Service bureau or in-house data processing

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The financial factors to consider when evaluating system changes are discussed. Methodology is presented for quantitatively evaluating alternative system implementations.
(Received November 1975)

As management consultants, Midlands Computer Associates was engaged by an Electric Utility Co-operative to determine management objectives in data processing and to perform a feasibility study. The feasibility study was designed to determine whether to continue service bureau processing or to install an in-house data processing system.

Since 1972, the utility had contracted with a time-sharing service bureau for selected data processing services. Those services included, but were not limited to, online processing of customer accounts and the preparation of customer invoices. In addition, bi-monthly payroll preparation was accomplished through online processing of employee records.

From early 1972 through 1974, the average annual customer volume increased from 12,800 to 18,000 accounts—an increase of 40 per cent. In contrast, the total monthly billing by the service bureau increased during the same period from an average of $2,200 to $4,350—a total increase in service costs of 96 per cent. Though the percentage increase in service bureau costs was more than double the increase in cost which may be attributed to additional information requirements of the utility, the increased data processing costs were not proportional to the increased transaction volume.

The expected average yearly increase in the account volume was 12·5 per cent. A projection for an eight year period from the 1974 average volume of 18,000 accounts provided an estimated 1982 average account volume of 46,000. This is an expected increase of 28,000 accounts or a growth of 175 per cent during this eight year period. Due to the variable charge arrangements with the service bureau (based on number of accounts, transactions and lines of printing) the total cost of data processing would be expected to rise from $4,350 per month in 1974 to $12,260 per month in 1982.

As an alternative to service bureau processing, manual processing was estimated to be even more expensive. An estimate of 50 per cent savings in office personnel in those areas serviced by data processing was used as partial justification for automating those activities. In addition, extra management control had resulted from information concerning rates, power utilisation, cash flow and work scheduling. This control led to management decision making which kept costs of operations lower than would otherwise have been the case.

Consumer growth would also lead to greater utilisation of data processing. Other areas, when automated, would yield benefits which would justify their conversion from manual to machine data processing. Data required in a management information system, for example, must be input through subordinate applications such as purchasing, accounts payable, inventory control, job cost, vehicle maintenance and others. The obvious direction for this utility was toward greater automation which would necessarily result in greater data processing charges with the time-sharing service bureau.

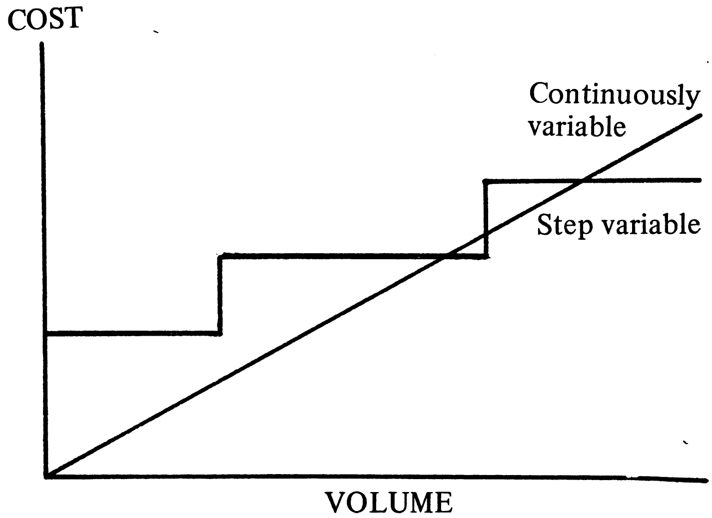

Fig. 1

Since the service bureau charge for data processing was variable, based on volume, consideration had to be given to a step-variable charge type of data processing. A step-variable charge would exist with an internal data processing system having sufficient capacity to handle a specified number of transactions or volume of accounts. As the utilisation approaches the system capacity, the system is upgraded to the next capacity level. In this way, costs are stepped up periodically as the variable amount of processing increases.

