May 7, 1957

Memorandum to: Mr. D. W. Pendery

Subject: DPM Comparison System

In the data processing industry a great problem exists in the evaluation of machine systems. Many systems of evaluation have been used in the past but none have been widely accepted. Most systems attempt to give an overall comparison by considering only a few machine characteristics, such as, add time and the calculate-to-tape ratio.

The purpose of this comparison system is to provide a rapid means of locating a machine's position in the ever increasing spectrum of machines. In machine evaluation, however, there are some items to consider that present extreme difficulty in placing a figure of relative merit. It may be necessary in these cases to make an individual case study to arrive at a more accurate and comprehensive analysis. For example, two machines may be very similar except that one is capable of processing a larger problem than the other because of additional storage, tape drives, etc. Also, special situations such as individual customer's machine loading requirements, and job cost comparisons involving extra shift rental may be best judged by case study programs. Though the case study method has been widely used in the past and will be used in the future for analysis of the special cases, it is a very time-consuming and expensive method and still does not provide a complete picture. For these reasons it is mandatory that IBM look for and adopt a more rapid, efficient and less expensive evaluation system.

It is my belief that it is necessary to compare many different machine characteristics in order to arrive at a conclusion. By evaluating the many items of consideration independently and applying a figure of relative importance to weigh these items, it is possible to correlate many items and arrive at an overall comparison figure.

These independent considerations are established facts, arrived at by programming, machine performance statistics and machine specifications. In order to properly correlate these facts, it is necessary to assign a value of relative importance to each one. The flexibility of this system enables one to conveniently alter the weights to fulfill the requirements of machine evaluation by making comparisons from many different standpoints. An example of this ability might be in the evaluation of machine A when it is compared to the competitive machine B. The two

machines are to be considered for several types of applications; such as, life insurance, public utility, manufacturing or scientific computing. Since these machines are general purpose by nature, they are capable of processing a wide variety of applications. However, these applications will vary considerably in importance when the machine is compared from the standpoint of different users. It is this variation that may readily be taken into account by this system of machine comparison.

There are four major areas of consideration in a comparison of machines. They are speed, programming ease, operational features, and cost. To gather the data for these four categories, the method of measuring should be standardized. The following list of comparison factors suggests a possible method of gathering data. At this time the factors will be explained briefly to merely establish the system.

A. Speed

1. Program Parts

Representative parts of typical programs are selected to illustrate a wide variety of jobs that are run on general purpose data processing machines. These representative program parts are as follows:

a. Low Activity File Maintenance

This program is a measure of a machine's tape passing, comparing, testing and branching ability for reading one tape and writing one tape. Machine checking will be included as required.

b. High Activity File Maintenance

Internal record manipulation, comparing and testing data, reading two tapes, writing one updated tape and writing one tape with print editing and format control are measured by this program.

c. Loop Control

A measure of the machine's ability to perform an iterative process is obtained by this program. Address modifying, indexing, indirect addressing, counting and testing features are evaluated.

d. Sorting

This program tests the machine's ability to perform an internal record sort.

e. Checking

This program considers error detection, error correction, check points and restarts.

f. Computing

A measure of the machine's arithmetic speed is obtained from this program.

g. Subroutine Linkage

Facilities for branching to and returning from subroutines are evaluated.

h. Data Translation

Both conversion from source recording to machine language and the ability to translate coding systems are evaluated.

i. Other

The system is open-ended, other programs may be used for comparing specific things. As the system is developed, new programs will be included.

2. Unique Functions

To fully evaluate certain machine characteristics, a separate comparison of individual functions may prove useful. The store-for-print command in the 705 and table lookup in the 650 are examples of these unique functions.

3. Input-Output Time

The amount of time the computer is interrupted for input-output operations is used for this comparison.

B. Programming Ease

Measuring a machine's programmability is a difficult task because of the human factor involved. This is because of the variation in familiarity in applications and machines. Counting the number of instructions required for a program may also give misleading results when three address machines or special functions controlled by one instruction are evaluated. The number of entries required on the coding sheet is a more accurate figure because it represents the number of logical operations required of the programmer. The same programs that were written to evaluate machine speed are also used as the basis for measuring a machine's programmability.

