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A Comparison of Manual and Computer-Based Text Editing

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1. INTRODUCTION

This note summarizes the cost of using computer text editing to prepare documents for reproduction and distribution. In particular, experimental data from three projects is analyzed:

- Project 1. Preparing a 43-page specification of a computer graphical language facility (George 1969).
- Project 2. Preparing a 44-page description of a model for privacy and access control in computer systems (Hoffman 1969).
- Project 3. Preparing a 50-page study of features of various computers (Russell, George, and Levine 1969).

2. USE OF THE TEXT EDITOR

An on-line interactive text editor (Riddle 1968) was used to initially input and to revise the documents' text. Then a non-interactive formatting program was run to print out the revised, updated documents (using a TN (upper and lower case) print train if desired).

3. COST OF USING THE TEXT EDITOR AND THE FORMATTING PROGRAM

Table 1 shows the cost of using the text editor and formatting program for Projects 1 and 2 during a four-month period. Unfortunately, these cannot be broken down to show the cost of each project due to the way the data was collected. Intuitively, however, we feel that each project accounted for about half the cost. The charges are based on the then existing rate schedule, shown in Table 2, at the Campus Facility of the Stanford Computation Center. A description of what each item contributing to the cost entails is given in Table 3. Table 4 lists the average cost for Projects 1 and 2. Using these averages, the cost of Project 3 was estimated. This estimate and the actual cost of Project 3 are shown in Table 5.

4. COST OF MANUAL EDITING

We now make some assumptions about the nature of manual text

editing in order to be able to compare the costs of manual and computer-based text editing. These assumptions probably do not hold for any one particular person. Nevertheless, we hope they are reasonable in approximating how a "typical" writer of a scientific paper prepares his document if he has no computer-based text editor available. In particular, we assume that the manual user performs his editing project in the manner shown in Table 6.

We consider as costs in the manual case only typist time, treating as negligible the costs for supplies (paper, typewriter ribbon, etc.). We realize that in doing this we are ignoring the fact that the user will be doing something between the time his input draft enters the typist's work queue and the time it is typed and returned to him, even if it is only spinning his wheels or marching around in The Plaza (nee Lytton Plaza). If he has another project to which he can (and will) devote all his time in this period, then it is no disadvantage that the typist's turn-around time is significantly longer than that of the computer. If, on the other hand, the author is intensively working on a project, he will obviously be handicapped by this factor; he will then either type the revised draft himself (which adds cost in at least author time) or he will defer getting a "clean" copy made. But at some point he will have to pause to get a legible "clean" copy made, and at that time he may spin his wheels waiting for the clean copy to come back from the typist. This also has the cost of at least some degree of frustration and lost initiative. But these costs which, if included, would put the manual method in a poorer light are not always applicable and are to a large degree subjective. We therefore have not included them in the overall costs of the manual method.

We obtained from Ada Schwartz of the SLAC Technical and Public Information Group a cost estimate for typist time. This estimate does not include indirect costs associated with a typist performing the clerical tasks of Table 6. She estimated this cost between \$2.50 and \$5.50 per page, depending on the material being typed.

We also obtained an estimate from William F. Miller, Group Leader of the SLAC Computation Group, for costs of letter typing. He costs letter typing at \$6.00 per hour, including indirect costs.

5. CONCLUSIONS

The manual method of text editing costs between $\$2.50 \times 87 = \217.50 and $\$5.50 \times 87 = \478.50 for editing two documents totalling 87 pages of text (using Ada Schwartz's figures). It costs $\$6 \times 87 = \522.00 using Dr. Miller's estimate. The cost of the automated method is \$867.00 for the same documents. We see that the monetary cost of the automated method is approximately twice

as much as the monetary cost of the manual method.

6. SUGGESTIONS

The costs of the computer-based system could be decreased in a number of ways. A brief user's manual which would give examples of trivial but not always obvious ways to save on print costs would be most helpful. A user who plans ahead can have the non-interactive formatter print out only those text pages he has changed, rather than the entire document every time. However, if he has not set up his file in a simple (but not obvious, at least to Mr. Hoffman) way at the start, it is difficult to change the file to gain this desired property. If a user could print only 10% as many pages (on the line printer) during the editing phase, the print costs would be reduced by approximately a factor of 10. A reduction of the print cost by a factor of 10 would make this particular computer editing method competitive with the cost of manual editing.