A consideration, then, had to be made for an internal data processing system. In general, costs may be compared as in **Fig. 1.**

It is important to note that at some point in time as volumes increased, the continuously variable and step-variable costs could intersect. Whether they do intersect or at what time they intersect is a function of data processing charges, internal data processing costs and the related volumes. Further, consideration must also be given to the value of benefits and the timing of their receipt in determining net costs for each possibility. Also, since cash flow and investment opportunity affect net cost, they must be accounted for in determining the breakeven point.

The choices to be made in types of data processing systems or application automation are like capital budgeting decisions. In concept, investments in data processing must be justified by earning a satisfactory return on cash outflows. Risk is also associated with choice. The more variable the expected returns, the riskier the investment. The riskier the investment, the greater the return must be to be satisfactory. The most common method of dealing with risk is on a strictly informal basis.

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The decision maker recognises that some choices are 'riskier' than others.

Many decisions involving data processing are made on the subjective basis of 'risk' analysis by the decision maker. Other decisions include comparisons of net costs for the choices at hand. Although many decisions are concerned with subjective values or involve fixed, constant payments for each choice, many decisions require consideration of uneven flows of cash. Consequently, it is necessary to expand the analysis of choice to deal with varying payment and receipt streams for the various choices under consideration.

In making data processing decisions, it will be found to be extremely useful to have a formula; one which will allow us to relate a stream of future payments or receipts to their present value. We may approach the problem by asking ourselves how much we will lend someone who promises future payments of $1 at the end of each year for five years. Assume that we would demand a 10 per cent rate of return on this investment. The maximum amount we would lend would be the present value of the future sums. Over a five year period, we will receive $5; we will invest less than this because we want to earn 10 per cent on the amount that we are investing.

Generally, knowledge of the dollar amounts, the interest rate desired and access to present value tables are all that are required. Of course, the dollar amounts of costs and benefits may require extensive research, but once dollar amounts are known, many decisions can be made using the technique known as Present Value Analysis.

Taking each of the factors previously introduced into consideration and applying them for each cost situation was possible using Present Value Analysis. This form of analysis weighs all financial data by according an appropriate cost factor to the timing of inflows and outflows of equivalent sums of money borrowed at certain interest rates. In this way, different cash flow and benefit timings would be compared at the same point in time.

In considering relative costs and benefits of applications to be automated, billing, accounts receivable and payroll were thought of as previously justified for automation. Our approach was determined by whether the new application benefits were greater than the costs of service bureau data processing.

Benefits were determined as follows.

1. *Material inventory control*
Expected inventory reduction of 20 per cent through tighter control would be accomplished by analysing inventory usage, establishing inventory order points and safety stock levels and the use of economic order quantities. Total Annual Savings: $14,000.

2. *Accounts payable*
Improved cash flow management would result through cash requirement reports generated by due dates of invoices as well as timely payment to take advantage of discounts offered. Total Annual Savings: $15,000.

3. *Job cost accounting*
An increase in job efficiency of two per cent would accrue due to better job management. Job management would improve through knowledge of expected manpower and inventory utilisation on jobs. In addition, forecasting requirements for future jobs would smooth out manpower and equipment requirements. Total Annual Savings: $16,000.

4. *Vehicle maintenance*
Preventive maintenance scheduling would sustain the useful life of vehicles making them more productive. Breakeven analysis on vehicles would determine the most appropriate time to scrap or trade in vehicles. Total Annual Savings: $4,000.

5. *General ledger accounting*
A reduced future clerical staff would be required. Based on a comparison of manual and automated systems personnel requirements, the increase in staff need would be reduced by 50 per cent over the eight year period. Total Annual Savings: $63,000.

6. *Management information system*
Tighter control, better management of assets, efficiency of operations and reduction of costs would be benefits. Several previous management decisions based on data available from the computer were used as a basis for this value. Savings attributed to earlier decisions were extrapolated through the eight year period to yield estimated benefits. Total Annual Savings: $50,000.