C. Operational Features

1. Console

Machine and operator communication facilities of the machine play an important role in the operation of a machine. The basis for this factor is the time required to perform these operations and their complexity.

2. Setup Time

The time required to load and start a program and setup the input-output units is the factor of comparison for this category.

3. Reliability

This factor has not yet been fully investigated, however, it might be stated in terms of the probability of a machine malfunction.

4. Maintenance

The amount of time required for preventive maintenance and corrective maintenance is the basis for comparison.

D. Cost

Included in the category for cost are the following items:

1. Machine
2. Maintenance
3. Programming
4. Operating
5. Installation
6. Education

a. Programmer
b. Customer Engineer
c. Sales Personnel
d. Operator

As was previously discussed, in order to correlate these comparison factors it is necessary to assign a weight to each factor. The weighting process is merely assigning a number to each of the factors to indicate their relative importance. If the comparison is to be made for one particular set of circumstances, it should be sufficient to make one set of weight values. Such a comparison would be made from a customer's standpoint. However, to arrive at a more comprehensive comparison it may be necessary to make several sets of weight values.

To illustrate the system there is attached a chart for the comparison of seven machines. Listed in the left hand column are the various comparison factors to be considered. The weight assigned to each factor is in the next column. Under each machine compared there are three columns; the first, labeled base, is filled in directly from the preliminary research data compiled for each factor for each machine. It should be noted that this entry may be in terms of hours, microseconds or dollars, just so it is consistent for each comparison factor. The second column, labeled norm, is the normalized base value; one machine's normalized base is assigned a value of one, the other machines' base values are set relative to one. It should be noted that the normalized base is a dimensionless number but does represent relative merit for each factor. The third column is the product of weight times the normalized base value. This column is then added for each machine. The result is a set of numbers that represent the relative position of the machines for this comparison.

It is also desirable to establish hypothetical boundaries for a comparison. To accomplish this, two additional machine categories are used on the chart. They are labeled maximum and minimum, they represent two machines that have merit ratings equal to the best and worst machine for every comparison factor.

