INFORMATION TECHNOLOGY INVESTMENT IN UTILITIES

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July 1986

Center for Research on Information Systems
Information Systems Area
Graduate School of Business Administration
New York University

Working Paper Series

CRIS #138

GBA #86-103

The author would like to thank Professor Jon Turner for the original inspiration for the paper and numerous constructive comments throughout its preparation.

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1. Executive Summary

The purpose of this document is provide managers of utilities with an insight into the mechanism of investment in information technology (IT). IT can be embedded into the business strategy of an organization at three levels; Transaction, Information and Strategic. The level chosen will critically affect the type of IT investment.

To aid in the understanding of IT investment a simple model is proposed [see Figure 1] which contains three aspects;Input, Firm and Output. Input is the measure of how much is invested in IT as compared to a convenient measure such as revenues. Firm is the internal conversion process which is determined by factors such as management expertise, internal systems and the level of IT investment targeted. Output is the measure of performance which for utilities would include financial result, service level, cost per unit output and public image. The studies that exist in this area are almost exclusively investigations into the Input aspect of this process and tend to be surveys.

The results of two studies, Datamation and Diebold are presented in the appendixes. The combined findings of these studies indicate that the American utilities surveyed spend between 0.7 and 1.0% of their revenues on IT per annum. This

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figure tended to be less for utilities than for the average of all businesses. These figures should be used only as a rough guide as these studies contain a number of limitations including relatively small sample sizes.

No useful information concerning the Firm and Output aspect of the model was found. This appears to be predominately due to reasons of confidentiality. The only information found was case study based and suffers from an inability to generalize from the results. As a consequence is is recommended that each organization measure and track their Input and Output IT investment as a guide for future investment. A technique for performing this process is suggested in section 7.

2. Introduction

One of the emerging business strategies for the eighties is the use of information technology as a competitive advantage [5] [3]. This strategy relies on the use of IT to make an organization more competitive. The use of IT is embedded in the organizations business strategy at three levels [4]. These are:

1. Transaction: IT can used to reduce costs and lead times for information processing eg: billing and account processing.

2. Information: IT can be used to provide more timely and accurate information on the organization's activities for use in decision making and improved communication.

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3. Strategic: IT can be incorporated into the way of conducting business so as to provide a competitive advantage and thus be more attractive to customers eg: electronic funds transfer or automatic teller machines.

Much space in the management literature is devoted to this theme with discussion of "end user" computers, communication networks, electronic mail, strategic information systems ,online data acquisition systems etc. The proponents of an IT strategy suggest that all organizations from consumer goods manufacturers to government utilities can benefit from this orientation. If this strategy is adopted a significant investment in IT is required. Organizations considering this type of strategy are therefore interested in determining the amount of resources to invest and whether this investment is likely to produce significant results.

The purpose of this document is to assess whether utilities, in particular have followed this advice and are investing in IT. To assist in understanding the IT investment mechanism- a simple model is proposed in the next section. Statistical results from two studies into IT investment, Datamation [1] and Diebold [2] are presented and the results assessed. This document concludes with recommendations for techniques for determining whether any investment made in IT is producing results. These techniques

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concentrate on the measurable results as other less tangible benefits such as improved customer image and internal morale are very difficult to quantify.

3. Modelling and IT Investment Measures

In proposing a model of IT investment three aspects are important. Resources are Input to the system and converted by the Firm to Outputs. Consider Figure One which presents a schematic of the model.

