As to Rate?

As to Bases of Value?

9. Is there a "Freeport" on "Bonded Warehouse" type of tariff deferral available in Germany?

10. Is it feasible to bill in Germany for payment in U.S.?

B09-3700

Split

Distributed

No income statement in Germany.

net worth & change is what is taxed.

* Revaluation of assets is common in Germany
Profit carry over is on the balance sheet. Fund for new equip. shows on the balance sheet.
Profit is determined by stockholders

①②③ are state taxes.

Profit & income are not necessarily the same.
Reserve for inventory of 10% is allowed

All taxes are centralized in Germany.

① Trade income tax — Community levelled
12½% to 16% of income.

The name for this is the Hebungsfactor

Community Tax = (5%)(Hebungsfactor)
↑ Federal
↑ Typically 300%

② Trade property tax — non deductible
= (0.2%)(Hebungsfactor)
~~Federal property tax~~
Can be as high as 1% of essentially net worth
inventory is included. ~~Trade~~ non-deductible

③ Trade Payroll tax - Levelled on total gross payroll
This is frequently waived by the community.

Profit is divided for:
a.) tax
b.) dividend
c.) ~~xxx~~ fund for new equipment

Sub part F income.

Germany is tough on branches. Cannot convert a branch to a GMBH tax free.
GMBH cannot issue public

INTEROFFICE MEMORANDUM

COMPANY CONFIDENTIAL

DATE 2/14/63

SUBJECT Computer Sales Forecast

TO K. Olsen
H. Anderson
S. Olsen
G. O'Dea
W. Hindle
D. Mills
D. Best
M. Sandler
G. Bell

FROM N. Mazzarese

PDP-1	Quantity	Value	Probability	When
CRC	1	97K	100%	0-3
Raytheon	1	200K	100%	0-3
BBN	1	600,000	85%	0-3
Lincoln Labs.	1	200K	50%	0-3
Princeton	1	250K	100%	0-3
LRL	1	350K	50%	0-3
Stanford	1	280K	75%	0-3
ADX				
S.T.C.	1	300K	50%	0-3
PDP-4				
Foxboro (Fitchburg)	1	160K	85%	0-3
Foxboro (Westinghouse)	1	120K	50%	0-3
Foxboro	2	120K	50%	3-6
JPL	3	250K	90%	0-3

PDP-4	Quantity	Value	Probability	When
AECL	1	200K	75%	0-3
Worcester Foundation	1	80K	50%	3-6
Bell Labs.	1	80K	50%	3-6
Leeds & Northrup	1	80K	50%	0-3

Less than 50% 0-6 Months

		Type of Machine
Univ. of Rochester	200K	PDP-1
Systems Development Corp. (Info. International)	300K	ADX
Sylvania	Rental	PDP-1
JPL	120K	PDP-1
Beckman Instruments	120K	PDP-1
Litton Systems	80K	PDP-4
Michigan Univ.	120K	PDP-1
Maryland Univ.	120K	PDP-1
Raytheon Co.	120K	PDP-1

NM/jr

February 13, 1963

Determining Current and Future Manpower Requirements

K. Olsen
H. Anderson
S. Olsen
R. Best
M. Sandler
R. Mills
E. Harwood
W. Hindle

Bob Lassen

I am quite concerned over the increasing number of open personnel requisitions. Most of these requisitions have been submitted to me on an "apparent urgency" basis. I feel we should review not only our current open requisitions but also future manpower requirements. This meeting will be held in Ken Olsen's office on Friday, February 15, 1963, at 1 P.M.

*OPEN PERSONNEL REQUISITIONS - 2/14/63

Signed Requisitions

1	Secretary	- R. Best
1	Clerk-typist	- N. Mazzarese
1	Secretary	- Programming
1	Clerk-typist	- R. Beckman
3	Technicians	- R. Savell
5-10	Field Technicians	- R. Beckman
1	Sheet Metal Mechanic	- L. Prentice
1	Sheet Metal Mechanic (A)	- L. Prentice
1	Wireman	- R. Boisvert
1	Expeditor (repl.)	- H. Crouse
1	Electro-Mech. Draftsman	- R. Melanson
3	Electrical Draftsmen (repl. 2 job shoppers)	- R. Melanson
1	Printed Circuit Layout Man	- R. Melanson
1	Clerk-typist	- R. Melanson

Unsigned Requisitions

1	Sheet Metal-Machinist (repl.)	- L. Prentice (OK - KHO)
1	Clerk-typist	- R. Mills
1	Secretary (repl.)	- E. Harwood
1	Secretary (repl.)	- J. Koudela
1	Secretary (repl.)	- S. Olsen
1	File Clerk	- J. Myers
1	Switchboard-Clerk (repl.)	- B. Towle
2	Silk Screen (1 repl.)	- M. Sandler
1	Spray Painter (repl.)	- L. Prentice
1	Sheet Metal Operator (repl.)	- L. Prentice
1	Wireman	- E. Harwood/N. Mazzarese
2	Technicians	- E. Harwood/N. Mazzarese
2	Wiring Inspectors	- R. Hughes
1	Drafting Illustrator	- R. Melanson
1	Mechanical Draftsman	- R. Melanson

* Total addition to payroll would be $4000 per week.

dec INTEROFFICE MEMORANDUM

COMPANY CONFIDENTIAL

#36

DATE February 12,1963

SUBJECT Display 30A

TO Harlan Anderson ✓
Dick Mills
Bob Savell

FROM Ed Simeone

An analysis of the actual cost of the Type 30A Display is as follows:

Labor			$282.00
Overhead			689.00
Materials:			
	N.J.E. Power Supply	$555.00	
	Focus Coil	150.00	
	Display Tube	95.00	
	Deflection Yoke	175.00	
	Miscellaneous Purchased Materials	38.00	
	Shroud Assembly	600.00	
	Comp. Plate & Container	209.00	
	Heat Sink & Resistor Stack	849.00	
	30A Logic	452.00	
	Display Table Assembly	495.00	(includes Tilt Turn Housing)
	Miscellaneous Mfd. Parts	297.00	
	Modules	982.00	
	Power Supplies	320.00	
	Power Control	98.00	
	Light Pen	87.00	
	Light Pen Amp	34.00	
	Miscellaneous Finished Goods	22.00	5458.
			$6429.00

COMPANY CONFIDENTIAL

dec INTEROFFICE MEMORANDUM

H.F.Q.

DATE February 7, 1963

SUBJECT Princeton University Computer

TO Harlan Anderson
Stan Olsen
George Rice

FROM R. Mills

I had a call this afternoon from a Mr. Caruso who works for the buyer at Princeton, a Mr. Shultz, to inquire as to the paragraph on patent infringement, which we had expanded somewhat. He has agreed to send us a letter agreeing to the patent infringement items #1, 2 and 3 contained on page two of George Rice's letter.

He stated that there was a considerable push to get the purchase order out and that the agreement by us as to the above mentioned items, clears the way for the purchase order to get started thru their processing.

# # #

dec INTEROFFICE MEMORANDUM

DATE February 7, 1963

SUBJECT Propaganda for IRE Show

TO Jack Atwood
Stu Grover
Harlan Anderson
Stan Olsen
Gordon Bell
Dick Best
Bob Savell

FROM Kenneth H. Olsen

We have a large number of new products, or products which have not been pushed before, which we should use to make a real dent at the IRE Show.

The Drum Systems which we have are a large advantage over our competition and we have to have literature which shows their usefulness and the fact that we actually have them. This might be included with the literature which shows that we make a complete line of peripheral equipment. The line units are very dramatic and very exciting. We should package them so that they are neat things that we would like to show off and then we ought to push them hard at the show.

The other item is a Type 31 Scope. We can immediately outline a magazine article on this because the mathematics of the correction is rather fascinating and this is a unit for which there is apparently a significant market. We can get most of the magazine article into a brochure to hand out at the IRE Show.

Kenneth H. Olsen

dec INTEROFFICE MEMORANDUM

DATE February 7, 1963

SUBJECT Bus/Pac - Programming for DEC

TO K. Olsen
H. Anderson
G. Bell
H. Morse
M. Graetz

FROM R. Mills

As a result of our meeting on February 4, 1963, the following items were proposed as a way to implement the phase-over of all of our DEC business applications from IBM machines to the PDP-4 installation:

1. That Martin Graetz from the programming group, will start on the Bus/Pac February 5, 1963 to work two weeks learning the operation of the package with Dit Morse and Fred Mac Lean.

2. That a requisition be entered for (1) interpreter, which appears to be an absolute must, if we cancel out our other IBM equipment.

3. Request an order for (1) - IBM - 1440 Power Head and (1) - 1440 Disc Pac. This was to be ordered for Gordon Bell on an experimentation basis, for evaluation, etc., at a total cost of $1,140.00.

4. Enter a requisition for business programmer at once. The basis here is a well known one, being that once a company is committed to computerize its accounting operations, this becomes a continuing refining evaluation process.

# # #

dec INTEROFFICE MEMORANDUM

DATE February 7, 1963

SUBJECT Sales Call to Princeton-Pennsylvania Accelerator Concerning Display 31 & PDP-1

TO Harlan Anderson

Nick Mazzarese
George Rice

FROM Bob Savell

Personnel People That I Talked To:

Dr. Gerard O'Neil is the top physicist and actually the man who runs things technically at the Accelerator. Dr. White is the administrative head of the lab. Dr. Schumaker and Dr. Lemonick are assistant directors of the laboratory. Dr. Benoit is the computer specialist. Dr. Blumenfeld is the bubble chamber specialist. Mr. Schultz is the second in command of the two business types who run the Accelerator.

All their questions were answered satisfactorily to the best of my knowledge. The whole atmosphere was very favorable to DEC with much interest expressed in the 31 and 30 Displays and the distinct impression that they were forging full speed ahead with a PDP-1 system order which George Rice had made quotations to them for.

They would like information on the following items;

1. Price and delivery on Type 30 and Type 31 for the 7090.

2. Extra IOT's for closely spaced points on the Type 30 and 31.

3. The 30C - price and delivery.

4. Price and delivery on the standard Type 31. Also a price for grid lines and short deflection set-up time instruction.

5. Price and delivery on high density IBM compatable tape transports and controls.

6. Some general interest at the present in connection through a 1414 IO synchronizer and a 1410 to the 7090 from the PDP-1.

7. Class schedules either here or there for both programming and maintenance.

8. Information on maintenance contract and on lease versus purchase arrangements over the life of the machine.

Programming Assistance:

They would estimate that they might need programming assistance on a Deutsch like application of one experienced programmer for 3 or 4 months. They are very much interested

in buying a PEPR sometime in the future and would require programming assistance on this as well.

INTEROFFICE MEMORANDUM

DATE February 7, 1963

SUBJECT Option Status

TO H. Anderson

FROM J. Smith

Displays

Number	Status
30A-6000-7899	CRC
30A-6000-7900	in stock
30A-6000-8130	in Checkout (80% complete)
30D-5000-8128	Returned from show damaged, being reworked
30D-5000-8129	in Process (50% complete)

Mag. Tape

EN 2399	3 Tape Units Type 50 (ITT Duplex)	in Checkout (complete)
EN 2398	1 Type 52 Control (ITT Duplex)	in Checkout (complete)
7000-8803	Tape Unit Type 50 (Standard)	in Checkout (90% Complete)
7000-8804	Tape Unit Type 50 (Standard)	in Process (80% complete)
2000-8995	Tape Unit Type 51 (Standard)	in Process (80% complete)
4000-8792	1 Type 52 Control (Standard)	in Process (90% complete)

dec INTEROFFICE MEMORANDUM

H.G.

DATE 2/5/63

SUBJECT

TO K. Olsen
H. Anderson
W. Hindle
S. Olsen
N. Mazzarese
G. Bell
G. Moore
D. Morse

FROM B. Maxcy

Report on the Bio-Medical Market

Robert F. Maxcy

February 5, 1963

Outline

Report on the Bio-Medical Market and its use of EDP Equipment

I Introduction

II Divisions

A. Hospital Use

1. Statistics
2. Research by AHA
3. Funds
4. Problems

B. Biological

1. Statistics
2. Research Use
3. Funds
4. Problems

III Role of Government

IV Role of Private Industry

V Common Problems of EDP User's in Bio-Medical Field and Communication Problem of Science and Industry

VI Evaluation of the Market Re: DEC

Report on the Bio-Medical Market

The information pertaining to the use of Electronic Data Processing Equipment in the Bio-Medical Field is not well documented. The following information was gathered largely as a result of telephone and mail contact with persons actively engaged in Biological and Medical Research. A small amount of information was gathered from government statistics.

The users of EDP Equipment in the Bio-Medical Field are divided into two broad groups: (1) Hospital Use and (2) Use by Research Organizations.

Hospitals

There are 6,923 hospitals in the U. S. Of these, 6.3% (437) are Federal, 3.2% (222) are Tuberculosis, and 7% (483) are psychiatric. The remainder fall under the heading of "general short and long term".

Excluding Federal, in 1956 these hospitals had total assets of $8,300,000,000. In 1961 the figure was $12,775,000,000 or an increase of 1.3 times. Expenses for the same period were up 1.7 times.

According to the American Hospital Association, only twelve (12) of these hospitals are known to be using EDP Equipment. This equipment is being used for the following purposes:

A. Prescription Monitoring
B. Patient Monitoring
C. Records Keeping
D. Pure Research
E. Combinations of the Above

Because of the lack of information on this subject, the AHA formed a special group and has undertaken a study on EDP use in hospitals. This study has been going on for several months and should be completed in March.

Their primary goal is to provide their member hospitals with up-to-date information regarding EDP use. The data collected in this study will be tabulated by type, brand, and model of EDP equipment used in hospitals. This will be further analyzed by geographic area and characteristics of hospitals using this equipment.

They have not decided if and how they will offer this information to EDP manufacturer's. They have had offers to buy this information on an exclusive basis, but they are hesitant to do this as they do not want any one manufacturer to gain a large advantage in the market.

The financial ability of hospitals to purchase EDP equipment is low.

The National Institute of Health is unwilling to grant hospitals funds to purchase equipment for accounting and record's keeping purposes. They will, however, grant funds for Medical Research by hospitals. Only a few of the large hospitals have the facilities and personnel for research on any appreciable scale, so the basic problem of funds remains.

Bio-Medical Research Organizations

The information regarding this class of EDP user's comes mainly from the Federation of American Societies for Experimental Biology. These societies are generally a part of some large university, some are private, and some are associated with the Department of Health on state or federal levels.

Information regarding Bio-Medical studies being done by industry is not available as companies generally try to keep their research efforts confidential.

At the present time, 416 research organizations are under grants from the National Institute of Health for the use of EDP equipment in Bio-Medical studies.

In awarding these grants, the NIH must be convinced of the following facts:

1. That the research team is highly competent and that they are aware of present medical breakthroughs.

2. That the research will produce results beneficial to the national health.

Before any organization can receive a grant, it must describe to the NIH the type and cost of the EDP equipment that is needed. This means that at least 416 research organizations have, or are presently buying, EDP equipment.

The Federation of American Societies for Experimental Biology is now undertaking a study to determine the feasibility of setting up a computing center for use by their members. Such centers are already in existence. Dr. Walter Rosenblith from MIT has been responsible for establishing two or three centers and is now working confidentially on a new center.

Role of Government

At the present time, the government, or specifically, NIH is financing an estimated 80% of all Bio-Medical Research. Their grants are for pure research applications only. Requirements for grants are tough, and hundreds of organizations are turned down each year because of lack of government funds or because the organizations do not meet NIH standards.

The government has made a half-hearted attempt to document some of the information regarding EDP use in the Bio-Medical Field. There are various fact-finding organizations that are part of NIH. The information gathered by them is offered in its pure form to the scientifically-interested, non-profit organization only. This same information is turned over to the Department of Commerce and consolidated into general statistics which prove of little value to DEC.

Role of Primate Industry

Primate industry plays its biggest role by performing its own research. Large drug and chemical houses are actively engaged in Bio-Medical Research. There is a strong probability that a considerable amount of EDP equipment is used. Much of this may be called "process control equipment". The research and development activities of primate industry are generally very confidential, and information is difficult to obtain.

General Problems

There are some general problems which affect both hospitals and research organizations. One of the major problems is ignorance of the proper use of EDP equipment. Too many organizations obtain a computer with three or four programs and then make no effort to extend the use of their equipment through additional programming. One reason for this, which was used many times, was the expense of programming. The result is that researchers teach themselves to program, but it is a long process, and in the meantime the computer is being used unsatisfactorily.

Another major problem is equipment and prices. In general, manufacturers are not willing to design new EDP research equipment for a single user if future sales are uncertain. The cost of such one-customer designs puts them out of the range of most research organizations and of almost all hospitals.

EDP equipment, in general, is priced beyond the reach of the research team unless the government is enlisted for financial support.

Communication between various Bio-Medical groups is poor. Much of this is due to poor documentation of existing practices, and some is due to secrecy of the research team. For about the same reasons, the communication between science and industry is poor.

Many researchers regard industry as an outsider whose interests are mainly profit making rather than scientific.

Evaluation of the Market and DEC's Position

The Bio-Medical market appears to be still in its infant stages. Leaders of Research Organizations, The American Medical Association, and the American Hospital Association have become aware of the great future in EDP use and are conducting studies to gather data and explore future possibilities.

It appears that the companies that will offer some flexibility of design, a wide variety of software packages, reasonable prices, and a close awareness of customer needs will be the future suppliers of EDP equipment to the Bio-Medical Field.

The leaders in the Bio-Medical Field are well aware of DEC's contribution to Massachusetts General and we should make the best use possible of this installation.

If we wish to continue in this field, we must become aware of not only Massachusetts General's needs, but of the general needs of all research and hospital groups. More software and customer education regarding machine use is needed. The market is there, but we will have to concentrate our efforts in order to enter it on any appreciable scale.

Harlan Anderson

INTEROFFICE MEMORANDUM

DATE February 5, 1963

SUBJECT Type 24 drum (Pomboro) Schedule

TO Computer Guidance Committee

FROM E. T. Johnson

R. Best
G. Bell
A. Blumenthal
L. Conley
A. Hall

FINISH LOGIC

TEST MODULES

ORDER MODULE
& Pc. PARTS

PRODUCE MODULES

ASSEMBLY

CHASSIS LAYOUT
WIRING SCHEM.