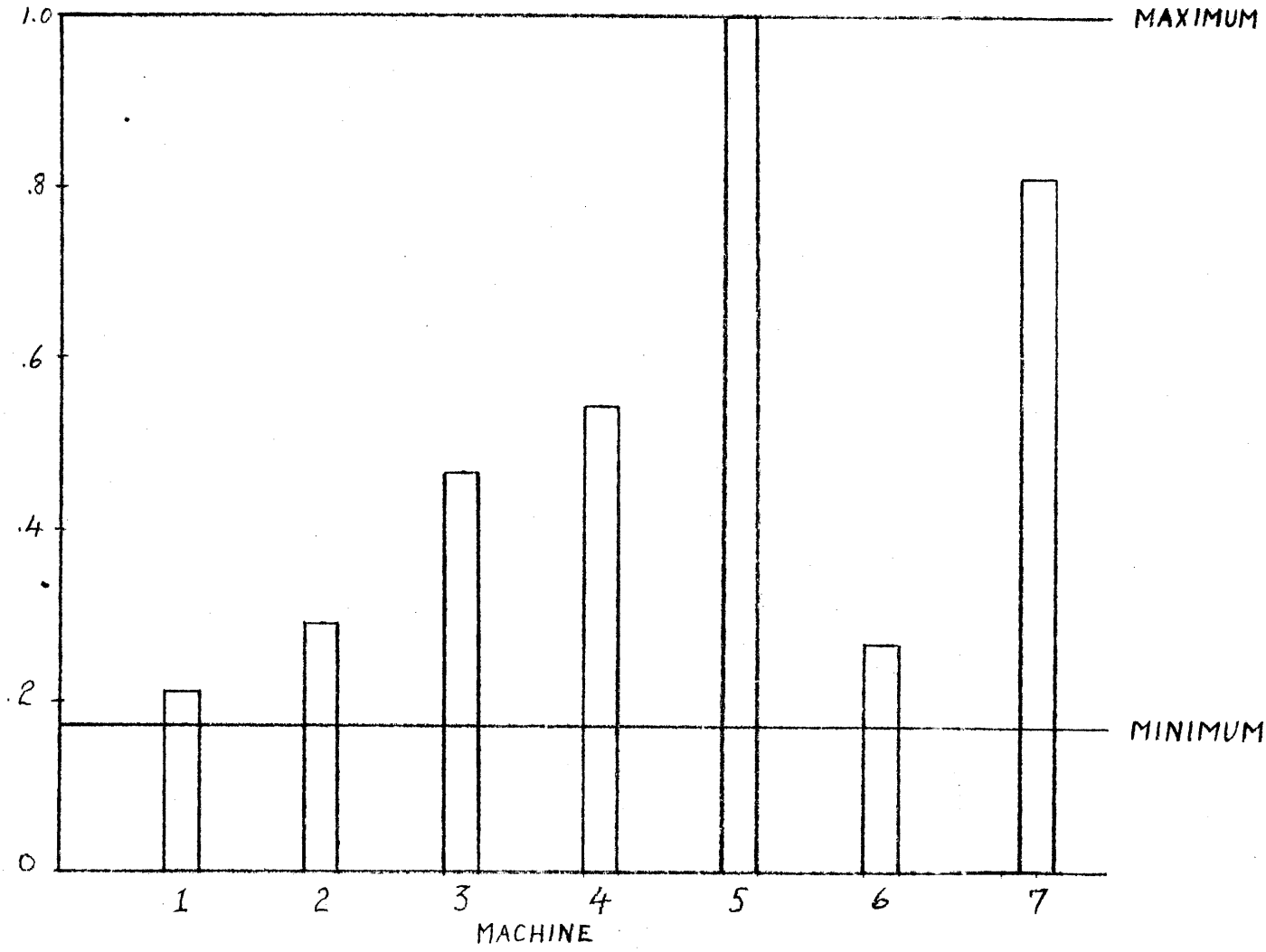
Following the comparison charts are five graphs. They illustrate the results of the comparison system in graphical form. There is a graph for each of the four major areas to be considered and one for the overall comparison.