One possible way to gain the benefits mentioned is to add a "PREAMBLE" to the formatting program, which would simply insert images of formatting program control cards at the start of each page. This relatively simple change would more than pay for itself in the CPU time per run. This could be implemented as a CS239 Project in the Computer Science Department. Another part of that project could be the recoding of the editor in XPL, rather than PL/1. Estimates on the speed improvement here range from factors of five to factors of ten. Again, the print cost would be significantly reduced.

It should be noted that part of the costs of the automated method in this study resulted from familiarization with the formatting program. This cost is not incurred by typists who are already familiar with their machine. Nor is it incurred by an experienced user of the automated system.

TABLE 1

Monthly Costs of Using the Text Editor and Formatting Program

ITEMS	MONTHLY CHARGES				ITEM TOTALS
	10/20/68- 11/20/68	11/21/68- 12/20/68	12/21/68- 1/20/69	1/21/69- 2/20/69	
ENTRY/EDIT CHARGE	129	46	68	80	\$323
STORAGE CHARGE	16	26	16	16	\$74
OUTPUT LINES CHARGE	19	9	8	42	
CPU TIME CHARGE	107	57	65	138	
INPUT READ CHARGE	13	4	2	6	
TOTAL PRINT CHARGES	139	70	75	186	\$470
MONTHLY TOTAL	\$284	\$142	\$159	\$282	\$867

Table 2

Campus Facility Rate Schedule -- September 1968

ITEM	COST
Entry/Edit Charge	\$4.00 per terminal-hour
Storage Charge	\$0.01 per track (approximately 7,188 8-bit bytes) per day
Print Charges	
Output Lines Charge	\$0.50 per 1000 lines
CPU Time Charge	\$4 to \$8 per minute (depends on user-selected priority)
Input Read Charge	\$0.25 per 1000 card images
TN Print Train Charge	\$5.00 setup fee

TABLE 3

DESCRIPTION OF ITEMS CONTRIBUTING TO THE COST OF USING THE
COMPUTER-BASED TEXT EDITOR

ITEM	DESCRIPTION
ENTRY/EDIT CHARGE	Charge for time connected to the on-line terminal system from a remote terminal. The cost of installation and maintenance of the remote terminals is not included in this analysis.
STORAGE CHARGE	Rental charge for the space in the computer's data base where the text is kept.
PRINT CHARGES	Printing was done by a non-interactive formatting program which ran as a normal batch job. The running of this program, like the running of any batch program at the Campus Facility of the Stanford University Computation Center, incurred three distinct costs--Central Processing Unit (CPU) Time, Output Lines Charge, and Input Read Charge.
CPU TIME CHARGE	Charge for time used by the CPU of the computer.
OUTPUT LINES CHARGE	Charge for lines of output printed during execution of the job containing the printing program. Usually the normal (upper case only) print train was used, but occasionally (when the documents were in final form or nearly so) the upper and lower case (TN) print train was used, for which an additional \$5 setup fee was charged.
INPUT READ CHARGE	Charge for card images read by the spooling monitor. This is effectively a short-term disc space rental charge.

TABLE 4

Average Cost for Projects 1 and 2

Approximately 200 text pages were kept in storage each month; about 100 of these were for the current revisions of the documents, and the other 100 for archive documents and backup purposes. Using the figures of Table 1, we can arrive at the following cost breakdown:

ENTRY/EDIT COST	=	\$0.8075	PER MONTH PER TEXT PAGE
STORAGE COST	=	\$0.0925	PER MONTH PER TEXT PAGE
PRINT COST	=	\$1.175	PER MONTH PER TEXT PAGE

TABLE 5
Costs of Project 3

	ACTUAL	ESTIMATED
ENTRY/EDIT COST	\$ 53	\$ 40.38
STORAGE COST	8	4.63
LINE CHARGES	21	
CPU TIME	69	
INPUT READ	3	
TOTAL PRINT CHARGES	93	58.75
TOTAL	\$154	\$103.76

TABLE 6

STEPS A USER TAKES IN PREPARING HIS DOCUMENT FOR DISTRIBUTION.

1. Prepare a complete handwritten (or typed) very rough draft of his paper.
2. Have a typist type a draft of the entire paper.
3. Make a major revision of the draft, penciling in corrections and rearranging sections with scissors and tape.
4. Have a typist type new pages to replace the ones altered in step 3.
5. The editing project has now been completed.

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