RECORD
CLOCK

OFF LINE TESTING

ON LINE TESTING

WIRE PDP 4
INTERFACE

DELIVERY

dec INTEROFFICE MEMORANDUM

DATE February 5, 1963

SUBJECT Present & Future Plans & Requirements of the Peripheral Equipment Department

TO Ken Olsen

FROM Robert Savell

Harlan Anderson
Dick Best
Gordon Bell
Nick Mazzarese

Personnel Needs:

Our needs for the immediate and forseeable future, which I consider to be the next six months are listed below.

1. Sales engineer in the Sales Department

This man should have a good engineering background with preferably some CRT work so that he can handle 90% of the work connected with customer's display inquiries of which a considerable portion at present are referred to the Peripheral Equipment Department. I believe that locating this man in the Sales Department will tend to keep him doing selling whereas if he were located in the Peripheral Equipment Department the temptation would be very great to steal some of his time for engineering projects. I believe that the cathode ray tube display field is just beginning to get off the ground and that so far we have a good position in that field which we should strive to keep and improve by selling enough displays so that when people think of displays they think of Digital Equipment Corporation. I further believe that the majority of displays which we sell will differ from one another in various ways so that in many cases individual price quotations and special engineering will be required.

2. Field service personnel

The field service personnel must be better educated about displays in particular and also other peripheral equipment. I have suggested to Bob Beckman that his field service people be scheduled through display checkout one at a time as part of this education process.

3. One circuit engineer

This engineer should, I believe, preferably be located in the Circuit Group under Don White and Dick Best as I believe that most module circuit work can best be done by circuit specialists who are designing circuits day in and day out and designing testers and test procedures for modules day in and day out. I plan to have almost all my module

circuit work done by the circuits department from now on. We must by all means keep our hands in the circuits business, and as long as we design displays especially we most certainly will be doing so.

I have immediate needs for a faster intensification amplifier 4688, a faster light pen amplifier, a light pen amplifier tester and test specifications, a light pen circuit tester, a feed forward circuit for the Incremental Display, testers and test specifications for the sample and hold module 1575, testers and test specifications for the cathode ray tube protection module 1708 and power control 826.

Note:

Bill Long, who is presently an engineer with Contronics and has some cathode ray tube experience, will be out on February 4th for an interview and might possibly fill number one or number three but if number three in my department. He has had character generating experience so would be an asset in that end of our activity.

4. Engineering assistant or junior engineer

If the line and curve generator is to be done anywhere near IRE show time, work must be immediately started but in parallel with the work Jim Sullivan is doing on the Incremental Display.

5. Technician Personnel

Three are required as soon as possible for work on displays, paper tape readers and punches, medium speed printers, line and curve generators and further work to be described later on in this memo.

6. Future technical personnel

I believe that within six months to a year the display business in particular, and to some extend the special input-output equipment activity, may increase to the point where we would require two to four more technicians. I will discuss possibilities for such people with Bob Lassen and stake an early claim to those who look promising.

7. Future engineering personnel

I believe we have suffered somewhat by not having a better engineer to technician ratio in the past. The present complement including myself is five engineers and engineering assistants and only three technicians. This ratio will be remedied by the addition of the three technician personnel requested above.

The addition of a sales engineer as requested in number one and of a circuit engineer requested in number three will relieve some of the load now carried by members of the Peripheral Equipment Department. There are, however, a number of projects that have been discussed recently on which a decision to proceed as fast as possible shoud be made as soon as possible. These projects are:

1. Eyeball Design, both Digital and Analog, including selection of both 16 and 35 mm film transport mechanisms. Estimate 2 to 5 man weeks engineering.

2. A fast character generators - estimated 6 to 10 weeks engineering.

3. Fast Display probably electrostatic deflection - I estimate 6 to 10 weeks engineering.

4. Cheap monitor display - I estimate 2 to 3 weeks engineering.

5. Projection TV - I estimate an initial one week engineering for tests to prove feasibility for continuing further with the project. An uneducated guess for projection TV system might be 3 to 7 weeks engineering time.

If it is desired that these projects proceed as fast as possible, ie, have work begin on all of them before the middle of February without setting back other projects already scheduled, I would assume the addition of between one and three additional engineers.

Status of Peripheral Equipment Projects as of January 1, 1963

In general, with the exception of Jim Sullivan, we were approximately 2 months behind as of January 1st on projects scheduled to be finished by that time. This does not mean that all projects up to that time were two months late in completion. The lag in time is due to various reasons. On my own projects it has been due mainly to much more time spend on unscheduled projects, new projects and sales, including proposal writing, than I had estimated. In the case of Derrick Chin it is due in part to under-estimation on both his part and mine as to time required to complete his various projects, plus more time than we had alloted spent on routine display checkout assistance when John Duffy was still with us. This has been remedied by transferring display checkout to a location physically removed from us over in production under the supervision of the Production Department.

With Jay Cleary it was primarily a case of extra work which was assigned to him by me after his schedule was made out which caused previously scheduled projects not to be commenced.

Larry White was late primarily due I think to his newness. He has been with us since August and the Sumbol Generator Type 33 was his first logic design project.

Jim Sullivan was caught up primarily due to the fact that most of his projects were clearly defined and he has few interruptions in his schedule.

I believe that I can improve this situation in the future by closer checking on the progress of projects delegated to those under me. I plan to achieve this by delegating some of the work I am presently doing myself. It will be possible to delegate this work providing we obtain more technical assitance in the department as requested above so that the other engineers may in turn delegate as much as possible to the technicians

under them commensurate, of course, with the technician's cababilities. I believe we have not made as full use of technicians in the past as we should have.

Project Assignments:

Following are a list of project assignments within the Peripheral Equipment Department. Both present and future suggested projects are listed according to the engineer they are assigned to.

1. Derrick Chin

Present projects scheduled for completion approximately February 28th:

a) Completion of immediate development problems on Type 31 Display including cathode ray tube beam protection circuit, drift of S300 power supply focus coil and yoke alighment problems, coil coupling, recovery time, setup time, and focusing circuit check, checkout procedures established, prints completed and up to date, and measurements completed.

b) Color display #2 completely installed and checked. Prints brought up to date and an outline of a checkout procedure established.

c) Selection of a thermal switch to replace the air-actuated sail switch in the deflection output amplifier heat sink assemblies.

d) Supervision of measurements of stability of 00 point gain and repeatability on all available in-house units of Type 30 Display.

e) Completion of portable display tester manual.

Future Projects

a) Further Type 30 and Type 31 developments not scheduled as yet.

b) Advertising brochures for Type 31.

c) Completion of manintenance manual for Type 31.

d) Proposal writing for special 31 systmes.

e) Education of field service and customer personnel for both Type 30 and 31, customer.

f) Initial investigation into the feasibility of construction electro-statically deflected displays, estimated one week.

g) Initial tests to determine feasibility of proceeding further with projection television approach to large screen display, estimate one week.

h) Initial efforts to determine feasibility of producing a cheaper display, estimate one week.

i) Possible further color display work.

j) Possible line, curve and conic generating displays.

k) Cheap monitor display.

2. Jay Cleary

Present projects to be finished approximately February 7th.

a) Potter paper tape reader and spooler evaluation.'

b) Completion of reader, punch and typewriter incoming inspection, modification and test procedures for both reader, punch, and typewriter equipment for PDP-1 and PDP-4.

c) Incorporation of redesigned reader, punch, typewriter and punch motor control logic into PDP-1 and completion of price quotation for L. Buckland for addition of a Soroban high-speed 300 character per second punch to a PDP-1.

Future Projects

a) Completion of IBM Selectric input-output writer logic, and initial tests, two to three weeks.

b) Design of DEC paper tape reader?

c) Further investigation of Kleinschmidt medium speed printer.

d) The possible design of IBM equipment control units for Shelly Boillen at BBN.

e) Evaluation of Omnitronics, Rheem, and possibly Photo-circuits, paper tape readers for possible savings of approximately 1,000 dollars per PDP-1. Estimate two to three weeks.

f) Tally Punch evaluation.

g) Eyeball circuits?

3. Larry White

Present projects scheduled for completion February 1, 1963.

a) Digital Symbol Generator Type 33.

Future Projects

a) An estimate for interfacing display 30 to a CDC 160A, estimated 3 days.

b) Interfacing Display 30 to IBM 7090 and 1410. I estimate one week on each design.

c) Various Symbol Generator modifications to install the generator in various customer's displays?

d) Special Display for AECL, two to four weeks.

e) Interface for Display Type 31 to Control Data Corporation 924 for MIT, estimated 3 weeks.

f) Fast character generator, estimate 6 to 10 weeks.

g) Assisting Derrick Chin with various Type 30 problems.

4. Jim Sullivan

Present projects scheduled for completion March 18.

a) Type 34 oscilloscope display tests.

b) Control for 35 mm camera for Type 31 Display.

c) Camera equipment for Type 30 Display.

d) Incremental Display.

e) Display 30 test programs - Microscope, Decoder Adjustment writeups.

f) High speed printer test programs and alignment improvements measurements.

g) Card Reader Test Programs and test runs.

Future Projects

a) Dataphone

b) Holley Printer interface for NSA, estimate two to three weeks.

dec INTEROFFICE MEMORANDUM

DATE February 5, 1963

SUBJECT Results of the Meeting Concerning Future Tape Units

TO
K. Olsen
H. Anderson
D. Best
G. Bell
W. Hindle
T. Stockebrand

FROM Roland Boisvert

The following are the conclusions which were drawn from the tape from the meeting concerning future tape units, and the action to be taken.

1. Order a MT120 Transport from Potter capable of both 75 and 120" per second.

2. To prepare the engineering change over and make all future tape unit orders the MT120.

3. Development of 200/556/800 cpi read-write circuitry.

4. To make sure that we get a one year warranty on the MT120.

5. From the manpower viewpoint, we cannot consider a slow inexpensive tape unit with a low transport character rate at this time. There is a strong feeling our present line plus the linc tape system will eliminate a need for this type of transport.

INTEROFFICE MEMORANDUM

DATE February 4, 1963

SUBJECT SHOWING OF KODAK FILM: "PHOTOGRAPHY AT WORK"

TO Cost Center Managers

FROM Jack Atwood

CC K. Olsen
H. Anderson
G. O'Dea
W. Hindle

Eastman Kodak is lending us its latest film on industrial photography, "Photography at Work - A Progress Report," on Wednesday, February 6. This is a 16 mm. color film narrated by Chet Huntley which treats a number of subjects of interest to various departments. For example:

1. Photographic recording of a nuclear event with a lifetime less than 1 millionth of a second.
2. Studying internal combustion engine flows pattern for fuel improvement.
3. Production of printed circuitry.
4. Exacting missile circuitry production by photography.
5. Analysis by photography of missile re-entry problems.
6. Research analysis of paper in the making.
7. Study of controlled underwater explosions for metal forming.
8. A cake baking - from the inside!
9. Photographic observation of super-cavitating marine hull design tests.
10. Photographic records of company progress and for store planning.
11. Photographic progress reports to keep management up to date.
12. Exploded views and photo drawings for creative material, manuals and training aids.
13. On-the-spot evaluation and analysis of assembly and production operations.
14. X-raying airplane hulls to check for internal flaws.
15. Photographic prospecting for oil-by reflective Seismograph.
16. Mapmaking with the aid of aerial photography.
17. Nonperspective photo drawings for better engineering communication.
18. Fiber optics for complex photographic monitoring - around corners!

The film will be shown to the Technical Publications group at 12:30 p.m. Wednesday in my office. Since others in the company may also be interested in seeing the film, we will schedule a repeat showing at 5 p.m., same day, same place.

If you would like to attend the 5 p.m. showing or if you would like any of your people to attend, please call Florence Dudzinski on Extension 224 right away so that we can arrange the necessary accommodations.

dec INTEROFFICE MEMORANDUM

DATE February 4, 1963

SUBJECT Computer Production Construction Plan for March and April

TO K. Olsen
H. Anderson
S. Olsen
M. Sandler

FROM J. Smith

First effort will be given to customizing customer configuration machines that are presently in Checkout. If possible, we will continue to construct at our previously determined schedule of one PDP-1 and two PDP-4's. I am quite confident that schedule dates will continue to be met.

Each machine constructed will continue to receive a full complement of modules. However, customer shipments will be given first priority on all module issues. A line of communication will be set up between Jim Myers and myself where modules can be removed from computers in order to meet commitments to customer orders.

INTEROFFICE MEMORANDUM

DATE February 4, 1963

SUBJECT

TO Dick Best
Stan Olsen
Harlan Anderson

FROM Kenneth H. Olsen

We have planned now to do something dramatic for our modules at the IRE Show in March. One possibility would be to come up with a new multiple flip-flop package for a very low price. We might do this with the new Sprague cira-plates. If we told Sprague that we were going to do this, they would probably get the samples to us quickly. One package might be six flip-flops in a plug-in unit. With this we can only bring one side of a flip-flop out except for the first digit. There would then be a common clear and a common read-in and six in and six out. Dick says that for use in decoders, it would be good to have both the zero and the one side out available for the first digit. This still leaves us spare pins.

With the more expensive modules we can make it both shift and count. We are coming to the conclusion that we don't need two + 10's for most of our modules. This would free one more pin. We could then put 8 flip-flops in a package and still have a common clear, common read-in and the other side of the first flip-flop.

We ought to consider any other possibilities for making a dent in the show. I'm afraid that three C's is hurting our module sales with their very low priced 200 kc modules. We ought to see what we can do to make flip-flops really inexspensive for the 500 kc range in which case we could really hit them hard.

Kenneth H. Olsen

dec INTEROFFICE MEMORANDUM

DATE February 1, 1963

SUBJECT

TO Bob Savell

FROM Kenneth H. Olsen

cc: Dick Best
Harlan Anderson

I got a call from Clare Farr of Mitre Corporation on Wednesday, January 30. He was answering a letter I sent to Bob Everett several weeks ago that we were in the display business. He said that Hawley Rising, who with Bill Barn is heading up Department 13, is the only hardware group in Mitre and they would be the only ones interested in displays. He also said that it was their understanding that we had promised Hawley Rising a price on the Type 31 and that this was holding up any future interest in their project.

On Thursday, January 31, I got a telephone call from Dr. Hyde of Eyeball Associates, they would like a price and delivery on our computer with a Type 31, a Type 30 and a Light Pen. I told him that we would send him a letter giving him this information along with an approximate price and status on a high speed analog converter that they can use on an eyeball for film reading.

They used our PDP-1 and scopes at LRL and have concluded that our scopes are much better than we claim they are. They are raising money now and they feel that they will raise enough money to buy a computer with the appropriate cathode ray oscilloscopes. I would like to have Bob Savell call them because I obviously haven't picked up all of the information.

The area code number is 415 in Livermore, California and the telephone number is 447-8785.

Kenneth H. Olsen

dec INTEROFFICE MEMORANDUM

DATE February 1, 1963

SUBJECT

TO L. Prentice

FROM Ed Harwood

The problem of the taper pins shorting when we use taper pin blocks has been temporarily solved by the use of caterpiler type nylon strips, which we mount on the top and bottom edges of the mounting panel. We consider this only a temporary solution to the problem and would like to hear some suggestions from the Mechanical Design Department as to a permanent solution to this problem.

Suggestions have been made to solve this problem by cutting down only the panels that use these taper pin blocks, or perhaps cutting down all mounting panels. I would like your views on both of these suggestions.

INTEROFFICE MEMORANDUM

DATE January 31, 1963

SUBJECT 16 MM. SOUND PROJECTOR

TO Cost Center Managers

FROM Personnel Committee

CC K. Olsen
H. Anderson
G. O'Dea
W. Hindle

The company has rented a 16 mm. sound projector for the month of February to determine how much such a machine might be used if we were to purchase it.

There is a good selection of training films available on loan or rental from various organizations and commercial film libraries. Many of these could be used to advantage with our personnel.

A film catalog is being prepared by the Personnel Office and the Technical Publications Department. This catalog will be kept in the Personnel conference room.

The projector and screen will be stored in Technical Publications. John D'Orsi will schedule the use of the equipment and instruct in its proper operation.

If you feel it would be worthwhile to show your personnel a film on a given subject:

1. Check the catalog for available films (unless you already know where to obtain the film you want).
2. Arrange with the Personnel Office to secure the film or films you select.
3. Call John D'Orsi (Extension 366) to reserve the projector and screen.
4. Have your "projectionist" see John for instruction on the operation of the machine (a Bell & Howell Filmosound Specialist).
5. Have someone pick up your film at the Personnel Office and return it to the Personnel Office after the showing.
6. Be sure to review the film before showing it to your group. You may find that it is not suitable or worthwhile.

NOTE: If you have any information on films suitable for inclusion in the film catalog, please pass it along to the Personnel Office.

CAUTION: Make your plans <u>well in advance</u>. Otherwise you may find that the film you want is not available when you want it or that the projection equipment is already reserved for another user.

dec INTEROFFICE MEMORANDUM

H.B.G.

DATE January 31, 1963

SUBJECT Snapshot

TO Ken Olsen

FROM Roland Boisvert

cc H. Anderson
S. Olsen
J. Atwood

Tom Stockebrand this morning suggested a catchy name for the fixed address transport which identifies in one word what it really does. That word is SNAPSHOT (small picture of core locations on tape).

dec INTEROFFICE MEMORANDUM

DATE January 31, 1963

SUBJECT Drum System (Parallel Transfers ala BBN)

TO Ted Johnson

FROM Gordon Bell

cc: A. Blumenthal
S. Grover

✓H. Anderson -- Computer Guidance Committee

At present the only description of the BBN drum system is a permanent memo by me, M-1102A.

We should formally announce the drum system as a product bulletin, and include it as a release to DATAMATION, etc. The drum is a significant and unique contribution as a computer system component. Several customers either want the drum or would like information about it.

We must:

1. Get a product bulletin now.
2. Release it to magazines.
3. Start peddling it actively, since it makes PDP-1 more favorable.

dec INTEROFFICE MEMORANDUM

DATE January 30, 1963
(dictated 1/29/63)

SUBJECT Information on SDS

TO Ken Olsen
Harlan Anderson
Stan Olsen

FROM Win Hindle

Bill Congleton called today to report that he had been in Chicago last week and met Edgar Greenebaum, who is an independent electronics consultant. Bill was exchanging information with Greenebaum about small companies, and mentioned DEC. Greenebaum did not know us, but reported that he was one of the founders of SDS. Since Bill refused to give him any factual data on DEC, he did not receive much information on SDS except for the fact that they now claim to be shipping two computers per week.