WRE:pv
Att/cc: Poughkeepsie Product Planning

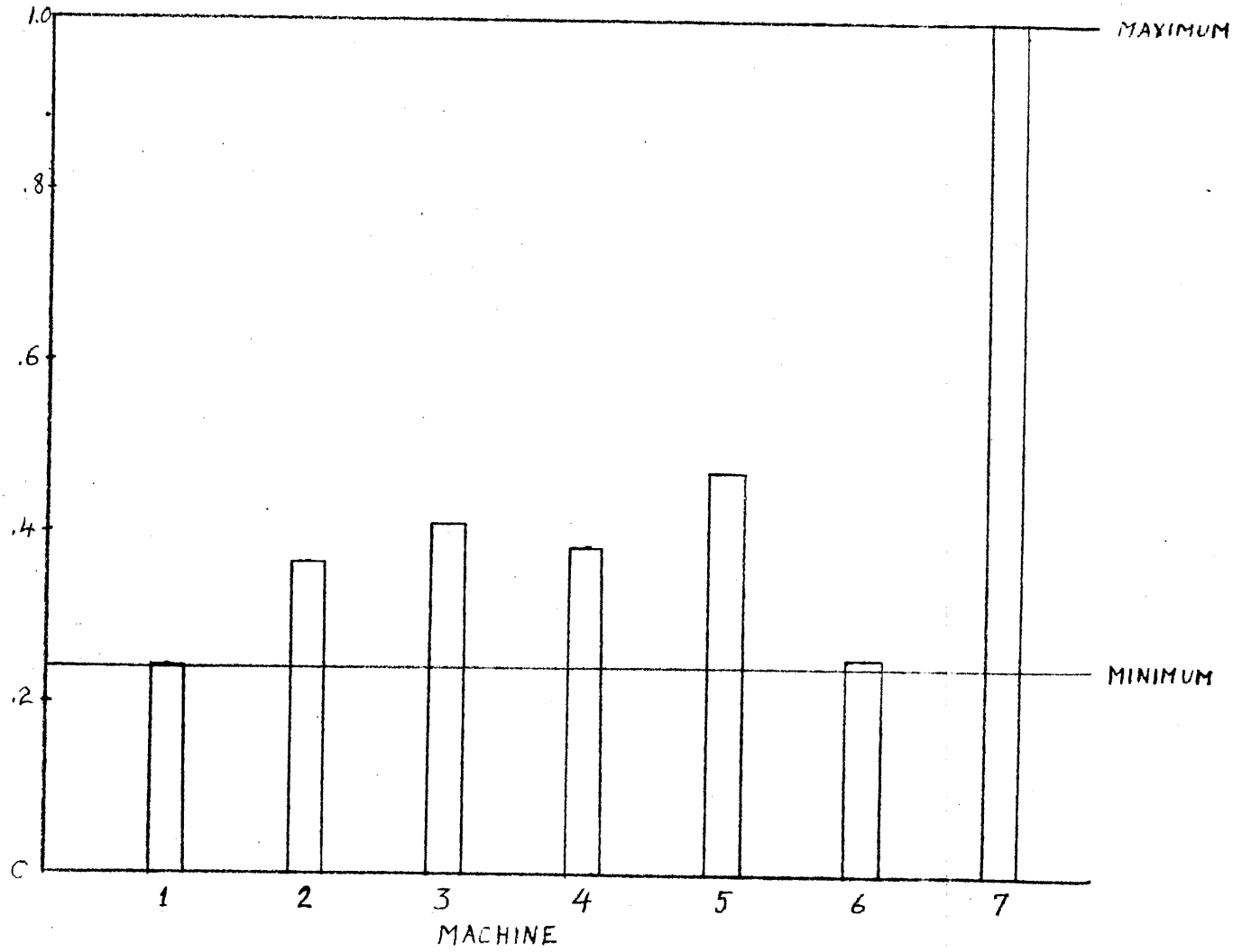
W. R. English

FACTOR	WEIGHT	MACHINE 1 BASE	1 NORM	1 W x N	2 BASE	2 NORM	2 W x N	3 BASE	3 NORM	3 W x N	4 BASE	4 NORM	4 W x N	5 BASE	5 NORM	5 W x N	6 BASE	6 NORM	6 W x N	7 BASE	7 NORM	7 W x N	Maximun BASE	Maximun NORM	Maximun W x N	Minimum BASE	Minimum NORM	Minimum W x N
Speed -																												
Low Activity File Main.	70	2910	.23	16.1	1755	.39	27.3	1560	.43	30.1	885	.76	53.2	675	1.00	70.0	1755	.39	27.3	675	1.00	70.0	675	1.00	70.0	2910	.23	16.1
High Activity File Main.	70	164	.27	18.9	102	.43	30.1	82	.54	37.8	59	.75	52.5	44	1.00	70.0	102	.43	30.1	44	1.00	70.0	44	1.00	70.0	164	.27	18.9
Loop Control	10	64	.11	1.1	146	.05	.5	7	1.00	10.0	38	.18	1.8	7	1.00	10.0	241	.03	.3	14	.50	5.0	7	1.00	10.0	146	.05	.5
Sorting	60	98	.12	7.2	75	.16	9.6	38	.32	19.2	32	.37	22.2	12	1.00	60.0	80	.15	7.5	14	.86	51.6	12	1.00	60.0	98	.12	7.2
Computing	25	124	.36	9.0	310	.15	3.8	62	.73	18.3	170	.26	6.5	45	1.00	25.0	1958	.02	.5	398	.11	2.8	45	1.00	25.0	1958	.02	.5
Input/Output Interrupt Tim	15	59.8	.02	.3	77	.02	.3	29.5	.04	.6	57.5	.02	.3	1.2	1.00	15.0	14.4	.08	1.2	6	.20	3.0	1.2	1.00	15.0	77	.02	.3
Programmability -	250*			52.6			71.6			116.0*			136.5*			250.0*			66.9*			202.4*			250.0*			43.5*
Low Activity File Main.	40	53	.13	5.2	32	.22	8.8	40	.18	7.2	35	.20	8.0	40	.18	7.2	45	.16	6.4	7	1.00	40.0	7	1.00	40.0	53	.13	5.2
High Activity File Main.	40	65	.15	6.0	40	.25	10.0	55	.18	7.2	44	.23	9.2	55	.18	7.2	57	.18	7.2	10	1.00	40.0	10	1.00	40.0	65	.15	6.0
Loop Control	15	15	.20	3.0	10	.30	4.5	4	.75	12.5	10	.30	4.5	4	.75	12.5	11	.27	4.1	3	1.00	15.0	3	1.00	15.0	15	.20	3.0