New applications benefits expected to be earned each year after implementation are shown in **Table 1** totalling $788,500 over the eight years. Present value is calculated to be $494,000. In other words, that amount of money would have to be invested today at 10 per cent interest to draw out or receive benefits in each year totalling $788,500 as shown.

Ten per cent interest was used as the basis for calculation since this was the rate at which the utility borrowed money. Any undertaking such as internal data processing would require additional funds which would be borrowed at the 10 per cent rate.

Based on current service bureau billing rates, the costs of processing these applications are shown in **Table 2** totalling $274,260. The present value of these costs is $170,380, which would require an initial investment today of that amount at 10 per cent interest to pay out costs in each year totalling $274,260 as shown.

The net benefit to the utility of automating the new applications is $514,240, as shown in **Table 3.** The present value is $323,620, clearly making the new applications beneficial and justificable for service bureau processing. Because the entire set of applications are necessary for the management information system, no application cost versus benefit analysis was made.

A computer system with sufficient capacity to handle the volume of activity and with modular capability to handle growth as needed was selected for comparison with the service

Table 1 Dollar benefits of new applications earned each year

	1975	1976	1977	1978	1979	1980	1981	1982	Total
Material inventory control			7,000	14,000	14,000	14,000	14,000	14,000	77,000
Accounts payable			7,500	15,000	15,000	15,000	15,000	15,000	82,500
Job cost accounting			8,000	16,000	16,000	16,000	16,000	16,000	88,000
Vehicle maintenance		2,000	4,000	4,000	4,000	4,000	4,000	4,000	26,000
General ledger				63,000	63,000	63,000	63,000	63,000	315,000
Management information system					50,000	50,000	50,000	50,000	200,000
Total		2,000	26,500	112,000	162,000	162,000	162,000	162,000	788,500
Present value	$494,000								

Table 2 Service bureau costs of processing new applications

	1975	1976	1977	1978	1979	1980	1981	1982	Total
Material inventory control		6,895	7,100	7,315	7,530	7,760	7,990	8,230	52,820
Accounts payable	5,115	6,350	6,630	6,825	7,030	7,240	7,460	7,685	54,335
Job cost accounting		9,210	10,365	11,660	13,115	14,755	16,600	18,675	94,380
Vehicle maintenance		1,180	2,655	2,985	3,360	3,780	4,255	4,785	23,000
General ledger	2,845	3,530	3,635	3,745	3,860	3,975	4,095	4,215	29,900
Management information system		1,015	2,290	2,575	2,895	3,260	3,665	4,125	19,825
Total	7,960	28,180	32,675	35,105	37,790	40,770	44,065	47,715	274,260
Present value	170,380								

Table 3 Dollar benefits of new applications versus service bureau costs

	1975	1976	1977	1978	1979	1980	1981	1982	Total
Benefits of new applications from Table 1		2,000	26,500	112,000	162,000	162,000	162,000	162,000	788,500
Service bureau costs from Table 2	7,960	28,180	32,675	35,105	37,790	40,770	44,065	47,715	274,260
Annual net benefit (loss)	(7,960)	(26,180)	(6,175)	76,895	124,210	121,230	117,935	114,285	514,240
Present value—benefits from Table 1	494,000								
Present value—costs from Table 2	170,380								
Net present value of service bureau	323,620								

Table 4 Costs of internal data processing

	1975	1976	1977	1978	1979	1980	1981	1982	Total
Hardware	72,620	72,205	82,660	109,895	69,630	16,255	16,255	17,050	456,570
Software	11,940	6,660	4,680	2,315	2,315	2,315	2,315	2,315	34,855
Power, insurance, line cost, furniture, etc.	11,505	11,880	11,370	12,870	12,925	12,990	13,060	13,140	99,740
Personnel	31,000	49,400	50,500	53,700	57,200	60,700	64,450	68,405	435,355
Consultants	14,850	18,650							33,500
Total	141,915	158,795	149,210	178,780	142,070	92,260	96,080	100,910	1,060,020
Present value	731,000								