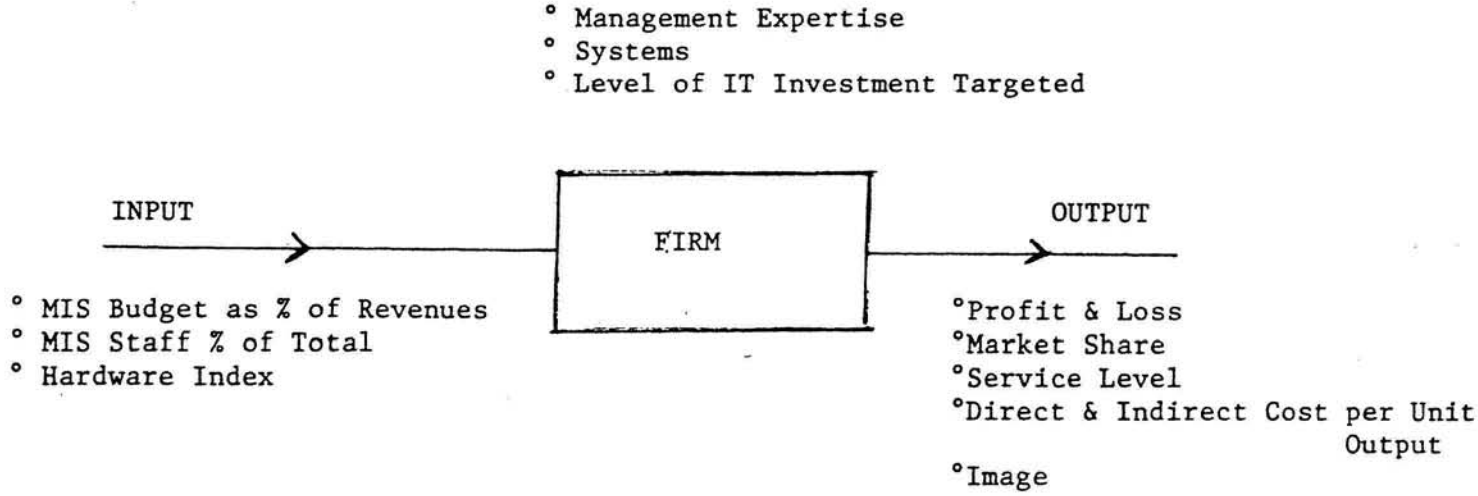

Figure 3-1: IT Investment Schematic

Input is the measure of how much is invested in IT as compared to a convenient measure such as revenues. Firm is the internal conversion process which is determined by factors such as management expertise, installed systems and the level at which the IT investment is targeted. Output is the measure of

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performance which for utilities is likely to be some combination of :

* surplus or deficit result
* service level
* cost per unit output
* public image.

Almost all of the IT investment measures available are Input measures which do not assess the efficiency of conversion to useful outputs. Measures of Input which are found in the literature include;

* Management Information Systems [MIS][2] budget as a percentage of revenues
* MIS staff as a percentage of total
* Data Processing budget as a percentage of revenues
* Estimated spending outside MIS budget[3]

These global measures are frequently broken down to major

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[2]The term MIS is used in a number of studies and is equivalent to IT.

[3]This includes any central IT expenditure on different budgets and IT expenditure by other functional areas not categorized as IT eg:Numerical Controlled Machinery.

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expenditure categories such as; hardware (mainframes and minicomputers), personal computers, personnel, consultants, outside services and off budget expenditure. The usefulness of these measures to a particular organization is highly dependent on how they are defined, collected and collated. The next section addresses these issues and presents the statistical data from the studies. Useful information relating to the Firm and Output aspects of the model is very difficult to obtain. Most organizations are reluctant to allow the publication of the sensitive data relating to internal efficiency, systems and detailed measures of output performance. As a consequence case studies are major source of information. Cases do provide interesting insights but have a number of shortcomings. It is very difficult to generalize quantitatively from the experience of one company in a case to any other. Differences in industry, environment, personnel and level of IT technology all contribute to this innability. Also it is very rare that failures of IT implementation are documented. The existence of case studies of the successful use of IT do however, provide evidence that dramatic improvements can be made with significant investment.

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4. Review of Studies

Studies of Input measures of investment are rare and generally are surveys of organizations to which the surveying body has easy access. For this reason the survey respondents are rarely randomly chosen nor represent a complete cross section of the population of organizations. The sample size, standard deviations of responses and the level of the respondent in the organization are vital issues in assessing the results of these studies.