Sorting	25	135	.48	12.0	105	.62	15.5	85	.76	19.0	90	.72	18.0	80	.81	20.2	95	.68	17.0	65	1.00	25.0	65	1.00	25.0	135	.48	12.0
Computing	20	265	.70	14.0	230	.80	16.0	250	.74	14.8	225	.82	16.4	235	.79	15.8	210	.88	17.6	185	1.00	20.0	185	1.00	20.0	265	.70	14.0
Record Handling	20	7	.29	5.8	7	.29	5.8	4	.50	10.0	6	.33	6.7	3	.67	13.4	7	.29	5.8	2	1.00	20.0	2	1.00	20.0	7	.29	5.8
Checking	15	130	.06	.9	50	.16	2.4	110	.07	1.1	50	.16	2.4	100	.08	1.2	35	.23	3.5	8	1.00	15.0	8	1.00	15.0	130	.06	.9
Debugging Aids	15	1	.13	2.0	3	.38	5.7	4	.50	7.5	3	.38	5.7	5	.63	9.5	2	.25	3.8	8	1.00	15.0	8	1.00	15.0	1	.13	2.0
Unique Operations	10	0	0	0	2	.40	4.0	2	.40	4.0	3	.60	6.0	4	.80	8.0	3	.60	6.0	5	1.00	10.0	5	1.00	10.0	0	0	0
Operational Features -	200*			48.9*			72.7			83.3*			76.9*			95.0*			71.4*			200.0*			200.0*			48.9*
Grouped	50	5	.28	14.0	12	.67	33.3	7	.39	19.5	13	.72	36.0	9	.50	25.0	12	.67	33.3	18	1.00	50.0	18	1.00	50.0	5	.28	14.0
Cost -	50*			14.0*			33.3			19.5*			36.0*			25.0*			33.3*			50.0*			50.0*			14.0*
Machine	200	1710	.57	114.0	1655	.59	118.0	4080	.24	48.0	2595	.38	76.0	4207	.23	46.0	972	1.00	200.0	1500	.65	135.0	972	1.00	200.0	4207	.23	46.0
Maintenance	50	25.6	.39	19.5	34.1	.29	14.5	13.5	.74	37.0	24.8	.41	20.5	12	.83	41.5	10	1.00	50.0	10	1.00	50.0	10	1.00	50.0	34.1	.29	14.5
Programming	100	354	.34	34.0	329	.36	36.0	219	.55	55.0	254	.47	47.0	176	.68	68.0	292	.41	41.0	120	1.00	100.0	120	1.00	100.0	354	.34	34.0
Totals	350*			167.5*			168.5			140.0*			143.5*			155.5*			291.0*			285.0*			350.0*			34.5*
	850**			283.0*			346.1*			358.8*			392.9*			625.5*			462.6*			737.4*			850.0*			200.9*