Bill suggested that any time we wanted to get information on SDS from a source outside the company, we might approach Greenebaum for this information. However, I am sure that we would have to divulge information on DEC before receiving any useful data from him.

Win Hindle

dec INTEROFFICE MEMORANDUM

DATE January 30, 1963

SUBJECT

TO Cost Center Managers and En 1000 Series Distribution List

FROM R. Mills

In order to control the charges to the attached overhead numbers we have found it necessary to institute the following procedure.

All charges to the attached list must be approved by the cost center manager who has been assigned these numbers.

Therefore, any charges of materials or labor to these numbers must be approved by the cost center manager or an alternate.

EN #	Description
	R. Hughes or J. Cudmore
1048	Test Equipment Headquarters
1073	Quality Control
1144	Quality Control: Test Equip., Labor & Materials
1145	Quality Control: Model Test
1146	Quality Control: Module Repair-Field Failure
1147	Quality Control: Module Repair-Salvage
	R. Best or Don White
1072	Standards
1049	Engineering Stockroom
	A. Hall
1069	PDP-1 Computer Administration
	S. Olsen or J. Myers
1019	Modules Sales
1088	Module Packaging for Shipment
	J. Fadiman or D. Whipple
1037	Core Tester and Memory Tester Sales
1038	Special System Sales
	H. Morse
1033	Sales Programming, PDP-1
1096	PDP-4 Programming
1141	Fortran
	N. Mazzarese or R. Maxcy
1034	PDP-1 Sales
1095	PDP-4 Sales

dec INTEROFFICE MEMORANDUM

DATE January 29, 1963

SUBJECT Gift of a PDP-1 to the American Hospital Association

TO K. Olsen

FROM Gordon Bell

cc:

H. Anderson
S. Olsen
N. Mazzarese
G. Moore

Shelly Boillen of BBN just called and asked if DEC would give a machine to the AHA who in turn would loan it to BBN. This might insure success of the project (100 machines to hospitals next year), and might be most profitable to us.

dec INTEROFFICE MEMORANDUM

DATE January 29, 1963

SUBJECT

TO Harlan Anderson

FROM Gordon Bell

INTEROFFICE MEMORANDUM

TO: Roland Boisvert, Don Smith, Steve Lambert and Alan Kotok

cc: Ken Olsen
Harlan Anderson
Stan Olsen
Dick Best
Win Hindle (for Engineering Projects and Computer Guidance Committees)
Nick Mazzarese
Ted Johnson
Arthur Hall

Schedules for:		
	57A	57 TCU Modified for PDP-1
	59	TCU for Data Channel & 50A
	50 A, B	TU for 200/556 bpi (low cost)
	XX	Data Channel for PDP-1, PDP-4
	59A	TCU for Data Channel & IBM 729 VI

Introduction

With the firm order for Type 56 and 57 contracts, we have found a more permanent solution to new tape control designs. Increased market pressure for IBM medium density tape (556 bpi) also necessitates considerable engineering outlay.

Market Pressures (in order of importance)

1. A low cost system which handles 200/556 bpi IBM compatible tape (15K control, 20K tape unit).

   a) The very minimum might use DATAMEC units and Type 54/51 program controls. (7K & 15K)

   b) A more permanent solution would use the 57 Control (57A for PDP-1) allowing higher transfer rates, simultaneous compute-operate tape and equipped with 50A (200/556 bpi) transports.

2. A tape system for IBM 729 series transports. The 57 might suffice although scatter read, gather write wouldn't work.

3. A very high performance system using programmable data channel which allows scatter read, gather write operation with no timing restrictions.

4. Every possible tape control for each pocketbook.

5. Only one tape control (minimizing the education of sales personnel).

Sales Constraints

1. The 57 has been ordered for March delivery.

2. The 56 has been ordered for June delivery.

3. Don Smith may leave DEC Maynard at any time for Bell Labs sales representative.

56 Control Decision

1. The 56 design is approximately 25% complete (no wiring diagrams, manuals, programs, personnel training, etc.).

2. The 56 scatters and gathers with timing restrictions.

3. The 59 Control with XX Data Channel yields a better and more permanent solution than the 56.

4. The 56 will be abandoned.

XX Data Channel

1. The data channel design will be begun when a description is approved by me. The description will be presented to the Engineering Projects Committee for review.

59A

The word can proceed in parallel with the XX Data Channel, and should be completed almost immediately so that the interface circuitry can be checked for the IBM 729 VI.

59

This work will be done when the 50A is complete.

57A

This modification (to PDP-1) will occur when the 57 is complete.

50A

This design should begin February 7, 1963 -- when a tape transport is selected. This is the most significant job we have to do.

50B - Datamec (or equivalent low cost)

The Datamec transport might be purchased and tested. This work is approximately two months overdue.

Personnel

1. Roland Boisvert is responsible for development of IBM compatible controls, units, and the data channel.

2. Steve Lambert will work on the 57, 57A, and consult on the 50A.

3. Don Smith will work with Roland on the XX Data Channel design.

4. Gordon Bell and Alan Kotok will consult on designs and scheduled weekly discussions. will be held.

5. A circuit designer should be alloted now to assume secondary responsibility for the 50A development.

Scheduling

1. Roland and parties with secondary design responsibility should meet with Win Hindle and establish schedules.

2. Timing - ideal case

   a) XX and 59A - Two units by August 1st.

   b) 57 - March 1st.

   c) 57A - May 1st.

   d) 50A - May 1st.

   e) XX - 59B -- September 1st.

   f) 50B - June 1st.

Customers

1. Roland and I will visit NSA and describe the 59 and XX Data Channel in place of the 56.

2. LRL will have to be told about our decision of the data channel.

SEQUENCE

**1. 57 Control for PDP-4 (JPL)
Expansion for High Density

**2. 59A and data channel for PDP-1 (NSA)
(for use with IBM 729 VI)

*3. 50A (200/556 bpi) for Type 57

4. General 57 for PDP-1

5. Generalize data channel for PDP-4

6. 59B for use with 50A tape units

** Present commitments

* Decision very important but should be made independent of any customer commitment.

dec INTEROFFICE MEMORANDUM

DATE January 28, 1963

SUBJECT PDP-3

TO Ken Olsen

FROM Gordon Bell

cc: H. Anderson
D. Morse
N. Mazzarese

Beginning now, A. Kotok should be assigned full time to PDP-3.

The character of a machine influences our growth tremendously since day to day development decisions are always made around existing machines (eg. BBN system).

PDP-3 might be useful if it is: (I'm sure it could be placed in the same space as PDP-1)

1. Built to sell for under $200,000
2. 5 μsec cycle
3. Expandable (similar to BBN system)
4. Capable of running 704, 7040, 7044, 709, 7090, 7094 programs.
5. Built as if we intend to stay with it a while.
6. Entirely serial logic in the processor.
7. Complete systems approach:
   a) allow many memories
   b) allow many processors of various types.
   c) First processors might be very simple with complete trapping facilities to handle most every instruction, and provide only a very skeleton processor.
   d) Provide an encore (made with a faster parallel version).
8. Use new logic (if we have an extra 9 months for the project.)

INTEROFFICE MEMORANDUM

DATE January 28, 1963

SUBJECT Trip to Geotechnical Corporation

TO Harlan Anderson

FROM Roland Boisvert

cc: Bob Beckman
Steve Lambert
Nick Mazzarese

The problems at Geotech with the mag tape system turned out to be the program which we have released to them. This is called simple mag tape program written by Steve Lambert over a year ago. The accumulation of three variables results in a condition whereby the character buffer in the control is cleared and set at the same time, thereby locking the character buffer and causing the tape to backspace two records. When this happens, the program which Geotech has gets confused.

The above mentioned variables are tape unit speed, the program timing, and the actual configuration of data that was written. The only way to correct this condition is to correct the simple mag tape program. It has cost approximately $3,000 at Geotech to square away the program. I feel if you are going to make any money at all on future simple tape systems that this program ought to be immediately rewritten, hopefully, with the same constants and the same core locations as the present program so that customers who are trying to use the program in some context will not have to radically change any other programs which depend upon this program. In the case of Geotech, their program for running the system depends upon all the constants and procedures followed within the simple mag tape program. I pointed out to the people at Geotech the problems with the simple mag tape program and showed them exactly what it was doing and how it was causing the malfunction. I strongly recommend that this program be pulled out of our tape library and not be given out until it has been corrected and has been checked out as a proper tape system program.

I would also like to point out one other difficulty with the program and this is on the inter-record trash problem. It should be noted in cases of writing data that the write head should be allowed to slip down the tape an absolute minimum of 300 microseconds longer than the stopping of the tape head from a read condition or a spacing condition. This is to eliminate inter-record trash. This has not been controlled in the program and should be done so in any future revisions of the program.

J. Smith
January 25, 1963

Option Status

Displays

Number	Status
30A-6000-7899	in stock
30A-6000-7900	in stock
30A-6000-8130	in Checkout (80% complete)
30D-5000-8128	Show (Philadelphia)
30D-5000-8129	in Process (50% complete)

Mag. Tape

EN 2399	3 Tape Units Type 50 (ITT Duplex)	in Checkout (complete)
EN 2398	1 Type 52 Control (ITT Duplex)	in Checkout (complete)
7000-7412	Tape Unit Type 50 (Standard)	in Process (90% complete)
7000-8803	Tape Unit Type 50 (Standard)	Start
7000-8804	Tape Unit Type 50 (Standard)	Start
7000-8805	Tape Unit Type 50 (Standard)	Start
4000-8792	1 Type 52 Control (Standard)	Start

TO: K. Olsen
H. Anderson
S. Olsen
D. Mills
G. O'Dea
M. Sandler
R. Savell
D. Chin
R. Boisvert
N. Mazzarese
E. Harwood

Harlan Anderson

dec INTEROFFICE MEMORANDUM

SUBJECT: 25th Meeting of the Test Equipment Committee

DATE: January 24, 1963

TO: Richard L. Best

FROM: Russell Doane

Members of the Committee:

Robert A. Hughes, Chairman
Russell Doane, Secretary
Donald White
George Gerelds
Dave Dubay
Dick Tringale
Jim Cudmore
Larry White
Ken Wakeen

1. The new F_t tester at 10, 30, and 50 megacycles is in operation in engineering.

2. Ken Wakeen has ordered another 567 sampling oscilloscope for automatic module testing.

3. Ken Wakeen has ordered a Beckman Model 5350 digital AC-DC volt-ohmeter of 0.2% accuracy, and it has arrived.

4. Two dual trace type CA Tektronix oscilloscope plug-in units have been ordered to be delivered January 18.

5. Pat Greene needs a type 545A oscilloscope and both Lee Butterworth and Ed de Castro need a 543A scope according to the report of Dick Tringale. We have taken steps to meet these needs.

6. We discussed a request for readier reference to test equipment manuals from Barbara Stephenson. We agreed that the removal of manuals from Dave Dubay's file is quite undesirable since there is a tendency for them to become lost, but we agreed that connecting the manuals to the equipment was cumbersome and might be unreliable also. Our final decision was to establish a file in our library under the librarian's control, so that any instruction manual can be borrowed from the library just as a book is borrowed.

7. The following things have occurred since our meeting:

   a. We have revised our order to John Fluke Company, so that we will now receive our .01% flukemeter without the zener which will be shipped February 21, and we have ordered a conversion kit for $150. which will be available in June and which will allow conversion to zener diode reference. This procedure will cost us an extra $100. (The zener fluke was to cost $50. extra), but will make available the instrument several months sooner.

b. Barbara Stephenson has requested the committee to look into the purchase of equipment to enable her to test digital to analog converters to an accuracy of 0025%. This is the accuracy required in measurement to guarantee 14 bit accuracy in the final converter.

c. As a result of Item 6, Dave Dubay has made a complete listing of the manuals for all the test equipment that we have, and this list was passed on to Judy Ebner in the library. These manuals have been ordered at a cost of about $200.

d. As a result of our more efficient calibration schedule, we have dropped the idea of outside calibration of oscilloscopes.

8. The next meeting of the Test Equipment Committee will be on Tuesday, February 12, in Bob Hughes' office at 1:30 P.M.

9. A Hewlett Packard type 175A, 50 megacycle oscilloscope has been in Q. C. and production test for approximately one month. The following comments have been heard from various people who have used it:

A. Input probes are on the right side of the scope which is clumsy in our present test setup, since they are designed around Tektronix scopes which have probes on the left.

B. There is no 10% or 90% line on the face of the CRT which makes rise and fall time readings difficult. (When asked about this, the Hewlett Packard representative pointed out that the 6 centimeter height of the graticule makes it possible to set up 0 and 100% on the bottom line and the fifth line, and then raise the entire trace by 1/2 cm with the vertical control thus establishing the second and fifth lines at the 10 and 90% points on the wave form. He also expressed the feeling that Hewlett Packard would be willing to mark extra lines on the scope for us.)

C. Circuitry and adjustments are remarkably simple.

D. All parts of the scope, as in other Hewlett Packard equipment, are identified by numbers on the circuit board making the location of specific components much easier than in Tektronix oscilloscopes; this feature was enthusiastically praised by Dave Dubay.

E. Everyone likes the no-glare, no-parallax scope face in which the flat face is roughened to prevent reflection highlights and the graticule is cut into the phosphor itself.

F. It's nice to have the extra fast rise time. (The rise time with the dual trace plug-in unit is about 9 nanoseconds corresponding to a band width of 40 megacycles. A Tektronix type CA dual trace plug-in with a 543 oscilloscope gives a rise time of 14 nanoseconds corresponding to a band width of 25 megacycles. Single probe plug-in units deliver rise times of 7 nanoseconds minimum and 12 nanoseconds minimum respectively for the two scopes.)

G. Both horizontal and vertical plug-in units are interchangeable, thereby allowing a delaying sweep plug-in unit which provides features similar to thosefound on a Tektronix 545 scope to be added.

H. In view of these various reactions, Russ Doane recommended that the next oscilloscope that DEC buys for general purpose use should be a Hewlett Packard 175A. The cost would be quite close to the cost of a 543.

dec INTEROFFICE MEMORANDUM

DATE January 23, 1963

SUBJECT PDP-4 at Itek

TO Nick Mazzarese

FROM Gordon Bell

cc: Ken Olsen
Harlan Anderson

Norm Taylor called Ken in regard to a computer costing under $100,000 for their drafting machine (A PDP-1 less 25% is less than $100,000.) In order to complete the job, a special block transfer instruction should be added.

The Block Transfer Instruction on PDP-1

The machine is stopped. Words come from memory into the IO and out, or words enter the IO and are placed in memory. External timing determines words timing. A block of 512 words is transferred beginning at one of 8 fixed core locations. The word transfer rate may be 200,000 words/sec.

A Block Transfer Instruction for PDP-4

Without special consideration a similar instruction could be installed on PDP-4 providing a transfer rate of 125,000 words/sec. Perhaps something could be done to allow a destructive read from memory or a write into memory (assuming memory is 0) at a 200 KC word rate.

Gordon Bell

dec INTEROFFICE MEMORANDUM

DATE January 23, 1963

SUBJECT

TO Nick Mazzarese

FROM Gordon Bell

cc: K. Olsen
S. Olsen
H. Anderson

Today Shelly Bollen at BBN called and asked if we were interested in interviewing computer sales personnel.

The IBM Cambridge representative, Mr. Hoars, selling 7040 - 7044 came to BBN and was very enthusiastic in regard to their time-sharing system.

dec INTEROFFICE MEMORANDUM

H.E.G.

DATE January 23, 1963

SUBJECT

TO Harlan Anderson

FROM Kenneth H. Olsen

cc: Arthur Hall

I got a call from Dick Sonnenfeldt at about 10:15 on Wednesday, January 23. He was at Pittsburgh talking with U.S. Steel and felt rather optimistic. Last week they visited ISI, TRW and IBM and Dick was afraid that they would forget about Foxboro after this long trip. However, we and Foxboro did make a lasting impression and they are optimistic about our position. Dick feels that he should know how we stand by the end of the day. He also called to say that things looked promising at Fitchburg. The concessions we had made on the business equipment sounded very desirable to them. He met with their President last week and he will recommend the replacement of the IBM equipment if their business consultants are satisfied.

The consultants are Ernst and Ernst of New York, who are office and business systems specialists. These people know little about hardware, but they apparently have had quite a bit of experience in EDP Systems. When we hear from them, we should treat them very well because they will be the key part of the sale. Having these critical consultants coming from the outside will be very valuable to us. We will then know fairly well how we stand in the business applications. If they come out negative in conclusion, this will be the most valuable thing we can learn.

Kenneth H. Olsen

Harlan ✓

dec INTEROFFICE MEMORANDUM

DATE January 22, 1963

SUBJECT Obtaining Information for Munich Office

TO File

FROM George O'Dea

Harlan and I met with Mr. William Snow, retired counsel on Foreign Affairs of the Dewey and Almy Chemical Division of the W. R. Grace Company.

Mr. Snow's observations were as follows:

Branch vs. GmbH:

If you expect a loss, use the Branch form - if you expect a profit, use GmbH.

Permission to Operate Branch:

Local Ministries are straight forward in granting same. May entail a great amount of paperwork (more than GmbH).

Import Duties:

Best negotiated in Germany. Can hassle over item classification - but duty rates are sacred.

Duty Values:

Once the rate is set the Value must be determined. Basically, the Value cannot be less than the price offered our best distributor.

What about technical competence implicit in DEC domestic price? This would be provided by Munich Office. Could this reduce duty price? Maybe.

Shipping Components:

As assembly operations are undertaken in Germany we can ship components - by procuring as an agent for the GmbH we can charge them our ~~list~~ cost which would be minimal as regards duty Value - but watch out for

a) Duty differentials

b) Dilution of renegotiation benefits.

Turn Over Tax:

Would not apply to original shipment to Munich (either under Branch or GmbH structure) but does apply to subsequent billings. This charge is

Turn Over Tax (Cont'd)

not contributory to foreign tax credit in computing U.S. Tax.

Shipments from Munich Outside Germany:

Profits therefrom are "tainted" and treated as distributed income on U.S. Tax Return.

Advantages of AG over GmbH:

Principal difference is in calculation of Corporate Income Tax:

Under AG the Tax is a straight 30% of distributed profits.

Under GmbH only the first 8% of Paid In Capital is taxed at 30% - excess if taxable at 45%.