4.1. Datamation

Datamation regularly conduct a survey of the magazine's circulation base and the Fortune 1000 & 400 firms, to assess the MIS Input investment of companies. A response rate of 13% is typical for the Datamation studies. Datamation catagorizes their findings into 11 industry groupings and sum these all together in an overall category. Utilities is one of the groupings and includes water, electric, gas and some phone companies. Appendix I presents the results for the last three surveys. A brief summary of the major findings for utilities is given here.

* MIS budget over utility revenue was 0.4% in 1985 and estimated to be 0.57% in 1986. The Datamation survey is statistically biased [due to the large number of small sites] and underestimates MIS expenditures in large organizations. Adding 0.3 to 0.4% will indicate likely values for large MIS centers.

* MIS budget over revenues has been consistently lower

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for utilities than for the overall category whilst the revenues for utilities has been significantly larger than average total revenues. For 1985 utilities spent approximately 28% less than was spent in the overall category.

* The traditionally lower MIS spending for utilities has changed in the 1986 budget estimates with a 9.8% increase [as compared to 1985] whilst for the overall category the increase was 4.2%. Spending for utilities is still budgeted at 25% lower than the overall category.

* 1983 and 1984 figures can be effectively ignored due to the small samples and the changes in methodology and technique employed from 1985 onwards.

4.2. Diebold Study

The Diebold Group Inc. conducts biennial surveys of major corporation's MIS expenditure and has collected data for the last ten years. Sample sizes were typically smaller that for Datamation and in the 1984 survey 166 large North American companies were surveyed. These companies are categorized into thirteen groups of which four are non industrial. One of the non industrial groups is utilities which includes all non telephone utilities. An overall category is also provided and is an average of the nine industrial groups. Non industrial groups are excluded from this average as the revenue figure for banks and other financial institutions is meaningless for comparison. The results from 1971 to 1983 are presented in graphical form in Appendix II for utilities and the overall group. A number of interesting

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trends can be gleaned from the data. These trends for utilities are:

* MIS as a percentage of revenues is increasing over time but has exhibited a significant fluctuation with a sharp increase in 1979. It has ranged from 0.58% [1975] to 1.46% [1977] and seems to reflect the economic cycles of the day. The 1983 figure is 0.97%.

* The hardware index [ratio of hardware expenses to personnel costs] has exhibited a very gentle upward trend over time with fluctuations representing shifts of emphasis from hardware to personnel. In recent years [1980-1983] a discernable increase in the hardware index was apparent probably reflecting the penetration of the personal computer into utilities.

* MIS employees as a percentage of total employees was approximately constant at around 1.1% from 1971 to 1975 and rose significantly to be approximately constant at around 2.9% from 1979 to 1983.

Recent trends for MIS overall are:

* 1983 was the first year for ten years that real hardware expenditure increased. This change includes significant personal computer investment.

* The average MIS budget [1983] as a percentage of revenues was 1.44% and represents a significant increase over previous years. The budgeted increase for 1984 was a 13.6% increase over 1983.

* The expenditure for software increased significantly over recent years.

* The number of MIS employees increased by 4.8% in 1984 to be 2.0% of the total workforce.

* MIS Input investment as a percentage of revenues

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increased over time gradually but consistently except for a dip in 1981. The average level was 1.0%.

Comparing utilities to the overall category the trends were:

* MIS investment as a percentage of revenues for utilities was higher than for overall in 1977,1979 and 1980. For the other years utilities expenditure was lower. This contrasts with the Datamation findings.

* Greater variance was exhibited for utilities [Std Dev = 0.29%] than for overall [Std Dev = 0.16%] MIS expenditure as a percentage of revenues.

* Hardware index for utilities and overall was very similar until 1979 after which the utilities index increased significantly.

* The percentage of MIS employees to total number of employees was significantly higher for utilities [Mean = 1.6%] than for overall [Mean = 1.6%].