Table 5 Service bureau costs versus internal data processing costs

	1975	1976	1977	1978	1979	1980	1981	1982	Total
Service bureau costs: existing applications	64,760	71,350	79,455	91,000	103,015	116,630	130,045	144,310	800,565
New applications from Table 2	7,960	28,180	32,675	35,105	37,790	40,770	44,065	47,715	274,260
Total	72,720	99,530	112,130	126,105	140,805	157,400	174,110	192,025	1,074,825
Internal data processing costs from Table 4	141,915	158,795	149,210	178,780	142,070	92,260	96,080	100,910	1,060,020
Annual net benefit to internal data processing	(69,195)	(59,265)	(37,080)	(52,675)	(1,265)	65,140	78,030	91,115	14,805
Present value—internal data processing	731,000								
Present value—service bureau	673,860								
Present value in favour of service bureau processing	57,140								

bureau costs. Costs of the hardware were based on the purchase of the system with a 48 month, 10 per cent loan, payable in equal monthly installments. Additional items of equipment will be purchased for cash as required. The total cost of $252,000 is for the equipment to be purchased with a 25 per cent down payment of $63,000 and monthly payments of $4,925.

The costs of the internal data processing system are shown in **Table 4.** All costs connected with implementation and operation are shown, including such items as floor space rental, utility costs, support personnel, maintenance, insurance, etc. It was extremely important to identify both the correct timing and the amount of internal data processing costs. Present value analysis attaches enough significance to the timing of cash flows so that care had to be taken to include costs which might otherwise have been absorbed in normal organisation operations.

At this time, *all* costs associated with the service bureau were grouped together by year. Service bureau costs were totalled on the basis that all applications, both *those currently being processed and the new applications* were to be compared with an in-house system providing the same total service. Total service bureau processing costs were accumulated as shown in **Table 5.**

Since current and proposed benefits clearly exceed the cost of service bureau processing the next consideration was to determine whether internal data processing costs were less than or greater than service bureau costs. As shown in Table 5, the costs for service bureau data processing were greater than the annual costs for internal data processing by $14,805 for the eight year period.

The comparisons were not as clear as they seemed, however, since the cash outflows for each option occur at different times. A clear indication of the least cost was found in calculating and comparing the net present value as shown in Table 5. In this case, because the largest cash outflow for internal data processing will occur early in the eight year cycle under study and the investment opportunity for those funds is lost for a greater period of time, the cost of service bureau processing will actually be *less* by a present value of $57,140.

Our approach to this decision making process was in three parts; first, the gathering of facts and figures to support dollar amounts of data processing costs *and* benefits; second, the analysis of cost versus benefit for the new applications; and third, the analysis of service bureau versus internal data processing costs. Threaded through the analyses was the application of present value analysis. This technique provided for the determination of the true costs of capital by comparing unequal cash flows in each alternative.

Naturally, overriding the final decision to be made by the utilities management were factors such as risk, desire for management control, prestige, etc. But these factors were only applied *after* the financial analysis had clearly indicated the dollar value gain or loss to be made as a result of the final decision.

Book review

Minicomputer Interfacing edited by Dr. Y. Paker, 1975; 279 pages. (*Miniconsult*, £9·00).

This is a volume of Proceedings of a three-day course at the Polytechnic of Central London, 27-29 March 1974. It forms part of a set of such proceedings, some of which have already been reviewed in this Journal.

It is not easy to write well about interfacing. Because there is a wide range of computers and an enormously wider range of peripherals, interfacing each to each, piecemeal, provides the possibility of a great number of individual designs. Each individual design may need to encompass a range of devices from push-buttons and relays through to whole plants. They may be standard or non-standard, near or remote, serial or parallel, synchronous or asynchronous, analog or digital—you name the possibilities: someone has probably solved the problem at least once. There are immense opportunities for reinventing the wheel. A book on interfacing, therefore, is apt to contain a set of special designs of little interest to the student or general reader, or it is likely to be so generalised that it is merely platitudinous. The organisers of the course which gave rise to these proceedings obviously thought a great deal about this problem for they have effectively produced a solution avoiding either extreme and have produced a document which many people will be able to study with profit.