Dewey and Almy was able to have this 8% limitation set aside for ten years.

Personalities:

We were introduced to one

Peter Binnenkade, Managing Director
Darex GmbH
Friedrichsgabe Bez. Hamburg

Telephone: 57-23-51-55

Mr. Binnenkade was most gracious and offered to help us in such matters as locating a good lawyer, advising on local practices, etc.

George O'Dea

GO'D:ncs

dec INTEROFFICE MEMORANDUM

DATE January 22, 1963

SUBJECT Progress Report PDP-1 and PDP-4 Construction (Nov. and Dec.)

TO K. Olsen
H. Anderson
S. Olsen
M. Sandler
G. O'Dea
R. Mills

FROM J. Smith

PDP-1

System No.		Schedule Date	Date Complete
PDP-1-34	9000-5129	11/2/62	11/2/62
PDP-1-35	9000-5863	11/21/62	11/21/62
PDP-1-36	9000-5864	12/7/62	12/10/62
PDP-1-37	9000-5865	12/21/62	12/21/62
PDP-1-38	9000-5850	1/4/63	1/4/63

PDP-4

PDP-4-7	8000-7437	12/14/62	12/17/62
PDP-4-8	8000-7718	12/18/62	12/21/62
PDP-4-9	8000-7719	12/31/62	12/31/62 (Module Test)
PDP-4-10	8000-8060	1/11/63	1/15/63

INTEROFFICE MEMORANDUM

DATE 1/23/63

SUBJECT

TO Ken Olsen
Stan Olsen
Harlan Anderson
Nick Mazzarese
Bob Beckman

FROM Bob Maxcy

ITT is requesting that we supply them with nine sets of the attached list of "support stock". Each set will cost DEC approximately $850.

We are investigating the validity of the list i.e., is it a reasonable set of spare parts for a standard ADX system.

BM/jr
Attachment

1. Is it really nine sets? - The letter does not say so -
2. When machines are out of warranty, what happens -?

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

ITT INFORMATION SYSTEMS DIVISION
320 PARK AVENUE · NEW YORK 22, NEW YORK
TELEPHONE PLAZA 2-6000

PLEASE REPLY TO:
PARAMUS ENGINEERING CENTER
580 WINTERS AVENUE
PARAMUS, N.J.
CO 2-6500

January 14, 1963

Mr. N. Mazzarese
Digital Equipment Corp.
Maynard, Massachusetts

Dear Nick:

In accord with our recent conversations, I have prepared a list of components which I feel will be sufficient for an initial warranty support stock.

As you know, we maintain a similar stock at each installation site and as defective components are replaced, they are returned to Paramus. We will exchange these defective components for units from the warranty stock. These defective components would be accumulated and returned to DEC. We would expect DEC to send replacements sufficient to maintain the warranty stock at the level of the attached list.

We have checked the high voltage protection on ADX-8 and recommend the same method of protection be used on all future ADX Systems. The plexiglas is quite satisfactory and I do not recommend a change to another material.

Schedules have been arranged with your Mr. Maxie for the quality control inspection of ADX # 1, 2, and 4. Based on these schedules, this project will be completed prior to January 18th.

Very truly yours,

L. L. Gainey
Director of Field Operations

LLG:evh
Attach. 1

1/7/63

WARRANTY SUPPORT STOCK

DIODE		Quantity
GTDX3		3
IN91	GE	3
IN270	TR	5
IN276	TR	25
CTP309		5
IN320A	TR	3
IN429	TR	5
IN645	CLV	25
IN748	TI	5
IN758A	TR	5
IN816	SYL	5
IN914	TR	5
IN994	TR	15
IN1217	WES	25
IN1220	WES	10
IN1227	ITT	5
IN1341	MOT	5
CTP2425		5
IN2808	MOT	3
IN3314B		3

PULSE TRANSFORMER		
T2003	DEC	2
T2006	DEC	2
T2010	DEC	2
T2012	DEC	2
T2017	DEC	2
T2018	DEC	2
T2019	DEC	2
T2020	DEC	2
T2021	DEC	2
T2023	DEC	2
T2024	DEC	2
T2029	DEC	2
T2032	DEC	2

TRANSISTORS		Quantity
GA004	Texas	3
2N224	Philco	10
2N317A	Philco	3
2N357A	RCA	3
2N393	Philco	10
2N412	RCA	10
2N456A	TI	10
2N501	Philco	10
2N504	Philco	10
2N588	Philco	10
2N599	Philco	25
2N670	Philco	10
2N711B	TI	10
2N982	SP	10
2N985	TI	10
2N1065	GI	25
2N1127	Philco	3
GT1170	GI	10
2N1184B	RCA	10
2N1204	Philco	20
2N1304	TI	10
2N1305	TI	20
2N1370	TI	10
2N1427	Philco	10
2N1499A	Philco	15
2N1545	Ben	3
2N1754	Philco	20
2N2099	SP	10

dec INTEROFFICE MEMORANDUM

DATE January 22, 1963

SUBJECT People Attending Seminar - January 23, 1963
Noon at the French Restaurant

TO

FROM Howie Painter

Ken Olsen
Harlan Anderson
Dick Mills

General Radio People:

* Ivan Easton	–	Vice President, Engineering
Bob Soderman	–	Group Leader & Engrg. Admin.
* Bob Fulks	–	Development Engineer
Morris Tuttle	–	Consultant, Eng.
Dick Frank	–	Group Leader
Ed Hurlbut	–	Controller
Phil Palamountain	–	Supervisor, Data Proc., Commercial
Dick Wilson	–	Supervisor, Data Proc., Production
Phil Powers	–	Assistant Vice President, Mfg.
Guss Lananas	–	Ad. Mgr.

DEC People:

* not present

Dick Mills
Fred Maclean
Gordon Bell
Ken Olsen
Harlan Anderson
Stan Olsen
Nick Mazzarese
Dit Morse
Jack Atwood
Howie Painter

H.E.C.

2nd Draft: For Presentation at Works
Committee Meeting of Jan. 21, 1963

THE DIGITAL EQUIPMENT CORPORATION

Statement of Inventory Policies

I. Inventory Mechanism

Our stated goal is to keep finished goods (Modules) inventory as an aid to customers and as a buffer against demand fluctuations. We plan to provide stock quantities of each module type to cover all orders (external and internal) AND to cover all expected orders; the company aim is to fill any order "off-the-shelf".

We maintain a stock list of approximately 250 module types. The addition of new modules types is a continuing result of our design improvements and our expanding markets. The raw material components in stock number approximately 1300, and manufactured parts in stock total approximately 1500.

A. Raw Material Inventory includes material, equipment, and components used directly in our products. We maintain Kardex perpetual inventory records for each part, recording receipts and issues of material. Raw material parts are classified and coded into categories which enable us to analyze the structure of this inventory. (See Appendix I for details).

B. Manufactured Parts Inventory includes parts and subassemblies manufactured and stocked by DEC. Kardex perpetual inventory records are maintained for these parts and the parts are classified and coded for analysis. (See Appendix I for details).

C. Open Jobs Work-In-Process Inventory includes Module Job Orders in process, Manufactured Parts Job Orders in process, and Special Systems and Computer Jobs Orders in process.

D. Finished Goods Inventory is modules in stock at manufacturing cost. Normally there will not be any Special Systems or Computers finished goods inventory.

II. Inventory Delineations

Modules	Systems and Computers
Raw Material (Class 10-18)	Raw Material (Class 30-36)
Mfd. Parts in Stock (Classes 50-54)	Mfd. Parts in Stock (Classes 70-74)
Work-In-Process (Open Jobs)	Work-In-Process (EN Open Jobs)
In Test	---
Finished Goods (Stock Room)	---

See Appendix I

Inventories are planned in response to actual and anticipated demand. Inventory levels and demand flows are both conditions of and determinants of procurement and production activities.

Inventory values flow from purchase orders, to receipts into Raw Material Inventory, to issues of Raw Material and Labor and Overhead to Work-In-Process Inventory, to completion of WIP Inventory to Finished Goods Inventory, to shipment or Cost of Goods Sold.

The determination of what to produce and what to buy flows in the opposite direction. Usage and sale of modules determine need to restock, orders written into Work-In-Process determine the need to procure Raw Material and Manufactured Parts Inventory.

III. Mechanics of Determination

A. Modules - Finished Goods: Once each month the determination of the coming Month's Module Production Starts is made according to the following procedure.

We maintain both an Actual Balance and an Available Balance record for each module type.

The Balance on Hand and Manufacturing Lots In-Process being known, Customer Orders and Internal (Computer and System) Orders are posted as a deduction to Available Balance for each module type.

Manufacturing Orders are written to correct minus availability and, upon issue, are an addition to Available Balance.

We now must plan for that amount of each module type to provide for expected orders. Usage records are maintained for each module type, one-month supply being the quantity used during the past three months adjusted by past historical records. Future order information is entered into the availability determination when available. It must be noted that demand for each module type varies an average of 50% over or under in any given month. Adjustments of monthly average usage also are made to reflect whether we are on an increasing or decreasing slope in rate of new orders.

The One-Month Usage is deducted from Available Balance as a requirement, and Manufacturing Orders are written (Planned) to the level of one-month usage.

Planned Issues are submitted to Sales for approval or change.

For example see Appendix II.

B. Module - Raw Material and Manufactured Parts:

The need for Components is determined by a similar basic availability mechanism and is calculated in conjunction with the Modules requirements procedure described above.

Actual module Manufacturing Orders not yet issued and expected future Module Manufacturing Orders are exploded into required types and quantities of components. We use the PDP-4 Computer to process the data:

1. A complete, current listing of all Raw Material and Manufactured Parts Components is maintained on punched cards and tape.

2. Complete, current Parts Lists for each module type is maintained on punched cards and tape.

3. The actual to-be-issued Manufacturing Lot for a module type is an "order". An expected future planned issue Manufacturing Lot is an "order". Module "order" quantities are then exploded into the required quantities of each component specified in the parts list for those required module quantities. This will be the current Need for each component.

4. We maintain perpetual inventory record cards for each component. This card indicates On-Hand Balance, Purchase Order Open Balance, and Module Types in which component is used.

5. Need for each component is deducted from On-Hand Balance to give Available Balance.

6. Purchase Order quantities are added to Available Balance to give a To-Be-Available Balance. A minus here will be the initial determinant to place a Purchase Order.

7. Minimum Available levels of stock for each component are determined by exploding the desired level of total monthly module unit production, the quantity for each module type being calculated by ratio of the One-Month Usage mix. The unpredictable mix of types in module orders urges us to add a safety factor to the minimum level of availability of each component. This factor is usually 25%.

Example

Component	Balance On-Hand	-Need	=Available Balance	±Open P.O.	=To-Be Available	Minimum Usage	To-Be Placed
1.5K Res.	10,000	13,200	-3,200	5,000	+1,800	10,000	9,000

8. Orders to be Placed are determined as above. The value of these orders is then calculated to give a prediction of Raw Material Receipts in dollars.

9. If actual total module usage is lower than minimum production level, the level of module unit production will determine the minimum required available stock for each module type and each component.

C. Computers and Systems:

Finished Modules are a large part of the Bill of Materials for each computer or Special System, and the procurement of these Modules is a requirement input to Modules Finished Goods Inventory and Availability.

Raw Material and Manufactured Parts Components unique to Computers and Systems are maintained on perpetual inventory record cards and the levels for each component are calculated on an availability balance. The historical background, however, has not been sufficiently repetitive and the final designs of each Computer and System are still in a condition of change. Basically, we try to insure that material be available for production of actual order machines, and for those built for inventory as approved by the Works Committee.

Peripheral Equipment (Readers, Punches, etc.) is expensive, and delivery is long. Need is determined on the basis of customer orders, but quantity ordered is usually determined by committee on the basis of discount and vendor consideration and appraisal of potential customer orders.

IV. General Determinations

Input rate of new orders, production capacity, and inventory levels are periodically reviewed to determine what production starts are to be undertaken.

If required production starts are higher than present capacity, we seek to increase our labor capacity by subcontracting operations to close the gap. If the increased demand is deemed to be a new level rather than merely a fluctuation, we seek to add people and alert to increase individual productivity by better planning and methods changes.

If required production starts are lower than present capacity, we seek to loan people to other departments and manufacture those units and subassemblies which will use the least amount of materials.

V. Future Plans

Component lists and product parts list are being handled by our PDP-4 Computer. We plan to process our receipts and issues and procurement orders through the Computer to give us instantaneous Availability information. We plan to program usage calculations to give us fast, accurate trend data.

Our components explosions now are in quantities; we will next add standard costs and prices to this calculation.

Standard labor hours and dollars are now available, and we plan to program this data to give us scheduling and definitive inventory value predictions.

It will be noted that we have not specifically introduced the time or timing dimension into the above discussion. Several time factors are available however, and are in use:

A. Lead times for individual component procurement are known and are a consideration in the determination of minimum availability levels.

B. Assembly time and production progress data for computers are available and are being used in the determination of Module Availability planning.

C. Standard labor times are being tabulated monthly. Production and productivity rates will thus be operational or process times rather than gross, generalized production rates.

The above data is not as yet completely formalized. Faced with sharply increasing demand, we issue Manufacturing Orders and Purchase Orders to meet that increasing demand, often at a rate greater than our current labor capacity will absorb. Faced with sharply decreasing demand, we issue fewer orders. Reaction to demand fluctuations is thus subject to time log. Certain computer programs are being studied in an attempt to quicken our reaction.

VI. Inventory Valuations

It is the Company's intention to evaluate each commodity in its inventory at actual cost, consistent with the "Lower of Cost or Market" concept and to include in inventory only commodities for which current usage is indicated.

VII. Obsolescence

Consistent with the Company's desire to produce a current quality Product, Engineering changes are to be expected and as a direct consequence thereof a certain amount of obsolescence is inevitable.

To minimize the obsolescence factor it shall be the responsibility of the Chief Engineer to consult with the Production Manager before authorizing changes in design in order that the phasing out of old commodities can be realized to the fullest extent possible.

It shall be the responsibility of the Production Manager to advise the Chief Engineer of the Probable obsolescence cost of any proposed Engineering change.

Obsolescence shall call for the removal of the commodity from Inventory and instigate efforts to recover such salvage value as can be realized.

VIII. Purchase Commitments

A detail file is maintained on all open Purchase Orders affecting Raw Material Inventory. This file spells out the Vendor, Commodity Class, Cost, and estimated delivery date of each Inventory Order. The purpose of this file is to anticipate cash disbursements and to provide an expediting tool to the Purchasing Department in those instances in which deliveries prove faulty.

1. No measurement of production capacity to fill the planned requisition.
2. How do we know when to offer longer delivery? and how much longer??
3. Mixture of modules — Ship complete orders??

APPENDIX I.

Inventory Class Codes

	Code Number	Description
Raw Material		
Modules	130-10	Capacitors
	-11	Diodes
	-12	Mechanical Components (Lamps Knobs, Connectors, etc.)
	-13	Resistors (Potentiometers, etc.)
	-14	Board and Panel Stock
	-15	Transistors
	-16	Transformers
	-17	Sheet Metal Stock
	-18	Miscellaneous
Computers and Systems	130-30	Peripheral Equipment (Readers, Punches, Typewriters)
	-31	Mag. Tape (Potters, etc.)
	-32	Printers
	-33	Display
	-34	Mechanical Components
	-35	Cabinets
	-36	Miscellaneous
Manufactured Parts (W-I-P)		
Modules	131-50	Etched Boards
	-51	Phenolic Panels
	-52	Transformers
	-53	Fabricated Metal (Chassis, etc.)
	-54	Sub-Assemblies
Computers and Systems	131-70	Sub-Assemblies (Wired)
	-71	Mag. Tape
	-72	Display
	-73	Memory
	-74	Fabricated Metals
Finished Goods	132-Model Number	

Assumes: All orders are currently due. Advance orders do not enter in here until one month prior to

APPENDIX II.

Module Availability Planning Sheet (Example)

Planned Issues is reviewed at each entry (line) in this sheet

How calculated?

Module Type	Balance On Hand	+ Open Jobs In-Process	- Orders	= Available Balance	-One-Month Usage	+ Planned Issues	= Planned Available	Action
1201	60	60	-	+120	110	120	+130	Status
1201	60	60	(30+24=) 54	(120-54=) +66	110	120	+ 76	Receive Customer Order for 30 Units, Computer Order for 24 Units.
1201	60	(60+120=) 180	54	(66+120=) +186	110	-	+ 76	Issue to In-Process Mfg. Lots for 120 Units.
1201	(60-30-24=) 6	180	-	+186	110	-	+ 76	Ship 30 to Customer, 24 to Computer
1201	(6+58=) 64	(180-60=) 120	-	+184	110	40	+114	Complete Mfg. Lots for 60-2 Rejects; Write planned Mfg. Lot for 40
1201	64	120	(97+48=) 145	+39	110	40	- 71	Receive Customer Order for 97, Computer Orders for 48
1201	(64+29-48=) 45	(120-30=) 90	(145-48=) 97	- 7*	110	(40+200=) 240	+123	Write Mfg. Lots for 200; Ship 48 to Customer; Complete Mfg. Lots for 30 - 1 Reject.
1201	45	90	97	- 7	140	240	+ 93**	New Calculation One-Month Usage

* Production Sequence Schedule and Expediting Action Indicated.

** Planned Manufacturing Lots to be Written for Issue.

INTEROFFICE MEMORANDUM

DATE January 18, 1963

SUBJECT DECAL at BBN

TO K. Olsen

FROM Gordon Bell

cc: H. Anderson
R. Beckman
J. Koudela
H. Morse
N. Mazzarese
S. Grover
S. Mikulski

BBN has invited DEC personnel to a 6-8 week class on DECAL beginning January 31st. The class meets every Thursday evening at 7:00 p.m. Hopefully at least three people from DEC will attend.

BBN might like us to help with a manual for the DECAL system. Stuart Grover should contact Dick McQuillan at BBN in regard to this activity.

dec INTEROFFICE MEMORANDUM

H.G.

DATE 1/15/63

SUBJECT

TO Win Hindle
George O'Dea
Dick Mills

FROM Stan Olsen

Notes on Establishing a Branch or Subsidiary in Germany

Basically, one consideration is that the taxes on the GMBH or subsidiary show more consideration than for a branch. The tax is a profits tax, and therefore, a lot of companies register with a branch first and then organize as a GMBH when they start making profits. They usually become a GMBH within one to two years.