4.3. Combined Findings from Both Studies

The studies both used surveys as the instrument for data collection. The studies differed in all other aspects including questionnaire design, companies questioned, industry groupings, incentives to answer and the level addressed in the organization. As a consequence it is not surprising that the results differed. The two studies have been combined and summarized and the key findings are:

* The MIS budget over revenues for utilities was between 0.7 and 1.0% for the most recent years [1983-1986] reported. This figure exhibited a gentle upward trend

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over recent years and was generally lower for utilities than for the overall category.

* The variance in MIS budget over revenues was larger for utilities than for overall.

* In recent years a discernable increase in hardware index has occurred for utilities.

* MIS employees as a percentage of total employees for utilities increased significantly in 1985 to consistently measure around 2.9% and was significantly higher than the similar measure for the overall category.

These findings provide a useful guide for managers of utilities in determining levels of MIS spending in their industry. The numbers are only indicators of MIS Input investment and provide no guidance as to the Output or performance effects. Similarly no information is provided as to the efficiency of conversion of this Input investment to performance.

5. Limitations

The information provided by these studies is useful but must be assessed with the understanding that a number of limitations exist. They are presented below.

* The sample sizes of the studies for utilities were typically small and ranged from 6 to 18 organizations.

* The data are from American organizations possibly reflecting a different scale of operations on average, to similar Australian utilities.

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* The variance of these results was typically larger over time for utilities than overall reflecting the disparity within the utility category and the statistical effects of small sample sizes.

* The data was voluntarily reported by companies and the categories such as MIS expenditure are likely to be defined in different ways across companies. The survey questionnaires attempt to include all non MIS department computing expenditure however in some cases this expenditure will appear on different budgets and not be included in the results. Examples would be computing expenditure on Computer Aided Design, Consultants and Communications.

* Given the small sample sizes the respondents are unlikely to be random and representative of all utilities. Included in this definition of utilities are several completely different types of organizations. There is no reason to believe that water boards, telephone companies, electric companies and gas companies do have, or should have similar cost structures.

* Accurate responses to detailed questionnaires rely on the good will of the busy officers of the organization to identify the required information and retrieve it [if it exists]. The incentive usually offered by the surveying party is a copy of the final results. Thus it is possible that approximate, estimated or incorrect information may be provided.

* Diebold use the "average of average" technique for reporting aggregate results rather than the "sum of actuals" method. The "average of average" technique takes no account of the raw size of the organizations [but biases towards the majority] whilst the "sum of actuals" biases the results towards what is happening in the larger organizations. The commentary of the Datamation survey suggests the upward adjustment of results to be representative of large organizations but does not describe the aggregating technique used. Appendix III outlines these two arithmetic techniques

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with an example.

6. Implications for Managers of Utilities

In order to assess the implications of these studies it is helpful to return to the framework of the model presented earlier. The information provided by these studies is useful only in comparing Input investment. Information such as that American utilities spend between 0.7 to 1.0% of revenues on MIS is helpful as a comparison but no information is conveyed in these figures about the Firm or Output aspects of the model.

The Firm aspect of the model is concerned with management expertise, installed systems and most importantly at which level [refer to introduction] IT is embedded in the business strategy. The three levels have different objectives [eg: Transaction IT investment is for cost and lead time reduction] and thus the efficiency of the conversion process is highly dependent on which level is being addressed. The information provided by the studies provides no insight as to which level a particular organization was targeting the IT investment. This is unfortunate as it is very likely that each level will require a different amount of Input investment. Any organization must first determine at which level IT will be embedded into its business strategy.

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The studies also provide no insight as to the Output aspect of the model. As a consequence no indication is provided as to how successful the investment in IT has been. Case studies of a particular firm's experiences can provide some insight, however the problem of generalization still remains. There are so many variable operating in this process that generalizing from any available Output data is frought with difficulty. As a consequence it is recommended that each firm measure and track their own experience as a guide for future investment. The next section suggests a technique for this process.

7. Recommended Measures for Self Tracking of IT Investment

In an effort to measure IT investment both Input IT investment and Output must be tracked. The former is more easily quantified although it is possible to at least estimate Output. The following measures and steps are recommended.

* Rigorously define IT investment attempting to include all relevant aspects including consultants, personal computers, communications, CAD, and training, etc.