The first paper is introductory, by Dr. Y. Paker, the editor of the proceedings, and is necessarily general. It covers, in twenty-five pages the whole topic in perspective—description of the task, the nature and operation of the minicomputer, operating systems, difficulties—with considerable clarity and elegant brevity; it is well in the tradition of the introductory lectures of the other proceedings of the series, which is to say, it is good. There follow five papers on the general problem and five on more particular solutions to it.

Since the proceedings are of a course rather than a conference, the general papers divide the subject up conveniently. The first is by M. W. Shawyer of Data Laboratories and deals with Analog Interfacing in forty pages, without leaving anything out that matters. The principles are well enough described for the general student, yet there is adequate detail to point the way to someone actually faced with the design problem.

Digital interfacing by T. Luffman of Instem briefly introduces the basic concepts of typical digital interfaces, serial, parallel and highway arrangements, multiplexing and the like, together with words of wisdom about choosing the right mini in the first place.

Interface data transmission by K. Boydell of Kent Automation Systems provides a compressed but clear description of the telecommunications aspects of interfacing. The paper includes useful tables and graphs demonstrating the merits and limitations of the available techniques. This is a most useful paper to a potential, or practising, interfacer since it distills out for the reader a necessary minimum of appropriate material from the redoubtable mass of telecommunication theory.

Minicomputer interface hardware by F. S. Ellis of GEC Computers, rounds off the general hardware section with a brief survey of the hardware strategies available—interrupt techniques, handshakes, bus and star systems and the like. It is general, but in sufficient depth to be useful.

The software aspect of interfacing is also a difficult topic to handle generally as well as usefully but A. M. Kermode of Logica achieves it by the neat approach of writing his paper in the form of a conducted tour, to use his own phrase, which he accomplishes in thirty excellent pages. The author starts with basic principles, describing and defining the techniques and their purpose; he builds up a comprehensible system structure which is simple enough for the non-software expert to follow. Having defined what needs to be done he then outlines the approach to doing it. Perhaps, because I am fundamentally a hardware man I find myself drawn towards liking software experts who really do understand hardware and who can explain their own art to engineers: anyway, I like Kermode's paper very much. It contributes a necessary ingredient to the overall coverage of this book.

In the customary pattern of good teaching practice the general exposition should be followed by illustrative and educative examples. Much art lies in the choice; in interfacing there is a great volume to choose from. The course organisers have chosen five wisely and well in my opinion.

The first application paper, by D. A. Seale of Micro Computer Systems, is entitled Interface design, which it does indeed describe. The paper goes through the successive stages of a design, the approach, the specification, 'costs and trade-offs', and then demonstrates the method applied to a data acquisition system first and illustrates it further with a numerically controlled machine system. This paper properly stresses the importance of maintenance considerations at the design stage.

Appropriately the next contribution describes a successful attempt to produce, by design and agreement between organisations a standard interface. R. C. M. Barnes of UKAERE Harwell describes in detail, with specifications, the CAMAC Interface system. This provides a good explanation of the principles of the CAMAC system as well as being a useful reference document. There are two papers which support the CAMAC paper. The first, Interface design constraints by the late B. E. F. Macefield of Oxford University is a closely reasoned progression through a typical design which leads logically to the CAMAC solution. The second, a CAMAC system for satellite check-out, by A. R. Rundle of Logica, provides an excellent illustration of the use of CAMAC.

The remaining paper is by P. Kellard of CERL: On-line data analysis and control: it is a detailed and thorough exposition of the instrumentation and control by minicomputer, of a very complex test rig. It is a truly illustrative example of the art, or science, of interfacing, competently and well designed and described.

In conclusion, this is an excellent volume dealing with a difficult subject well. Each paper is followed by a chosen bibliography. Anybody threatened with the possiblity of designing an interface would do well to read it.

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