Profits, as I understand it, are the normal percentage and equal type sales office would make on the sale of the products. This is a fairly vague statement but then this whole area is quite vague.

Now the basic thing that must be accomplished in either registering a branch or establishing a GMBH is to show that DEC exists and to what extent.

First of all you must recognize that the German Notary is of a fairly high status, equal probably to a lawyer, and he makes a 100% business of being a notary. The three steps to establishing a GMBH are:

1. A Notary Public here states that Kenneth Olsen is President and is lawfully authorized to sign for DEC.

2. The County Clerk certification of the Notary Public to be certified by the German Consulate.

3. The President's Authorization of someone (Huewe or the lawyer) to open office with power of attorney. This information is then taken to a German Notary and then taken to the Commercial court.

Most German companies have one or two people who have this power of attorney and are called chief clerks or the German word is Prokurist. He has power of prokura. This can be limited by a dollar amount and has no power over real estate.

Now to those first three items for our establishment as a GMBH to establish a branch there are three more things which have to be done. They are:

4. The articles of association or we would probably call them the articles of incorporation. These papers show the establishment with all changes in the corporation up until now and properly notarized.

5. List of all the signatures of officers who can represent the American corporation and sign on its behalf.

6. Permit of the Bavarian Ministry of Economics.

One other thing on the establishment of a GMBH, the capitalization is a minimum of $20,000 Deutschmark or $5,000.

As I understand it the establishment of a GMBH should take something less than a month because it is fairly simple. The establishment of a branch takes up to three months as there are several go arounds between the attornies, the Ministry of Economics, and the Commercial court.

It would then seem, from this information, that establishment of a GMBH would be by far the easiest and best method in the long run. We should probably now contact an American Attorney with experience in the German affairs of commerce.

I feel that Dr. Strobl is very good and quite competent but also very expensive and we should probably check with our attornies as to how reasonable his rate is of $150. per day. He has an office for which probably rents for $100-125 a month. He has one assistant and about three secretaries. I expect to receive a bill for his services up to date for $70.

Dr. Strobl gave me an 18 page document entitled Tax Problems of U. S. Enterprises in Germany. This is an address he delivered to the American Chamber of Commerce in

Munich on March 22, 1961.

cc: K. Olsen
H. Anderson

H. Anderson

dec INTEROFFICE MEMORANDUM

DATE January 15, 1963

SUBJECT Tape System – Data Channel Development

TO Computer Guidance Committee FROM Gordon Bell

cc: Dick Best
Roland Boisvert
Nick Mazzarese
Don Smith

Assumptions

1. Present tape systems

a) 51	7,000	1 mtg. panel	PDP-1 – IBM 200
b) 54	7,000	"	PDP-4 "
c) 52	29,000	7 "	1 & 4 "
d) 53	29,000	7 "	1 & 4 RR
e) 56	60,000	9 "	1 & 4 – 200/556/800
f) 57	15,000	4 "	4 – 200/556

2. Would like to minimize the number of controls by obsoleting the 52 and 56 if possible and have one system.

3. Would like to minimize the sales price for tape controls.

4. Must go to low cost high density system now.

Data Channel: -- Approach :

1. Design a stored program data channel which contains instructions.

   a) Provides scatter read, gather write operation.
   b) Provide a straight-forward program control.

2. Allow any I/O device to be connected to data channel with minor modifications.

Recommended Direction:

1. Proceed with data channel design.

2. Incorporate data channel in the design of 56.

Data Channel - Approach:

1. Provides a building block for new drum system for Foxboro possibly.

2. A new product.

3. A building block for new tape controls, disc file, and displays.

Results

1. 57 bare bones with 556 bpi machine would handle all PDP-4 work (superseding the 54 probably)

2. The Data Channel with an IBM-TCM or a variably density TCU should so precede the 52, and 56. (51 might still be sold)

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INTEROFFICE MEMORANDUM

DATE 1/15/63

SUBJECT

TO Dick Mills
George O'Dea

FROM Stan Olsen

Tax Attorney - Dr. Jacob Strobl
15 Brienner Strasse
Telephone 290745

Notes on Checking Account in the German Bank

The cancelled checks are not returned from the bank and there is no monthly statement. Statements are either semi-annual or annual, and statements come out when there is a change in the balance.

There is a copy of the checking account form to be made out here with the signature of the President and the list of people authorized to sign and whether it requires one signature or two signatures and the amount for such. Also, we must send along a copy of the official articles of incorporation to apply for the checking account.

The German checks are different than ours, and they may be cashed by the bearer not just the person designated.

Also, the bank will not return the checks, therefore, a receipt is necessary because the checks cannot be used as a receipt.

A good method of payment to people and suppliers in Germany is to send the check to our office and then our office deliver it in person and get a receipt for the check.

One method of protecting a check is to put two lines diagonally across the check which essentially means for deposit only. This qualifies the check and then it can only be deposited in that specified person's bank account. Also, this is an International symbol, the two lines, but we might also put the words Nur Zur Verrechnung. These words go between the two lines.

Of the bank accounts we have, the petty cash account is under bank no. 328447 Munich, under the name of Lieselotte Siebert. The personal account of Lieselotte Siebert is no. 1469488 Munich.

cc: K. Olsen
H. Anderson

INTEROFFICE MEMORANDUM

H.E.G.

DATE January 15, 1963

SUBJECT DECUS Executive Committee Meeting

TO Harlan Anderson
Gordon Bell
Bob Beckman
Elsa Newman
Nick Mazzarese
Stan Olsen
Win Hindle

FROM Dit Morse

On Wednesday, January 9, I met with the DECUS Executive Committee (consisting of Jim Wood - standing in for Ed Fredkin, Dick Hayes, Dick McQuillin, Eunice Cronin and Elsa Newman), mainly to discuss the relationship between DEC and DECUS with regard to the DECUS Program Library. Each of the members of the Executive Committee was given a copy of my memo (M-1156) which specifies operating procedures for the Program Libraries at DEC. The committee agreed that, for the present time, the procedures stated in the memo are acceptable to the DECUS Executive Committee with a few exceptions. The following items were those agreed upon:

1. Elsa will do the actual mailing of the tapes and writeups.

2. Since it is recognized that any numbering and classification scheme proposed by DEC is not binding on DECUS, the particular scheme chosen by DEC has not been immediately adopted by DECUS. However, it was decided that if revisions are to be made in the DECUS numbering scheme etc., there is no time like the present. So the advisability of considering a different numbering scheme than that presently used by DECUS will be considered by DECUS.

3. While there may be other and better schemes for the reproduction - verification of tapes, it was decided that since we have a working scheme presently in use, that DECUS would also use the scheme for the time being.

4. When we wish to send programs from the DECUS Library out with a PDP-1, these programs may go with the machine so long as the programs are requested from Elsa prior to delivery. It was generally agreed that a covering letter from DECUS should go out with all such programs as a

way of introducing our customers to the DECUS Organization.

5. In the near future DECUS will examine the tapes now in the DECUS files to:

   1. discard trash
   2. establish a list of tapes for distribution

6. The combination to the DECUS files will be known to Sandy Moore, and certain responsible people in DECUS, not designated at this time.

7. Any new tapes submitted to DECUS will be following the stated procedures.

H. R. Morse

dec INTEROFFICE MEMORANDUM

#5.G.

DATE January 14, 1963

SUBJECT LEEDS AND NORTHRUP

TO K. Olsen, S. Olsen, G. Bell, H. Anderson ✓, N. Mazzarese, D. Morse

FROM George Rice

Leeds and Northrup is coming very close to making the final decision as to which computer they will standardize on. I feel that a final decision will probably be made in the next week or two. This coming Wednesday, January 16, three men from Leeds and Northrup will be visiting our plant. These three will probably be the same three who met with some of us during the FJCC.

The particular configuration which L and N is interested in is:

PDP-4B
AU - Type 22
Real Time Option - Type 25
Paper Tape Punch and Control - Type 65
Printer-Keyboard and Control - Type 75

L and N wants formal quotes on the above equipment, the drum system, and the cost to extend the information collector in groups of 4 x 18 and 8 x 18. They may possibly want information on extending other parts of the Real Time Option and they certainly will want more firm commitments on our discount schedule.

L and N is very interested in parity. They know that we have offered parity on the PDP-1 and want to know if we will do likewise on the PDP-4. They say this will be important since if they use our machine they will be competing against others who use parity. The difficulty will come when L and N has to convince their customers that their machine (PDP-4 no parity) is better than somebody else's which has parity. We will have to convince them that parity is not only unnecessary on the PDP4, but give them some sort of figures (confidence) so they can present this to their potential customers.

During the visit by L and N I am sure they will want to have some time on one of our machines. We should have one available and in top condition. They probably will also want some explanations on programming techniques, in other words a short programming course.

We should also be prepared to talk about the following:

1. Field Service
2. Guarantee
3. New Products - to show future with DEC
4. Gordon's Automatic Counting Module
5. Software support - special programming assistance (?)
6. DEC's A-D's, or what we can offer.

X-EG

dec INTEROFFICE MEMORANDUM

DATE January 14, 1963

SUBJECT Digital's Tape System
Type 500

TO Engineering Products
Committee Members

FROM Tom Stockebrand

INTRODUCTION:

DIGITAL TAPE

Do you understand that, as a general rule, you cannot replace blocks of information already recorded on most tape systems presently in use? -- you must either rewrite the whole tape or replace the last block written and go on. This means that sorting, merging, collating, and updating must often use up valuable passes over the whole tape even if the information to be changed is near the present location of the head on the tape. The DIGITAL system (an outgrowth of work at MIT) eliminates this problem by providing ...

ABSOLUTE TAPE ADDRESSING

The system is similar to that used on a drum where each possible location is pre-specified by a fixed address track. For system of this sort high reliability is needed since a location must be always useful so we use ...

REDUNDANT RECORDING

In which all information is recorded on the tape several times to reduce errors magnificently.

Imagine carrying all your utility programs around in your pocket. No more lost paper tape. No punching our cards or paper tapes after program revision. The three and a half inch reel contain 2.5 million bits (since increased to 4 millions bits). With the PDP-4 the read-in is automatic and as simple as throwing a few switches. Since the recording system used makes reading and writing insensitive to speed, a

SIMPLE TRANSPORT

Without wear producing rolls, capstans and pressure pads has been provided.

ORIGINS

This system is an outgrowth, first, of Lincoln Laboratories TX-2 tape system and, second, of the LINC tape system developed for a small computer by Wes Clark at Lincoln. It also contains some ideas resulting from operational experience with both these tape systems. These two systems, both the huge and the tiny, are programmer oriented - their main purpose is to provide the man ability to rapidly load the machine with his programs. The machine thus contains a sort of Internal Library - more or less randomly available.

The single most important idea is of absolute addressing -- that is, the idea of recording block address and location information on the tape itself, once for all, which determines where on the tape various words and blocks are to be written. This is done by a timing track and a mark track. In the TX-2 system the mark track is simple, while in the LINC system the mark track is very much more complicated. In Digital's system it will be more complicated yet. The game is to trade mark track complexity for hardware complexity.

The next most important idea is that of using the Manchester Writing and Reading Scheme, that is using the polarity of the read-back signal to tell whether a 1 or 0 is written in a given spot. The use of this system allows the transport mechanism to have very sloppy speed control, it also allows information to be replaced at any place along the tape; the most significant system feature and one not present in NRZ systems. It should be mentioned at this point that the relation between tape speed, gap width and writing delays is a very subtle one -- understanding of this is essential to the understanding of the timing of the tape system.

The third important point is that the writing is done entirely with redundant heads, -- two head are wired in series for each channel to try to avoid the errors due to the very unreliable nature of the enviroment of a magnetic tape/head combination. It is also important, in my experience, to guard against unreliabilities even further by including hardware for a mechanically derived check sum to make as sure as conveniently possible that errors do not propagate down the tape when internal hardware failures exist.

The fourth point is that the tape transport has been designed to have the simplest possible mechanism. Since the reading and writing systems do not require the absolute speed control which makes a capstan drive necessary, the guiding is done by hydrodynamically lubricated bearings, which is to say the guide shoes are arranged so that a cushion of air supports the tape thus making it very easy to edge guide and reducing the wear to nearly zero. It might be noted at this point that the tension in the tape varies a great deal as the reels turn due to eccentricity of stacking and also the speed varies cyclicly as the reels rotate, which causes the air cushion between the tape and the head to be variable. Thus tension control is a certain problem.

CONTROL OF THE TAPE BLOCK TRANSFER PROCESS - GENERAL CONSIDERATIONS

This tape is different from all others in that the format - addressing is pre-recorded on the tape. Therefore, the distinction between control systems of various complexities like the type 51 and 52 are far less clear. The programmer never has the opportunity to do any timing and what counting for blocking he might do is always for the same number -- 256 + check sum. Much of the control's problems is taken care of by

markings on the tape which say when to do what.

Reference to figure one (attached) will illustrate the surprisingly complicated nature of the general transfer process from tape to computer or from computer to tape. When the details of timing are added, the picture becomes even more complex. The comments in this discussion are prejudiced toward the system of control illustrated in Figure 2 and are, therefore, not completely general. As a starter we will assume that the tape has several blocks of information alternating with address information laid out down along the length of a piece of tape. These areas are defined by code groups in a serial coded mark track. Further, this tape has two end zones on which are magnetically recorded information to tell the system that the tape has indeed arrived at the end. In general, then, to transfer a block one must first search the tape to find its location and then switch to writing or reading mode and transfer information. In writing the computer must be ahead of the tape -- the information from the machine must be loaded into the tape in-out buffer before the tape actually gets to the spot at which that information is to be written. This means that if the tape system is to warn the computer that a check sum should be deposited next on the tape, it must do so 1 or 2 words ahead of the time that the tape head actually gets to the area for writing the check sum so that sum can be prepared. It also means, in general, that there must be a section of tape which is skipped -- not writeable -- inmediately following the address information to enable the computer to load up buffers before the head passes into the writing area. Needless to say the turning on and the subsequent turning off of the writers must be a hardware function rather than a programmed function since it must be done at a time much more closely controlled with respect to the location of the head on the tape than that of which programming is capable (nearest 2 μsec). Also it is my contention that the turning off of the writer must be redundantly accomplished so that it is quite certain that it <u>will</u> happen. This is because in this system the block address information is contained in the same tracks in which information is recorded. Thus it is perfectly possible to write through the address information thus destroying the tape. A more sophisticated control would allow the recovery of blocks so destroyed but it would be definetely better not to have failure occur. There is no particular need for the various blocks in this system to be of the same length. However, it is more con-

venient and it is my experience that there is no particular loss of generality as long as the blocks are kept reasonably short. 256, 18-bit words is the currently accepted block length. The writing of the words in the block proceeds until the last word is written followed by check sum. The check sum is absolutely essential to the tape system under discussion and I feel that if it is at all possible, the check sum or other checking words should be written automatically by the hardware though of course the programmer should be able to ignore the results of the check if he so desires. This is because of my experience with tape systems -- they inevitably have failures which must be tracked down. Evidence is often missing at a later date when the tracking down process is undertaken if its gathering is left to the programmer. If the tape system is to inform the programmer when the check sum is to be written, as previously noted, this must have been done 2 slots before the actual writing of the check sum, thus requiring another mark. If the check sum is automatic, then the check word load operation can be initiated by a pulse coming from the hardware during or inmediately after the writing of the final data word.

The mark which defines the check sum slot should turn off the writers since it signifies that the last slot has passed under the head. The mark defining the next slot should also turn off the writers in case the check sum mark fails to do so. Inmediately following the writer turn off a short section of tape must exist which can be "clobbered" by the writing operation or else a special write turn off delay must be included in the hardware since the tape is disturbed both ahead of and behind the gap center line as the gap sweeps down the tape during the writing process. This slot is called the guard slot. A second guard slot should be provided to allow the above mentioned redundant turn off to operate without trouble. Note that changed guard slots are a good sign of trouble.

Once the writing has ceased the block is transfered but if a following block number is to be read it must be spaced a distance down the tape corresponding to the time it takes the read amplifiers to recover from any transients induced by the writing process. This time is allowed by including a recovery zone before the next block number. The reading operation also demands special pulses:

First, the number must be read to find that this block is in fact the desired block. Note that in reading the computer will be always later than the tape system. The information read out is not available until after the head has passed over the word to be read and is in fact reading the upcoming word or character. For this reason the first few flags, which were useful during writing, should be suppressed until the first word or character has actually been read off the tape. This is indicated in Figure 1 by the title "Read first of M words..." the reading operation is somewhat simpler than writing since the writers need not be turned on and off, though there is nothing wrong with turning them off redundantly as the check sum word goes by. The equipment must be informed, however, that the block has been read in and that the word upcoming is the check sum and, therefore, to be treated differently than the other words read in, (unless extensive program control of the transfer process is undertaken). In the case of the hardware it may well be that the same checking facility which wrote the sum can be used to check the sum.

If the tape should run off the end during its operation by the programmer, he might or might not know it. If the system were directly on the console, he would most certainly know it and no special provision would be necessary; however, if it is operated by uninitiated people or hidden away somewhere then end detection becomes most necessary. Both because they are fuzzy in location on the tape and because they do not provide "DC" off end information, reflective spots are in general less useful in this system. One solution is to number the blocks starting well into the end zones through a useful series of block numbers down the length of the tape into the far end zone with a continuing numerical progresion so that the searching mechanism need never cover the exceptional case of being off the end. A second idea is to label both ends differently (and incidentally with a complimentary read code, see below) and allow travel in the end zone only in the direction back on the tape. In any case a flag must be set or other note made of the fact that the tape is off the prohibited end for the unaware or unastute. Some need for an automatic rewind has been mentioned, the mark system should allow for this - perhaps in this case reflective spots can be of assistance.

Some time in the future we may want to read and write this tape in either direction. Even though this may never come to pass we should allow for it. In the addressing and mark track lay-out scheme, in Figure 3 we see the development of the marks in the mark tracks for a tape which is capable of being read in either direction. The idea is that the tape shall be marked in such way that whether it's read backwards or forward the same reading and mark detection circuitry shall operate to give outputs at the correct place on the tape. In order to provide some perspective on the problem, Appendix I is attached. It is a copy of a section of the LINC operation manual. PP 43 - 48 and 52 - 56.