* Measure and track Input measures including;

    - Revenue fluctuations

    - IT expenditure to total budget revenues [adjust for revenue fluctuations]

    - Hardware index [ratio of hardware to personnel expenses]

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- Software index [ratio of software expenditure to personnel expenses]

- IT budget by its major components eg: mainframe, peripherals, application software etc.

- IT employees as a percentage of total employees.

* Rigorously define a convenient measure of unit output eg: 1 megalitre of water delivered. A second measure for comparison and validation is also recommended eg: $100,000 of billing.

* Measure and track Output measures

  - IT costs per unit of output

  - Total costs per unit of output

  - Total fixed costs per unit of output

  - Total variable costs per unit of output.

If these indicators are gathered and compared over time, it will be possible to to get a good feel for whether an investment in IT has resulted in more efficient operation. If Input investment is significant and sustained over time and targeted to reduce costs [by Transaction level IT investment] the output measure should reflect this. Not all benefits will appear but change should occur. These figures will not provide the complete answer but will provide a solid basis for informed strategy decision making. To track and measure Output is more difficult from investment targeted at the Information or Strategic levels

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of IT investment. Attitude surveys to managers and customers is one approach to attain qualitative information.

8. Conclusion

In concluding a number of points deserve note.

* Three different levels exist for companies to embed IT into their business strategy; Transaction, Information and Strategic. The level or levels identified by a particular organization will affect the Input investment required and the return on investment expected.

* The mechanism of IT investment contains three important aspects; Input, Firm and Output as described by figure 1.

* The Datamation and Diebold studies provide useful insight as to IT Input investment by utilities in the USA, given the limitations identified. The utilities surveyed were spending between 0.7 and 1.0% of revenues on IT.

* Benefits from IT investment can be both measurable and intangible. A process of self tracking is recommended to capture at least part of any measurable benefits.

* There is no doubt that levels of IT investment are increasing in almost all organizations. The question that remains unanswered is what level of IT investment is optimum.

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APPENDIX I

DATAMATION STUDY RESULTS

	1983		1984		1985		1986	
	Utilities(%)	Overall(%)	Utilities(%)	Overall(%)	Utilities(%)	Overall(%)	Utilities(%)	Ov
P Budget of of Revenue[1]	0.5	0.6	0.08	0.2	0.40[4]	.56[4]	0.42[4]	0.57
ample Size	?	1083	6	642	18	?	18	?
evel of espondent								
DP Manager	N/A	100	N/A	35	N/A	N/A	N/A	N/A
Corporate Officials	N/A	0	N/A	28	N/A	N/A	N/A	N/A
P Budget hange[2]	+5	+7	0	+7.4	N/A[4]	N/A[4]	+9.8	+4.2
ajor Items								
Personnel	28.2	29.4	N/A	37.8				
PC's	0.7	4.9	N/A	9.6				
lear Revenues ($Million)			516	199	645	291	669	300
lear DP Budget ($Million)			0.403[3]	0.421	2.56[4]	1.65[4]	2.81[4]	1.72
urvey Base	Datamation Readers Only		Datamation Readers and Fortune 1000 & 400 Firms					