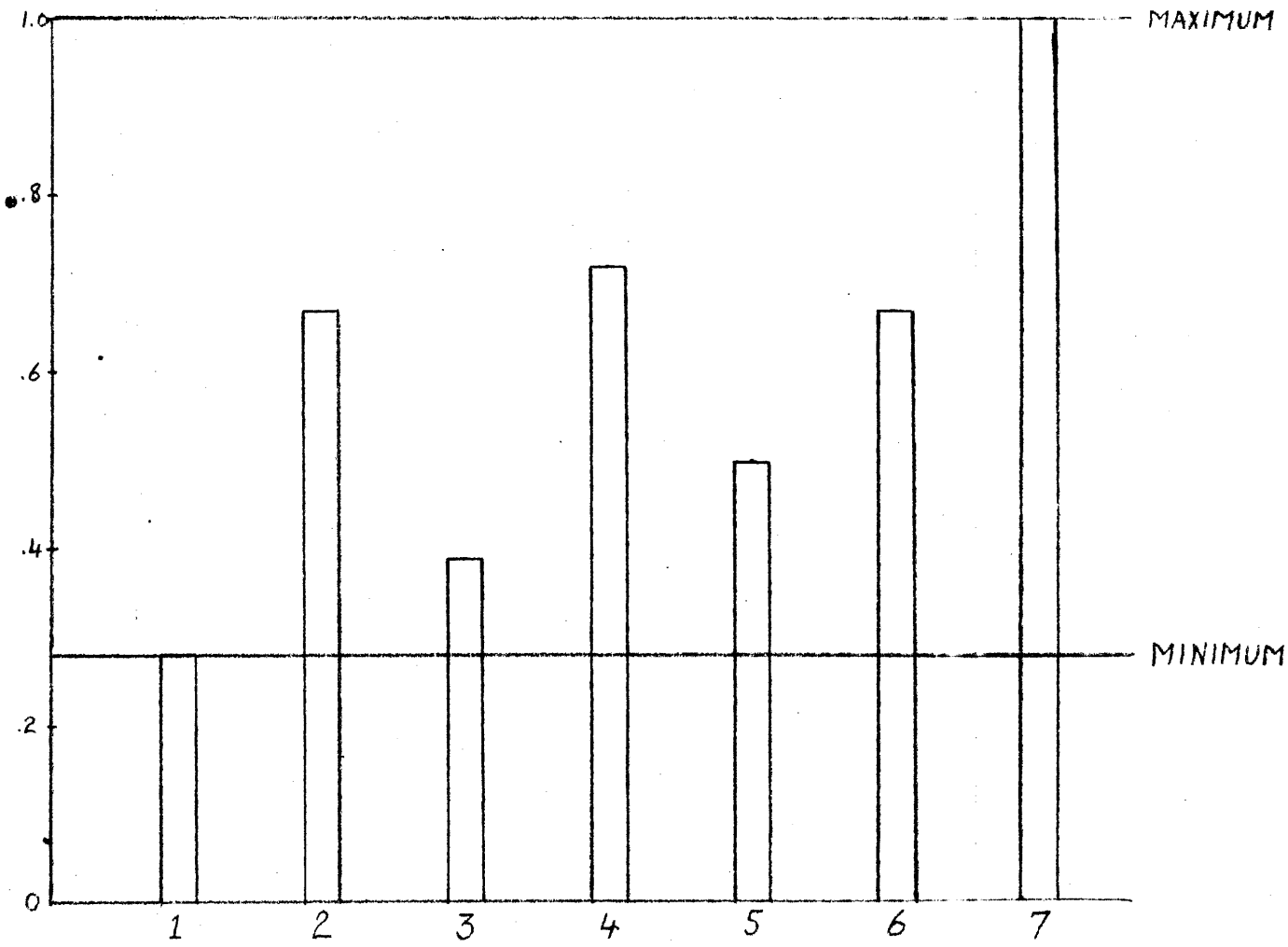
SPEED



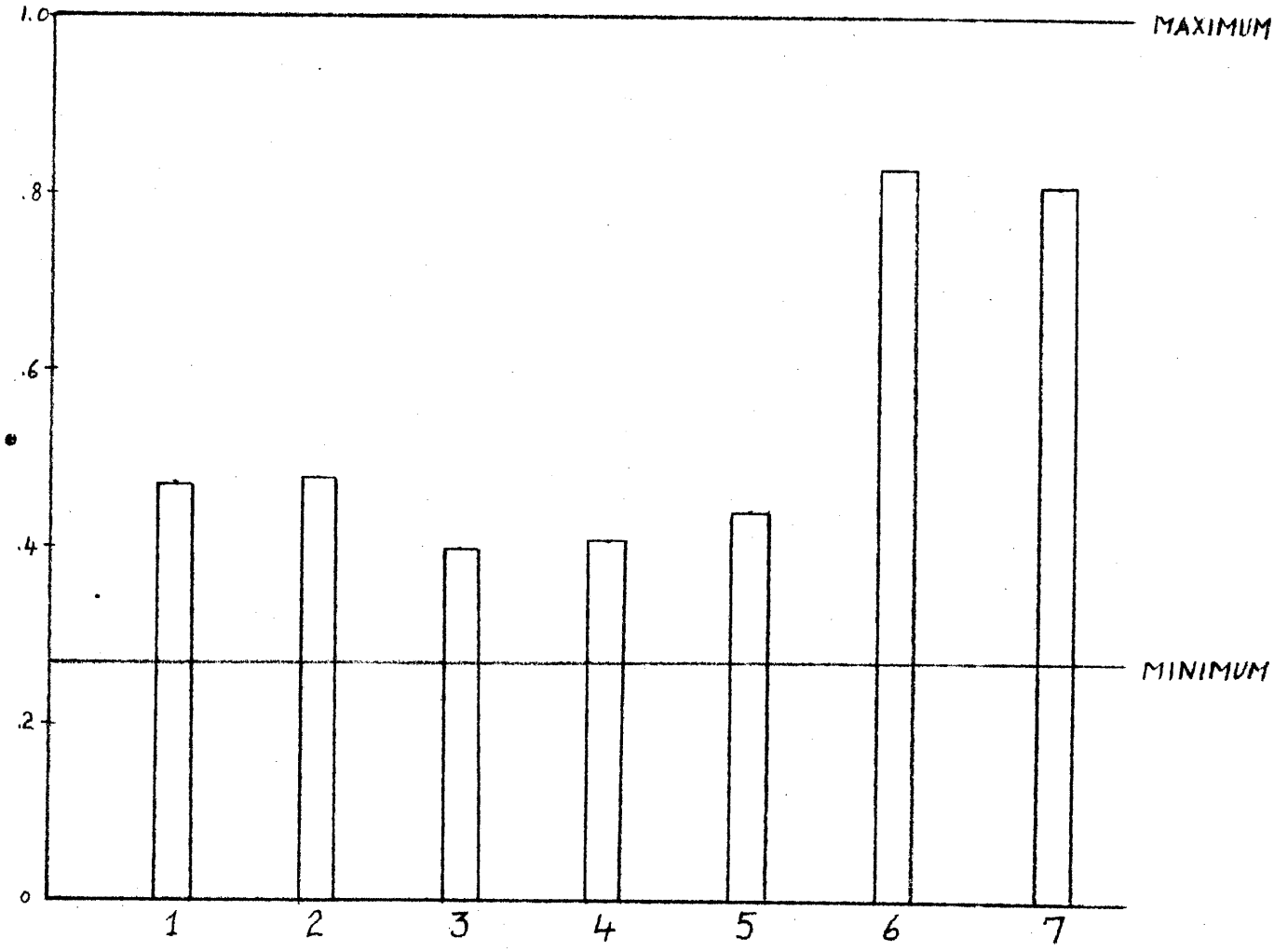
PROGRAMMABILTY



OPERATIONAL FEATURES



COST



GRAPH OF ALL FACTORS