We now make a small digression into the idea of reading backwards and forwards. It should be noted that the tape system on the LINC drive can read or write blocks of information forward only but must be able to search backwards over the tape to find a block address. It does this by having two sets of block series. The forward marks are written just before the blocks of information for which they stand. The reverse marks are written just after the blocks. The reverse mark itself is the same pattern as the forward mark except reversed on the tape so that the same block mark detection machinery can detect either kind of mark whichever way the tape is moving. The number in the marked slots itself must be both the compliment of the correct one and must be reversed within the slot so that the shift registers will not need to be bi-directional in order to straighten out the word as read off the tape. By this strategy the numbers read for the reverse marks will be correct as they appear in the buffer. A further point needs to be made that the actual numbers must be displaced down the tape in a forward direction from the blocks which they represent. This is because after recognizing a mark while traveling in the reverse direction one must turn around and pick up speed in the forward direction and still be ahead of the block which is sought. The amount that the block numbers are off-set is thus a function of the mechanical characteristics of the transport. Depending on how much of the searching is mechanised with hardware and how much can be left to the programmer this off-set problem can be solved in two ways. In the LINC case hardware did all the work so the off-set was necessary on the tape. It is perfectly possible to give the programmer the work

of going far enough past the desired blocks so that when he turns around he will still be ahead of the block of interest. Since we may want to develop control of two different degrees of complexity we should, I think, provide both sets of marks. Bearing all this in mind we sketch the complete block marking system in Figure three.

MARK TRACK

Figure 3 illustrates one block on the tape. It starts out with a recovery zone which allows the recovery of the read amplifiers from the write turn-off transient in case the preceding block had been written. The first mark is the block mark -- the block address number is written in the information channels adjacent to this mark. The next two marks are skip marks -- as read forward -- which provide the guard marks when writing backwards. The reverse check sum comes next; it is the point at which the check sum is written when writing backward. Following this is the first data word in the block and thereafter are 255 other data words. The last data word is marked especially as the final data word for the sum checking machinery and is followed by the forward sum check marks. Immediately following the sum check are two guard marks followed by the slot for the reverse mark number. The recovery area completes the picture. Several features of this layout are apparent; first, the tape is symetrical foward and backward except for the names of the slots. The letters above and below the tape mark information indicate something about the character of the marks to be written to wit;

1. The recovery zones and the data marks could be symetric marks -- readable in either direction by the same hardware since they should read in both the forward and reverse directions. For example: 100001 would be an acceptable data mark and 101010 might make a good recovery mark. Notice that several of these in a row are indistinguishable.

2. Marks B,C,D,E and G can and should be marked which are symetrical pairs; that is C & C' should be read by the same hardware as "skip" when traveling in one direction and "guard" when traveling in the other direction. Similarly for the end zones, the check sums, and the final and first data marks.

3. In addition to having "reverse symmetry", the block marks should be arranged so that the word written opposite the reverse block mark is complimented and obverted. Then it can be read backwards without the need of a bi-directional shift register -- this is done in the LINC tape system.

The bottom half of the page outlines, roughly, the various properties needed by the control. The first line discusses the LINC type search. For searching, only four marks need to be recognizable, they are: block ends, recovery areas, forward and reverse block marks. The block end information is used of course to stop the tape. If the control can recognize the recovery areas then a slow speed break or interrupt can be executed in time to allow the program to get its house in order to accept an upcoming block mark. This will help the simple type controls to take maximum advantage of programming. The actual searching, of course, is done with the block mark numbering itself.

When moving forward a given number is read and compared with the desired number. This presents three alternatives: either,

1. You are not there yet so keep going or,

2. You are too far so turn around or,

3. This is the number so change modes to read or write depending on the programmers desires.

If you are moving backwards in this LINC type search, then the comparison between the backward mark and the desires mark leaves only two choices - either "keep going" or "turn around and keep searching". This turn around must be done in such a way that you are guaranteed you are up to speed and ready to read the desired block after the turn around and not too far forward down the tape again so as to have missed the desired block. In LINC this is accomplished by off-setting the reverse mark down the tape. Though the same thing can be done with a hardware delay. We will do it with a hardware delay and I believe the LINC people are going this same way too.

A programed search in which bi-directional transfer is possible would necessarily need to recognize the same forward choices, but in this case the options available when sensing reverse block marks includes also the start of a transfer. In the case

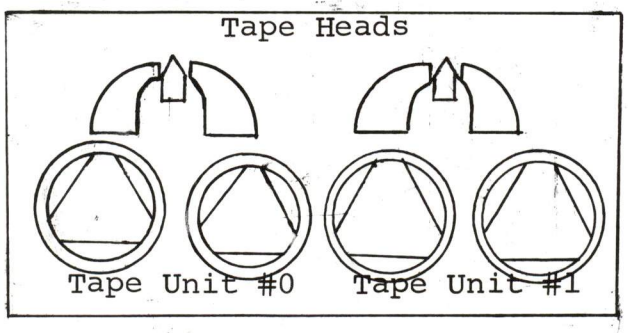
of a program search the delays of course could be built into the programming in the form of block marks off-set, a scheme which is absolutely necessary for variable speed drive such as TX-2 (in line with the idea that programmers should be helped out to the maximum possible in future tape designs, a more sophisticated control could in fact handle the variable speed block search problem when we get to building drives with 10^9 bits.

Once the correct block is found and reading takes place, the tape must be looked at more carefully. The marks necessary for reading forward are shown. Upon the receipt of the transfer in progress command for read the tape need do nothing until mark "D" the reverse check sum mark, appears. At this time the check sum register, which has previously been cleared, should be increased by the number in the reverse check sum slot but no transfer should be done to memory. Marks "E" "E'" and "F" all signify that a word should be transfered to memory and that check sum register should be increased by the numberical value.

Magnetic Tape Instructions

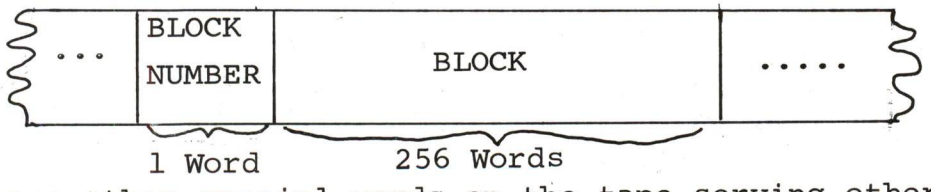
The last class of instructions, MAGNETIC TAPE, requires some discussion of the LINC TAPE UNITS and TAPE FORMAT. The LINC uses small reel (3 3/4" diameter) MAGNETIC TAPES for storing programs and collecting data. There are two TAPE UNITS on the LINC TAPE PANEL on which tapes are mounted:

LINC MAGNETIC TAPE PANEL



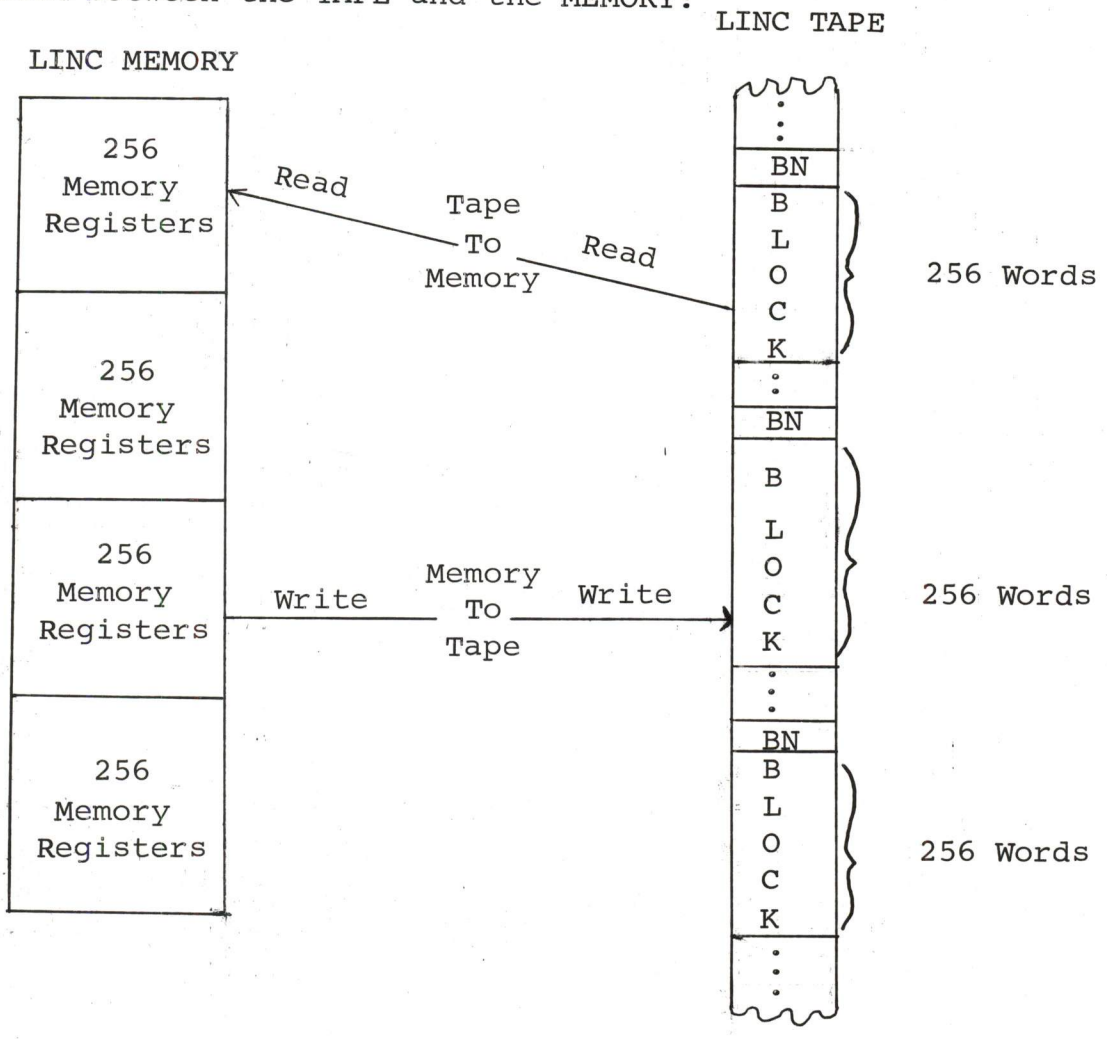
Any MAGNETIC TAPE instruction may use either the TAPE on UNIT #0 or the TAPE on UNIT #1; which unit to use is specified by the instruction itself; only one UNIT, however, is ever used at one time.

A LINC TAPE can hold up to 131,072 12-bit words on information, or the equivalent of 128 (decimal) full LINC memories. It is, however, broken up into smaller segments known as BLOCKS, each of which contains 256 (decimal) 12-bit words, - a size equal to one-quarter of a LINC memory BLOCKS are identified on any tape by BLOCK NUMBERS, 0 through 777 (octal), and MAGNETIC TAPE instructions specify which BLOCK to use by referring to its BLOCK NUMBER. On the tape a BLOCK NUMBER (BN) permanently occupies a 12-bit space preceding the 256 words of the BLOCK itself:



There are other special words on the tape serving other functions which complete the TAPE FORMAT. Before describing these, however, we may look more specifically at one of the MAGNETIC TAPE instructions, READ TAPE, RDE i m. READ TAPE is one of four MAGNETIC TAPE instructions which copy information either from the TAPE into the LINC MEMORY (called READING), or from the MEMORY onto the TAPE

(called WRITING). These are generally called BLOCK TRANSFER instructions because they TRANSFER one BLOCK (256 words) of information between the TAPE and the MEMORY:



All of the MAGNETIC TAPE instructions are two-register instructions. RDE, typical of the four BLOCK TRANSFER instructions, is written:

Memory Location	Contents	
p	RDE i m	1400 + 20i + 10m
p + 1	QN|BN	QN(2000) + BN

The first register of the instruction has two special bits. The i-bit is used to select the TAPE UNIT: when i = 0, the TAPE on UNIT #0 will be used; when i = 1, the TAPE on UNIT #1 is used. In order to execute any MAGNETIC TAPE instruction, the TAPE on the requested UNIT must be moving at a constant speed of 40 inches per second. Therefore, if the TAPE is not moving when the computer encounters a MAGNETIC TAPE instruction, it is started automatically and the computer waits until the TAPE has reached the required speed before continuing with the instruction.

The m-bit, or "motion bit," (bit 3), is used by the programmer to control the motion of the TAPE after the instruction is executed. If m = 0, the TAPE will STOP; if m = 1, it will continue to MOVE at 40 ips. If, for example, we want to do several MAGNETIC TAPE instructions at a time, it is sometimes more efficient to let the TAPE continue to MOVE after each one. If we let it STOP we will have to wait for it to start again at the beginning of the next TAPE instruction. Examples of this will be given later.

In the second register of the RDE instruction, the rightmost 9 bits are for the requested BLOCK NUMBER, BN; that is, they tell the computer which BLOCK on the TAPE to READ into the memory. The left 2 bits, called the QUARTER NUMBER bits, QN, refer to the MEMORY. They specify which QUARTER of MEMORY to use in the TRANSFER. The QUARTERS of the LINC MEMORY are numbered 0 through 3, and refer to the memory registers as follows (numbers are octal):

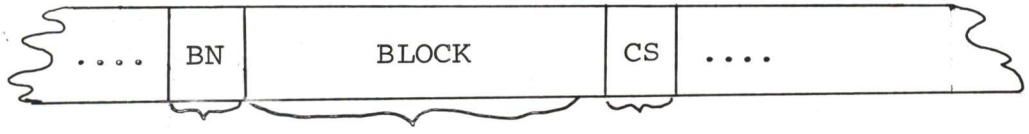
QN	MEMORY REGISTERS
0	0 - 377
1	400 - 777
2	1000 - 1377
3	1400 - 1777

Suppose, for example, we want to put data which is presently on the TAPE into memory registers 1000 - 1377. The data is in, say, BLOCK 267 and the TAPE is mounted on UNIT #1:

Memory Location	Contents		Comment
200	RDE i	1420	Select UNIT #1;
201	2 267	2(2000) + 267=4267	C(BLOCK 267)→QUARTER 2)

This instruction will start the TAPE on UNIT #1 moving, if it was not already moving. It will then READ BLOCK 267 on that TAPE into QUARTER #2 of MEMORY via the ACCUMULATOR and STOP the TAPE when the TRANSFER is completed. The computer will go to location 202 for the next instruction. After the TRANSFER the information in BLOCK 267 is still on the TAPE - only MEMORY REGISTERS 1000 - 1377 and the ACCUMULATOR are affected. Conversely, WRITING affects only the TAPE and the ACCUMULATOR; the MEMORY is left unchanged.

Another special word on the TAPE, physically located immediately following the BLOCK, is called the CHECK SUM, CS:



1 Word 256 Words 1 Word

The CHECK SUM, a feature common to many tape systems, is used to check the accuracy of the TRANSFER of information to and from the TAPE. On the LINC it is the complement of the sum of the 256 words in the BLOCK. Such a number is formed during the execution of another BLOCK TRANSFER instruction, WRITE TAPE, WRI i m. This instruction WRITES the specified MEMORY QUARTER in the specified BLOCK of the selected TAPE:

Memory Location	Contents	
p	WRI i m	1402 + 20i + 10m
p + 1	QN|BN	QN(2000) + BN

During the TRANSFER the words being written on the TAPE are added together in the ACCUMULATOR. This sum is then complemented and in the CS space following the BLOCK on the TAPE. After the operation the CHECK SUM

is left in the ACCUMULATOR and the computer goes to p + 2 for the next instruction. The i,m,QN, and BN bits are all interpreted as for RDE.

One means of CHECKING the accuracy of the TRANSFER is to form a new sum and compare it wil the CHECK SUM on the TAPE. This happens during RDE: the 256 words from the BLOCK on the TAPE are added together in the ACCUMULATOR while they are being TRANSFERRED to the MEMORY. This simple, uncomplemented sum is called the DATA SUM. The CHECK SUM from the TAPE is then added to this DATA SUM, and the result, called the TRANSFER CHECK, is left in the ACCUMULATOR. Clearly, if the information has been transferred correctly, the DATA SUM will be the complement of the CHECK SUM, and the TRANSFER CHECK will equal negative zero (all ones). We say that the BLOCK "CHECKS." Thus, by examining the ACCUMULATOR after a RDE instruction, we can tell whether the BLOCK was transferred correctly. The following sequence of instructions does this and READS BLOCK 500 over again if it does not CHECK:

Memory Location	Contents		Comment
→300	→RDE	1400	READ BLOCK 500, UNIT #0, into QUARTER #3
301	3/500	6500	Leave the TRANSFER CHECK IN THE ACCUMULATOR and STOP the TAPE
302	SAE i	320	SKIP to location 305 if C(ACC) = 7777,
303	7777	7777	i.e. if the BLOCK CHECKS. If C(ACC)
304	JMP 300	6300	≠ 7777, return to READ the BLOCK again.
305			

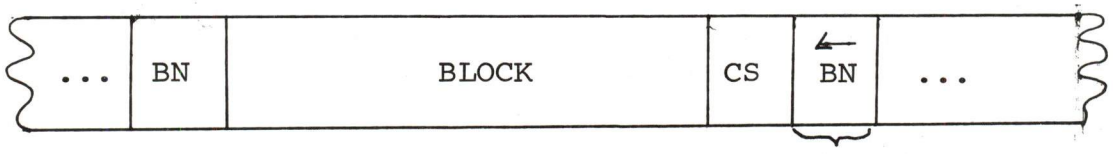
Since in most cases it is a good idea to CHECK TRANSFERS, the remaining two BLOCK TRANSFER instructions do this automatically. READ AND CHECK, RDC i m, does in one instruction exactly what the above sequence of instructions does. That is, it READS the specified BLOCK on the selected TAPE into the specified QUARTER of MEMORY and forms the TRANSFER CHECK in the ACCUMULATOR. If this does not equal -0, the instruction is repeated (the BLOCK is reread, etc.). If the TRANSFER CHECKS, the -0 is left in the ACCUMULATOR and the computer goes on to the next instruction at p + 2. The instruction is written:

Memory Location	Contents	
p	RDC i m	1401 + 20i + 10m
p + 1	QN BN	QN(2000) + BN

Memory Location	Contents		Comment
10	X	X	Store address for SAMPLES
11	-N	-N	Counter
⋮			
1000	TGN	1342	C(TGN) → C(ACC). Complement the
1011	COM	1350	number and store in register 11.
1002	STC 11	4011	
1003	→SET i 10	1070	Set register 10 to store SAMPLES
1004	1377	1377	beginning at 1400.
1005	→SAM 7	1307	
1006	STA i 10	130	Sample INPUT #7, store value and
1007	XSK 10	750	repeat until 400 (octal) SAMPLES have
1010	JMP 1005	7005	been taken.
1011	→WRC i	1423	When QUARTER #3 is full, WRITE it on
1012	3|200	6200	TAPE and CHECK the TRANSGER. The TAPE STOPS.
1013	LDA i	60	
1014	1	1	Add 1 to the BN in location 1012
1015	ADM	200	
1016	1012	1012	
1017	XSK i 11	771	Index the counter and skip if the requested number has been collected.
1020	JMP 1003	7003	If not, return.
1021	→WRC i	1423	If done, WRITE this program in BLOCK
1022	2|177	4177	177, CHECK the TRANSFER, and STOP the TAPE.
1023	HLT	0	HALT the computer

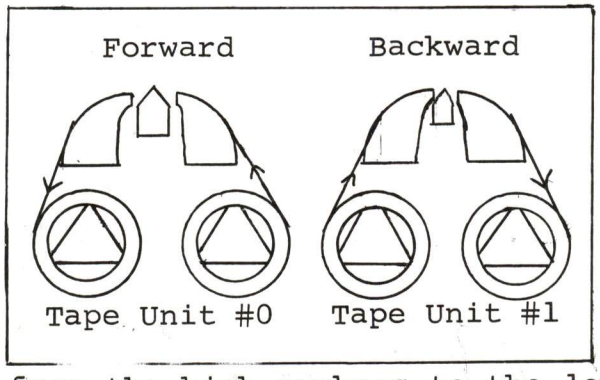
Since the program saves itself when finished, the user can continue collecting data at a later time by READING BLOCK 177 into QUARTER #2, and JUMPING to 1000. Since the BN in location 1012 was saved, the data will continue to be stored in consequitive BLOCKS.