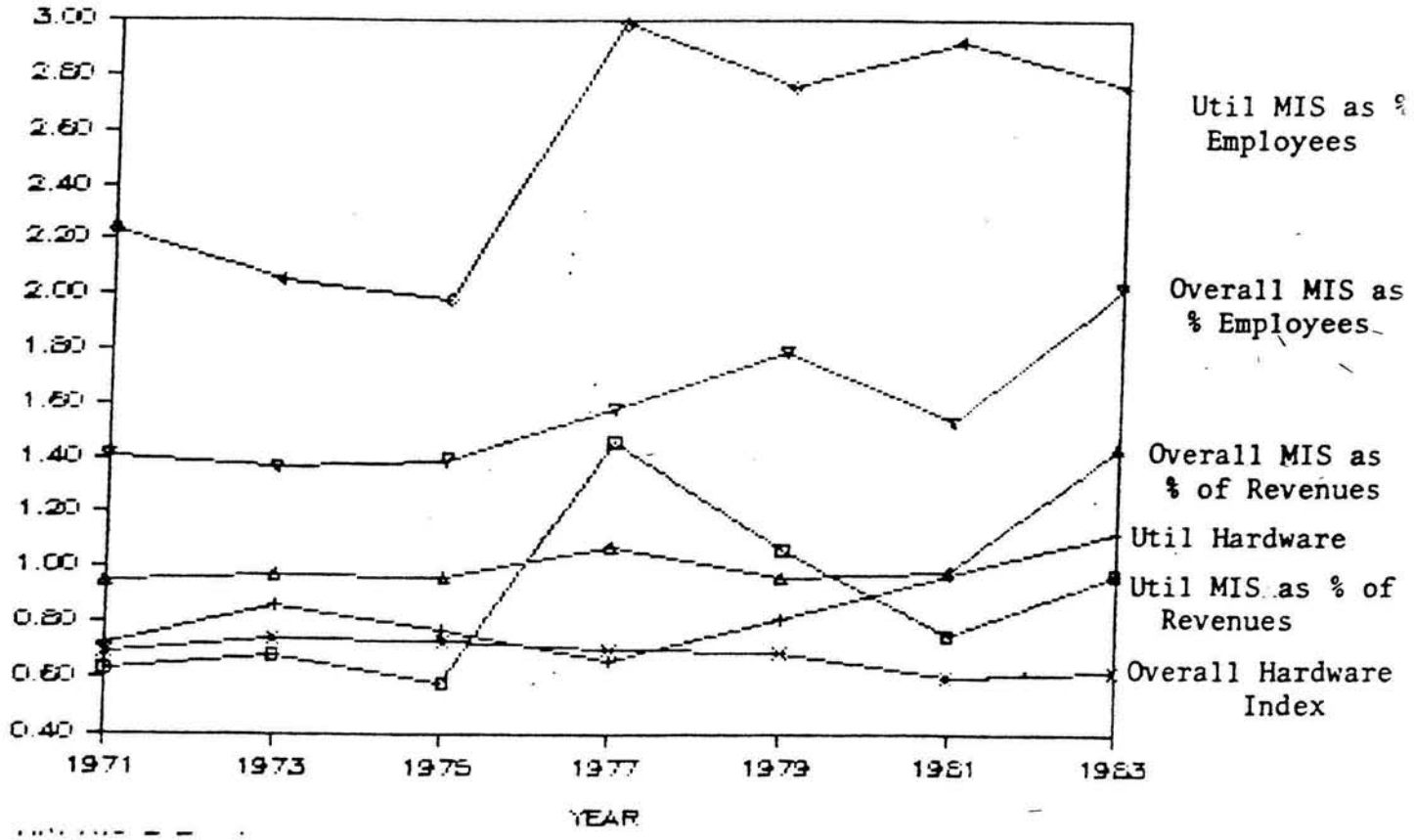
[1] There exists a small firm bias in the survey which underestimates the budgets of large organizations. The addition of 0.35 recommended for organizations with DP budgets larger than US$ 500,00

[2] DP Budget Change = $\frac{\text{Next Year's Budget - This Year's Budget}}{\text{This Year's Budget}}$

[3] Estimated during previous year

[4] Not comparable to pre 1985 due to different methodology and sampling techniques

II. Diebold Study Results



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III. Average of Average versus Sum of Actuals Aggregating Techniques

An example is presented to illustrate the differences between these techniques.

Organization Budget A	MIS Budget B	B as a % of A
300,000	8,000	2.67
5,000,000	50,000	1.00
4,000,000	60,000	1.50
9,300,000	118,000	5.17

Sum of Actuals = 118,000/9,300,000 = 1.27%

Average of averages = 5.17/3 = 1.72%

The example shows that the "average of average" technique biases the result to the happenings in the larger organizations. The "sum of actuals" method biases towards the majority of the group.

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