To describe the last two MAGNETIC TAPE instructions, READ NUMBER FORWARD and READ NUMBER BACKWARD, we must look again at the TAPE FORMAT:



Following the CHECK SUM is another special word called a BACKWARD BLOCK NUMBER, $\overleftarrow{BN}$. When the computer is searching the TAPE for a requested BLOCK, it looks at every BLOCK NUMBER until it finds the correct one. Since the TAPE may be positioned anywhere when the search is begun, it can move either FORWARD or BACKWARD to find the BLOCK. By FORWARD is meant moving from the low BLOCK NUMBERS to the high numbers Physically the TAPE moves to the left reel and the computer looks at the FORWARD BLOCK NUMBERS, BN, preceding the BLOCKS.

LINC TAPE PANEL



By BACKWARD is meant from the high numbers to the low; the TAPE moves to the righthand reel and the computer looks at the BACKWARD BLOCK NUMBERS, BN. Generally speaking, when searching for a requested BLOCK the computer decides whether the TAPE must move FORWARD or BACKWARD by comparing the first BLOCK NUMBER (whether BN or BN) it finds with the requested number.

To facilitate this comparison the BLOCK NUMBERS on the TAPE are <u>complemented</u>; for example, the BN in front of BLOCK 20 looks like -20, or 7757. The process of locating a specific BLOCK is best understood by describing the READ NUMBER instruction. READ NUMBER FORWARD, RNF i m, causes the computer to read the next FORWARD BLOCK NUMBER, $\overleftarrow{BN}$, it finds into the ACCUMULATOR. If the requested TAPE is not moving FORWARD when the instruction is encountered, the computer starts it in the FORWARD direction and waits until it reached the required speed before reading a BN. The instruction is written:

Memory Location	Contents	
p	RNF i m	1404 + 20 + 10m
p + 1	N	N

As with the other MAGNETIC TAPE instructions, the i-bit and the m-bit select the TAPE UNIT and control the TAPE MOTION after the instruction is executed. The second register, however, is used somewhat differently. After the computer has read a BN into the ACCUMULATOR, the contents of this second register are added to it. For example, if N in the second register equals zero, and the TAPE is in front of BLOCK 20, 2-20, or 7757, will be left in the ACCUMULATOR. These instructions permit the programmer to find out where the TAPE is at any particular time. Suppose we want to know how far from BLOCK 50 the TAPE on UNIT #0 is. If we write the instruction

Memory Location	Contents		Comment
20	RNF m	1414	Next BN + C(21)→C(ACC)
21	50	50	TAPE continues to MOVE FORWARD

and the TAPE is in fact in front of BLOCK 20, a +30 will be left in the ACCUMULATOR; we know that we are 30 BLOCKS away. Note that if the TAPE were in front of BLOCK 70, a -20 would be left in the ACCUMULATOR. Not only do we know from this that the TAPE is presently 20 BLOCKS away from BLOCK 50, but we can also tell from the sign of the number in the ACCUMULATOR that BLOCK 50 is "behind" the present TAPE position; that is, the TAPE would have to reverse its direction and go BACKWARDS to find BLOCK 50.

It is exactly in this way that the computer finds requested BLOCKS for the other tape instructions. Suppose the computer encounters a "WRITE-IN-BLOCK 230" instruction. If the TAPE is moving FORWARD at the time, the computer adds the next BN it finds to the number 230 and looks at the result. If the result is positive, the TAPE continues to move FORWARD until a new BN is found; this is then added to 230, etc. If the result is negative (other than -0), the TAPE reverses direction and the computer looks at BACKWARD BLOCK NUMBERS. These are added successively, to the number 230 and the TAPE direction reverses again when the result is positive. If, when the TAPE is moving

FORWARD, the result is -0, then BLOCK 230 has been found and the TRANSFER is made. TRANSFERS and CHECKS are only made in the FORWARD direction.

If, when the instruction is initially encountered, the TAPE is moving BACKWARDS, the computer adds the first BACKWARD BLOCK NUMBER, $\overleftarrow{BN}$, it finds to the requested number, uses the sign of the result to determine the direction, reverses the TAPE to FORWARD direction when the result is positive, and makes the TRANSFER when the result is -0 in the FORWARD direction.

For all MAGNETIC TAPE instructions except READ NUMBER BACKWARD, if the TAPE is not moving at all when the instruction is encountered, the computer always starts the TAPE in the FORWARD direction and waits until the TAPE is moving in this direction at the required speed before reading a BN. Also except for READ NUMBER BACKWARD, if m = 1, the TAPE continues to move FORWARD after the instruction is executed. READ NUMBER BACKWARD, RNB i m, is exactly like RNF, except for the TAPE direction. If the TAPE is not moving, the computer starts it in the BACKWARD direction; if it is moving FORWARD, the direction is reversed, etc. The first BACKWARD BLOCK NUMBER found is then added to N and the result left in the ACCUMUALTOR:

Memory Location	Contents	
p	RNB i m	1405 + 20i + 10m
p + 1	N	N

Here, when m = 1, the TAPE continues to move BACKWARD after the instruction is executed.

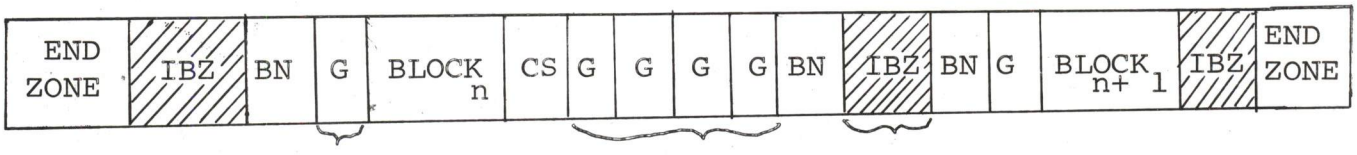
The READ NUMBER instructions serve the function not only of locating the TAPE position for a program, but can also be used to save time. If, for example a program must READ BLOCK 700, and the, at some later time WRITE in BLOCK 50, it is efficient to have the TAPE move BACKWARD toward BLOCK 50 in the interin while the program continues to operate:

Memory Location	Contents		Comment
100	RDC m	1411	C(BLOCK 700)→C(QUARTER 3)
101	3 700	6700	TAPE MOVES FORWARD
102	RNB m	1415	TAPE REVERSES. $\overleftarrow{BN}$+ 0→C(ACC).
103	0	0	TAPE MOVES BACKWARD
⋮	⋮	⋮	TAPE continues to move BACKWARD
⋮	⋮	⋮	While program continues
300	WRI	1402	C(QUARTER 0)→C(BLOCK 50)
301	50	50	TAPE STOPS
⋮	⋮	⋮	

In this example it would have been impractical either to STOP the TAPE (m = 0) after the RDC instruction in location 100 or to let it continue moving FORWARD until BLOCK 50 is called for. Although we are not interested in the BN left in the ACCUMULATOR after the RNB in location 102, this instruction does serve to reverse the TAPE. When BLOCK 50 is called for, the delay in finding it will not be so long.

Certain other facts about the TAPE FORMAT and MOTION should be mentioned before concluding. Other special words on the TAPE are shown:

LINC TAPE



At each end of the TAPE is an area called END ZONE, providing several feet of protection for the rest of the TAPE. When an automatically moving TAPE moves into an END ZONE, the TAPE STOPS, regardless of the conditions prevailing on the UNIT. (This prevents the TAPE from being pulled off the reel.) Words marked G above are called GUARD WORDS; these are areas bounding the BLOCK and CHECK SUM which protect the BN and BN when the WRITE current is turned on and off. GUARD WORDS do not generally concern the programmer except insofar as they are part of the TAPE FORMAT. INTER BLOCK ZONES, IBZ, are spaces between block areas which can be sensed by the SKIP instruction, IBZ i, when either TAPE is moving FORWARD or BACKWARD and up to speed.

COPY OF AN MIT INTERNAL MEMO

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Lincoln Laboratory

To: W. A. Clark August 4, 1961

From: I. E. Sutherland

Subject: Some Notes About Display Scopes and Plotters

Conclusions

The TX-2 Oscilloscopes (Sequence 60 and 56) should be adjusted so that 000000 is a different place from 111111, as they now are.

There has been talk of letting the user specify whether he wants to be the same, but if this is done it should be INDEPENDENT of the origin location. That is, new bits of the $IOS_{60}30xxx$ should be used for this choise.

A mode for the scopes where 18 adjacent bits were decoded as x and y coordinates (e.g. quarter 4 for x and 3 for y) would be useful for doing index register arithmetic with scope coordinates. In this mode the final bit now used would always be considered as zero.

The TX-0 scope now at the Institute should have its origin at the lower left corner.

The plotter (Sequence 74) should decode the leftmost bits in the 2 halves, and have its origin in the center (with 000000 and 111111 as slightly different points.)

Generalized Conclusions

For each type of display various configurations are listed in order of desirability. TX-0 type computation is assumed, so 9 and 18 bit decoding are important. For other machine, read 9 as n or n/2, or n/4 or something.

No. of Bits Decoded Per Axis	Decoded At	Origin Location	+0 = -0	Desirability for TX-2
1 - 8	leftmost part of each of 2 adjacent quarter	Center	no, but some doubt for 8 bit case	1
		Edges	no	2
		Center	yes	3
9		Center if parallel 9 bit addition & overflow detection possible (TX-2 AE)	yes	1
	2 adjacent quarters	lower left if only 18 bit addition possible (TX-0 or TX-2 Indexes)	no	2
10 - 17		Center	no	1
	leftmost of 2 halves	lower left	no	2
		Center	yes	3
18	2 halves	center (see 9 bit case)	yes	

I. Desirable Features

The desirable features of a display system, be it scope or plotter, are that it be easily possible to:

A. Draw lines or figures across the entire drawing area without encountering discontinuities within the area. E.G. no break as you pass the origin, i.e. scope is HOMOGENEOUS.

B. Detect the edge of the scope in some easy way so that figures moved over the edge may be eliminated if so desired, i.e. easy EDGE DETECTION.

C. Make the display represent a small section of a larger field i.e. like a WINDOW.

D. Carry numbers in the computer to a higher degree of precision that they are displayed, i.e. higher computing PRECISION.

It may not be possible to design a decoding system which will meet all these desirable features. I intend to show, however, that a choice need only be made between featured 3 and 4 and this can be left to the user. I give some suggestions on how to make good use of the system chosen for features 1 and 2.

II. Numbering Systems

The TX-2 is a one's complement machine which means that the number +0 is different from all other numbers in that it cannot be the result of an addition (except of (40) + (+0)). Therefore, there are only $2^{18} - 1$ possible states for a half word. For any display decoder which considers 000000 as a different display place from 111111, there are 2^n display positions. Since 2^n and $2^{18} - 1$ are mutually prime, $n > 0$, it is not possible to make each display point represent an equal number of computer points. If the display decoder is built so that it has $2^n - 1$ display points (considering 111111 as the same as 000000) the situation is similarly difficult unless n=18, which of course

it does not.

The TX-2 has a ring accumulator, by which I mean that carries generated in the "most significant" bit are used to change the "least significant" bit during addition. Thus, the result of cycling 2 number equally and then adding is the same as adding and then cycling. For arithmetic operations, then, I can choose the bit I wish to be "most significant" as I please, for example, as bit 4.8, considering bit 4.7 next, then 4.6, etc. and back around so that 4.9 is "least significant".

Bit 4.9 is somewhat different from the rest of the bits, however, because the overflow flip-flop and the JPA and JNA instructions detect it. In the discussion below this property of bit 4.9 will be used to simplify edge detection. It should be clear from the ring nature of the accumulator that Window and Precision are merely a matter of where <u>you</u> think of the most significant bit, not which bits are actually used in the display decoder.

M = Most Significant Bit
S = Least Significant Bit

XXXXXXXXXXUUUUUUUU	XXXXXXXXXXUUUUUUUU
.........SM........	M.................S
Maximum Window	Maximum Precision

III. <u>Homogeneity</u>

If the display decoder is designed to consider 000000 as different from 111111, homogeneity will be achieved as long as the bits (of a half word) <u>not</u> decoded for display are not all the same. This is because the case of the entire word's being either +0 or -0 is avoided entirely. If, however, the display decoder considers 000000 to be the same as 111111, homogeneity will be achieved only if the bits of the half word <u>not</u> decoded are a sign extension of the bits that are decoded. This rule applies whether the codes 000000 and 111111 result in display at the center of the scope or at its edge, although the lack of homogeneity is most noticeable when the origin is at the center.

As this paper is written the TX-2 scope is adjusted to consider +0 as a slightly different place from -0, a very sensible arrangement. It is proposed that the plotter will also work this way.

Programming Tip No. 1

When you do calculations for a display see that the unused bits (for the scope, bits 3.8 to 3.1 and 1.8 to 1.1) are set to something other than 000000 or 111111. Anything at all! That gives you nearly 2^8 different choises!

IV. Edge Detection

If the decoded bits are taken at the leftmost edge of the TX-2 half word and the origin is placed at the center, edge detection is nicely accomplished by using the ^{20}JOV instruction. Were the decoded bits chosen anywhere else in the TX-2 word, edge detection would be not nearly so easy.

Programming Tip No. 2

Put the origin in the scope center and use the ^{20}JOV instruction to tell when you have run across the edge of the scope. Programming tip No. 1 will give you a homogeneous display.

If the origin of the display is in the lower left hand corner (i.e. numbers considered as integers), then one has passed the scope edge when the bit one more to the left than the most significant decoded bit changes. This can be handly detected by the ^{20}JPA or ^{20}JNA if display decoding is run from bit 4.8 down. Unfortunately, it is still necessary to make the unused bits non zero to avoid confusing ± 0.

V. Window and Precision

Since there are only a certain number of bits not decoded these must be divided between the window (i.e. display field is a small part of a much larger computable field) and precision (i.e. coordinates are computer more accurately than they are displayed). Due to the confusion of ± 0 one can achieve a homogenous display only at the expense of some window or precision, because the undecoded bits must

not be all zeros or all ones.

VI. No Undecoded Bits

Suppose that we wish to store display points in 18 bits because we wish to get two points into each TX-2 word (or we are using the TX-0 or index register arithmetic on the TX-2). There will be no undecoded bits to make non-zero. If ±0 are made to be the same place (probably the center of the screen) the display will be homogenous with respect to each 9 bit half, and the JOV instruction can be used for overflow detection. This is a possible mode for use on the TX-2, providing 9 bit additions are performed to avoid carries from one coordinate affecting the other.

If a 9 bit configuration for addition is not available, as when using index register arithmetic or on the TX-0, the origin should be put at the lower left corner so that carries from the right 9 bits enter the left 9 bits only at the screen edge where this is least noticeable.

dec INTEROFFICE MEMORANDUM

d/3G

DATE 1/11/63

SUBJECT Telephone Conversation with John Curtis of EAI

TO File

FROM Nick Mazzarese

cc: H. Anderson
K. Olsen
S. Olsen
G. Bell

John Curtis is the new Marketing Vice-President at Electronic Associates. He is somewhat of a fireball and is presently evaluating a number of computer vendors to determine whom they shall enter the Hybrid market with on a joint venture basis.

They are presently evaluating the DDP-19, the SDS-920, the PDP-1, and the Packard Bell 440.

It is interesting to note that two of our competitors, at least, are offering a 30% quantity discount; however, John Curtis did mention that our machine is in a favorable position as regards quality, capability, and general performance. They are somewhat disturbed at our high price.

They have invited me to present our case to their management and engineering (engineering is already on our side).

There are some rather subtle things going on here; in that John Curtis implied that they are looking for more than the usual customer vendor relationship. I am not quite sure how far he plans to go in this.

He did mention that, off the record, he was thinking as far ahead as possible mergers. At this time he mentioned that he wasn't sure that he was willing to go this far with some of our competitors.

To this end, he requested that an officer of our Company come along to discuss our corporate set-up, long term technical skills, and future plans.

Harlan Anderson and myself will be visiting them January 9, 1963.

NM/jr

INTEROFFICE MEMORANDUM

DATE January 11, 1963

SUBJECT

TO Harlan Anderson

FROM Kenneth H. Olsen

cc: Nick Mazzarese

I got a telephone call from Charlton Walter at AFCRL at 1:15 p.m. on Friday, January 11. He was being visited by Miss Swanson of the Air Force Office of Scientific Research of Washington, D.C. They have a contract with Doctor Heinz von Foerster at the University of Illinois. He is now using time of the Illiac Computer, but he doesn't get enough time and badly needs a computer. She would like very much to see him have his own computer because she thinks very highly of his work. She thinks in the field of Cybernetics, he is doing work which is definitely the same level as the Russians. This includes work on artificial intelligence and so forth. The contract with the Air Force is such that they cannot buy equipment, but she feels that if they could get an educational discount from us he might get enough money from the National Science Foundation to buy a computer.

The question she was specifically asking was whether or not we could give a discount. I said I was sure that there would be some, although I didn't want to propose any numbers. It is now left that we will contact Doctor von Foerster and see if we can't work out a sufficient discount so that they could buy one.

Because you are the alumni of the University of Illinois, I think it might be good if you followed through on this otherwise, you might pass it on to Nick. I am not sure that we should go all the way to fifty percent but even that might be worthwhile because of the very high regard with which we hold the University of Illinois.

Kenneth H. Olsen

dec INTEROFFICE MEMORANDUM

H.E.G.

DATE January 11, 1963

SUBJECT

TO K. Olsen

FROM J. Smith

Attached you will find a cost estimate for each additional PDP-4 added to our schedule. I should have PDP-1 figures for you Monday.

January 10, 1963

PDP-4

Inventory Costs per Computer
(Material and subcontract costs)

Mechanical parts	2,045.00
Sub-assembly wiring (sub-contract)	3,448.00
Total	$5,493.00

Major Components	
Printer 28-C	1,097.00
Reader 2500	779.00
Punch	739.00
Memory System (wiring & stock)	3,900.00
Total	$6,515.00

TOTAL COST Without modules and power supplies $12,008.00

digital EQUIPMENT CORPORATION
MAYNARD, MASSACHUSETTS

Date: January 10, 1963

To: DEC Traveling Employees

Travel and Entertainment Expense - Rules and Regulations

Introduction:

The new law passed this fall gives the Internal Revenue Service complete authority to require that a corporation keep detailed records of its Travel and Entertainment Expenses. What this means to each and every corporation, is a tightening up of all expense account reportings. The Internal Revenue approach has been to make each company substantiate each deduction regardless of amounts, by keeping a business diary on a daily basis for those amounts less than ten dollars ($10.00) and all amounts of ten dollars ($10.00) or higher, to be substantiated with receipts or bills. You should remember that if the company deduction for your expenses is disallowed, this amount becomes taxable income to you.

Effective January 1, 1963, the following rules and regulations will govern the payment by DEC, of all travel and entertainment expenses due to proposed changes in the law by the Internal Revenue Service.

1. Travel Expenses:

Anyone claiming travel expenses while on company business will have to prove each one of the following elements:

a) Cost - This includes cost of transportation, meals, lodging and miscellaneous expenses such as telephone, cab fare, etc.

b) Time - Date and hour of departure and return, total days away from home, and total days or hours spent on business at each destination.

c) Place - Each place that you have visited, which should be a customer, will require the name and location in order that this can be substantiated at a later time upon examination by the Internal Revenue Service.

d) Business Purpose - This is the real meat of the law, in that, any travel expense must be directly related to a business purpose. What this means, in effect is, that all of your travel expenses will be for business and there will be no partial trips - part for business and part for pleasure, because there are other stringent regulations which apply in this case.

- more -

Date: January 10, 1963

To: DEC Traveling Employees

e) Mileage - Under the new proposed regulations, automobile mileage expenses will have to be supported by a detailed record of the companies called on, where they are located and how much mileage was expended going to and from each customer called. What this means, of course, is that no longer will the Internal Revenue Service allow taxpayers - both individual and corporations, to take a gross deduction for mileage and just call it for "business purposes".

2. Entertainment Expenses:

Any one of you claiming an expense for entertainment expenses must prove all of these elements:

a) Cost - You have to be able to substantiate the total cost for the entertainment and this means, bills, receipts, invoices for all of the cost - not just for a portion of it. The entertainment section is where the Internal Revenue is going to be most restrictive.

b) Time - You must have the date, the hour and the duration of time spent at this entertainment.

c) Place - You must have the name and address of the establishment and also describe the entertainment.

d) Business Purpose - You must put down the purpose of the meeting - if you are there to sell the man a PDP-1 or PDP-4, or modules or a system - put it down that way, with the expected result, hopefully, that he will sign an order or that this meeting came just before a business conference or just after a business conference, concerning the purpose.

e) Business Relationship - The relationship of each person entertained for whom you are going to claim an entertainment expense - must be listed. This will include the person's name, his activity in his company, or his occupation and the total number entertained. I want to repeat, that the cost of entertainment that directly precedes or follows substantial and bona-fide business discussions, are deductible - even though they are just to generate goodwill. What this means is, that if you are not there on a bona-fide selling mission but are doing some missionary work with the customer and that particular missionary trip is not directly related to the active conduct of a sale of a piece of equipment to the customer, it is still deductible, when so stated.

Date: January 10, 1963

To: DEC Traveling Employees

In relation to the business discussions mentioned before, in order that we may claim a deduction for the entertainment cost associated with the time preceding or following the entertainment, we must have the time (this means the date, hour and duration) and the place (the name and address) or location, the nature of the discussion, and the name and business relationship to DEC, of each customer or each person participating in the discussion. This is indeed getting down to unusual detail, but is required under the law and must be instituted.

It should be pointed out here, that DEC will not be able to reimburse anyone submitting a travel expense voucher that is not supported with sufficient detail in the above mentioned categories. The enclosed expense books are for this purpose.

Summary of Changes:

1. General Comment:

All this means, that you will have to keep an extremely detailed record of what you do each day, by way of business calls, cost to get to and from that call, conferences or discussions - preceding or following any meals or entertainment, and a careful record made of auto mileages on a daily basis.

Travel - Our current documentation of traveling expenses which includes, stubs of Airline tickets, auto rental slips, hotel and motel bills will be continued, with the additional use of the attached travel expense booklet, until the final regulations are issued by the Internal Revenue Service so that we can then proceed to prepare our own forms. As you will see, this calls for a breakdown of breakfast, lunch or dinner and gives a section for each day for entertainment, listing firm, person,title and place and amounts spent. I want to re-emphasize, that no payment will be made to anyone unless this detail is completed since DEC will not be able to take the deduction unless this is done.

Entertainment - The entertainment comments are as made previously but would add, that it is significant that in the case of an entertainment, the cost of your meal should be deducted from the total charge and shown separately under breakfast, lunch or dinner.

Meals - The primary change here is to recording individual meals, breakfast, lunch or dinner by the day, rather than as a total number of meals for a trip.

Traveler's Expense Books - The enclosed four (4) Traveler's Expense Books will take care of you for a month. Additional books are available locally or through the Sales Department. The making out of this expense book does not change the submission of our regular Travel Vouchers at all, since the book, together with

Date: January 10, 1963

To: DEC Traveling Employees

receipts, will be attached to the Travel Voucher and will constitute a basis for payment. If there is no Traveler's Expense Book attached to the Travel Voucher - no payment will be made.

General Note:

The Internal Revenue Service has not published final regulations for travel and entertainment expenses, since there has been considerable objection from business - due to the extra record keeping involved. At the time that the final regulations are issued, it is probable that DEC will issue a new form and you will be so informed of any changes at that time.

Richard F. Mills
Controller

dec INTEROFFICE MEMORANDUM

1.96

DATE January 10, 1963

SUBJECT

TO H. Anderson

FROM Ed Harwood

I called John Macarthy at Stanford today. Also, I spoke to Steve Russell and gave him the following information:

1 - PDP-1 with		
1 - Memory Extension	15	115 volts 30 amps
1 - Memory Module	12	
1 - SBS	20	
1 - Restrict Mode		
1 - Relay Register	26	
1 - Tape Control	51	115 volts 15 amps
1 - Tape Unit	50	
1 - Drum		115 volts 15 amps
6 - Precision CRT	30	115 volts 7 1/2 amps each
5 - Sorabans		115 volts 3 amps each

E. Harwood

Harlan: This is Jack Smith's Major Component Schedule

Inventory Investment

Based on one PDP-1 per month and two PDP-4's per month.

PDP-1

1 -- 3500 Reader	2,330
1 -- Computer Writer	1,960
1 -- punch	739
1 -- Memory Stack	3,500
	$8,529.

PDP-4

2 -- 2500 Readers	1,558
2 -- Model 28 KSR Printers	2,194
2 -- Punches	1,478
2 -- Memory Systems	7,000
	$12,230

TOTAL COST $20,759 ← per Mo - Commencing Mar 63

Standard Stock Items

3 -- Memory Stacks	10,500
3 -- Potters	18,000
	$28,500 ← permanent investment

TOTAL $49,259

H.R.C.

George 11/9/63

dec INTEROFFICE MEMORANDUM

3

DATE January 4, 1962

SUBJECT PDP-4 Construction Progress

TO K. Olsen
H. Anderson
S. Olsen
G. Bell
N. Mazzarese
K. Wakeen

FROM J. Smith

PDP-4-9 (8000-7719) was delivered to Checkout today. This is the machine that is assigned to K. Wakeen for module test. In addition to this system, two additional PDP-4's were completed during December, PDP-4-7 on December 17th and PDP-4-8 on December 21st. In keeping with our planned schedule, two PDP-4's will be completed during January, PDP-4-10 on January 11th and PDP-4-11 on January 25th.

INTEROFFICE MEMORANDUM

DATE January 4, 1963

SUBJECT

TO K. Olsen

FROM Arthur Hall

cc: H. Anderson
R. Best
G. Bell
N. Mazzarese
E. Harwood
R. Hughes
R. Savell

There have been inquiries from the Foxboro Company concerning the amplitude, frequency and power level of RFI from the PDP-4 computer. Foxboro has been asked to quote these figures to their customers. At least one of our competitors (CDC) offers a letter from an independent testing laboratory giving these values. We will surely be asked again about this for both computers and there is even a possibility that the FCC may require RFI reports in the future. (A Foxboro engineer who has a receiver-transmitter in his car reports a strong carrier at about 28mc when the RCA 110 is operating.)

The Acton Labs. Environmental Test Department can test conducted RFI (on the AC input lines) to 25 mc and radiated RFI from 14KC to 1KMC. Their charge for this is $100 for the report and $19 per hour of testing time with about 6 hours to test a computer. They will if we wish help us locate the cause of the radiation or decide what variety of programming is the worst offender, also at the rate of $19/hr. The tests would be conducted at the Acton Labs.

Those to whom I have spoken agree that it is a good idea to make these tests and so unless I hear evidence to the contrary by Thursday, January 10th, I will arrange to get a PDP-4 and PDP-1 as soon as possible from Checkout to send to Acton for these tests.

dec INTEROFFICE MEMORANDUM

DATE January 3, 1963

SUBJECT APPLICATION OF DEC EQUIPMENT IN THE MATERIAL TESTING FIELD

TO H. Anderson FROM A. Titcomb

The following is a summary of material which was presented by Mr. Donald R. Erb, Engineering Manager of Instron Engineering Corporation, 2500 Washington Street, Canton, Massachusetts.

I. MEASUREMENT OF LOAD OR STRESS

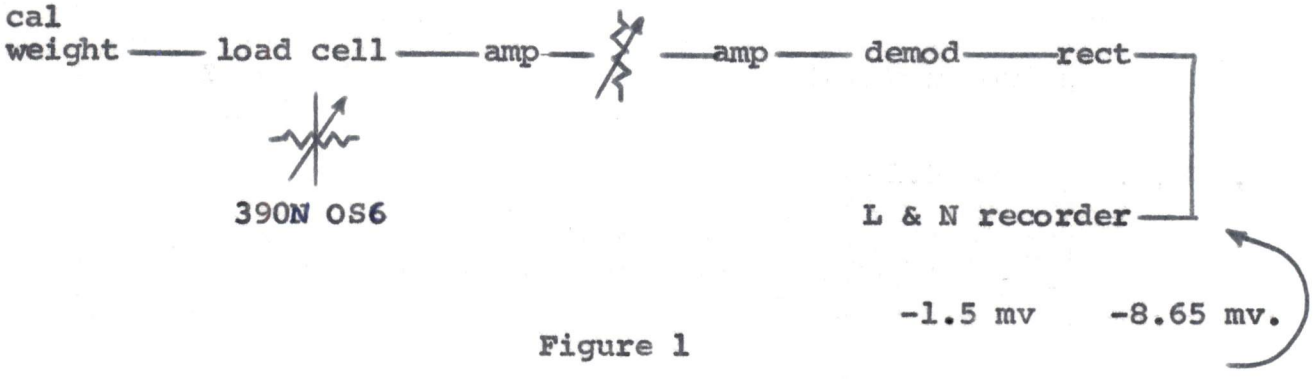


Figure 1

Source of Voltage Proportional to Load

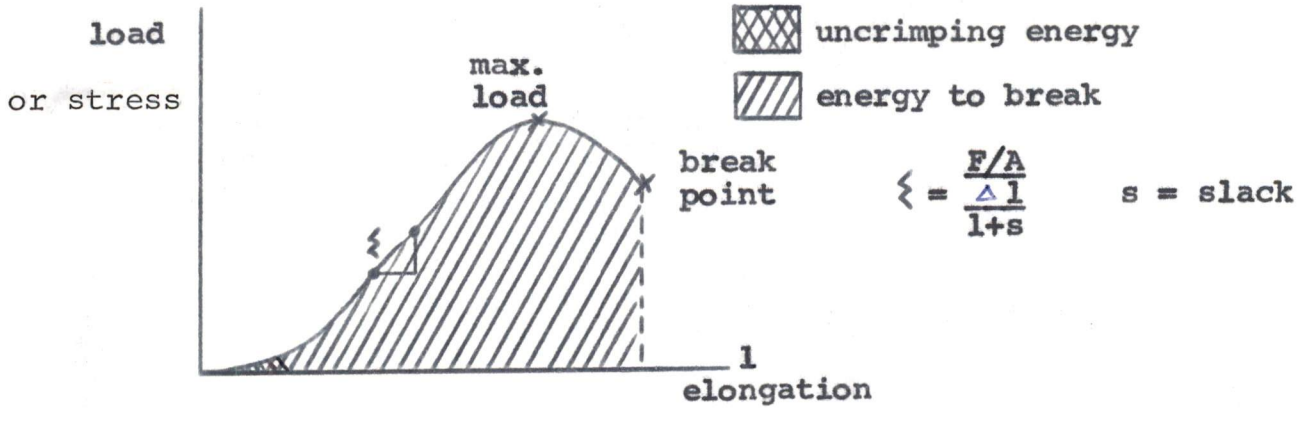


Figure 2
Typical Diagram

I. MEASUREMENT OF LOAD OR STRESS (continued)

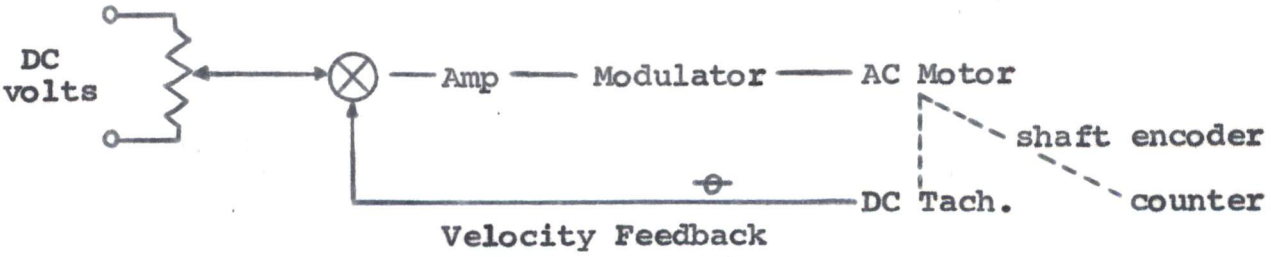


Figure 3
Extension Rate Control

II. DIGITAL READOUT SYSTEM (Instron)

Shaft encoding provides the digitized information which is printed out by a Monroe printer after storage in memory (mag. core).

Format:

test max. load break load

1 2 3 4 5 6 7 8 9 10 11

% elong. energy

1 2 3 4 5 6 7 8 9 10 11

Also available, an analog computer (?) attachment which provides Young's modules (slope of stress/strain curve).

III. PROBLEMS POINTED OUT BY MR. ERB

When plotting a curve the inked pen exhibits lag characteristics which are a source of error. Presently shaft encoding of the pen motion is used so that any error present is merely quantized. A diagram of equipment necessary for driving the recorder shows that the A to D conversion might be made after the rectifier using electronic means.

III. PROBLEMS POINTED OUT BY MR. ERB (continued)

The main problem and reson for the meeting, I believe, as far as Mr. Erb was concerned, is the characterization of the curve which is normally plotted and the extraction of points of interest.

A suitable solution will consist of the gathering of such information for presentation to a General Purpose Digital Computer. Mr. Erb exhibited a proposal which appeared very costly for the amount of work accomplished. Wang Laboratories apparently developed the system.

Both Shell Oil Company and Redstone Arsenal were listed by Mr. Erb as customers who desired the above information for computers which they had available. In at least one case the computer was located at a remote installation, necessitating mailing information to the computer center for processing.

At this point DEC expressed considerable interest, but at the same time Mr. Anderson explained that the most satisfactory application would include a very minimum of external conversion gear and our PDP-4 for processing data.

The remainder of this memorandum attempts to indicate where our efforts should be directed.

The economics of the situation may well show that a versatile machine such as the PDP-4 may prove cheaper than complicated preprocessing of data for the purpose of enabling a more restricted machine to handle same. Even should this not be the case, the PDP-4 installation can offer advantages which will permit more rapid final results and the real possibility of a new method of analysis of data such as our Visual Indicator.

Any installation must be considered individually including options desired; Tape Units, Multiplexing, etc. Before the initial conversion is made from A to D, the accuracy of conversion required should be specified. Customarily one specifies the most accurate system that state of the art allows without considering a more realistic and consequently more economical level of precision which would provide information of entirely as much significance.

At present, Rich Kohrumel, Test Laboratory Director, Dow Chemical Co., Box 467, Midland, Michigan, appears interested in such a system. It would seem that we should contact him with the purpose of establishing his needs. Subsequent to this, a proposed system could be worked out on paper, costs figured, etc.

This concludes this initial report. Any further developments will be discussed subsequently.

Allan Titcomb