



ACCOUNTING MATTERS

IT cost benchmarking: Drawing the right conclusions

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Abstract The use of managerial control ratios for benchmarking IT costs is widely accepted. This installment of Accounting Matters informs CIOs about IT managerial control ratios and the assumptions underlying the use of these ratios in IT cost benchmarking. Incorrect use of these ratios and violation of the assumptions can lead to faulty inferences and costly mistakes. This article proposes a technique for benchmarking IT costs to draw the right conclusions from the data.

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Imagine the following scenario: You're meeting Monday with the executive committee. One item on the agenda has your full, if worried, attention: IT costs assessment. Stacked on the desk in front of you is a cost benchmark study. For the third year in a row, costs are significantly higher than the industry average. Further, the cost comparisons have worsened while the firm faces stagnant sales.

1. Using benchmarking to justify IT costs

Managing and justifying IT costs is an essential responsibility of Chief Information Officers (CIOs). As the presented scenario illustrates, these

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responsibilities intensify during times of economic stagnation, when firms must search for ways of saving on costs. But even during periods of growth and expansion, IT managerial control ratios are at the heart of capital allocation decisions, which have operational and strategic impacts (Kobelsky, Richardson, Smith, & Zmud, 2008). A variety of IT investment evaluation methodologies can be used to analyze IT costs, including return on investment (ROI), net present value (NPV), internal rate of return (IRR), real options analysis (ROA), and the balanced scorecard (BSC). However, managers often reject these methodologies as impractical. Estimating IT costs and benefits is often difficult, expensive, and—in the case of estimated IT benefits—not entirely possible. Instead, CIOs turn to cost benchmarking to justify IT expenditures.

IT cost benchmarking compares IT spending against industry averages or best-in-class information systems (IS) organizations. Determining the

relative standing of one's IS organization, either in relation to other companies or business units in the same firm, provides support for extant or additional investments in IT. Comparisons can fuel cost-cutting initiatives or help justify higher spending levels.

2. IT managerial control ratios

IT managerial control ratios measure an organization's IT costs relative to its size and provide the analytic foundation for IT cost benchmarking. The ratio is a fraction with an IT cost variable in the numerator and an organizational size variable in the denominator (Nikkinen & Sahlström, 2004):

$$IT\ Managerial\ Control\ Ratio = \frac{IT\ Cost}{Organizational\ Size}$$

A variety of numerators and denominators have been used to measure organizational IT spending relative to size in practice and research (see Table 1). Trustworthy numerator and denominator variables should produce dependable ratios; however, each variable presents reliability concerns. For example, IT Spend is often used in the numerator of the ratio, but is not a reliable measure of organizational resources devoted to IT due to ambiguity surrounding what exactly constitutes an IT expense. To gather IT Spend data, IT market research firms survey senior technology leaders or chief financial officers (CFOs) regarding total IT expenditure of the firm. Yet, each individual's definitions/inclusions will vary. This challenge/weakness is illustrated by Brian Zrimsek of MRI Software (CIO Network, 2015):

IT spend as a percent of revenue is a very standard metric. What you need to be careful of are the definitions of what goes into your spend. As an example, telecom costs may or may not be in the IT budget.

Other 'hidden' sources of IT expense, such as depreciation of IT assets, are sometimes overlooked. All

this makes it difficult to obtain a reliable IT expense estimate. An alternative measure, IT Budget, is believed to be a less ambiguous and therefore more dependable measure of organizational financial resources devoted to IT. Unfortunately, it also, suffers from reliability problems. First, IT Budget does not include all IT costs; indeed, up to 30% of IT costs are believed to lie outside of the IT department (e.g., user training expenses; Mitra & Chaya, 1996). Second, using IT Budget as the numerator variable complicates cross-sectional comparison among companies, since organizations can be at different stages of IT infrastructure buildup. An organization with a mature IT framework may, for example, devote less money to its IT function as compared to an organization with an evolving IT function. As a result, budget levels will vary disproportionately with size.

Measures for firm size are used in the denominator, but they, too, suffer from limitations. Revenue can be too volatile a measure of organizational size, since income fluctuates from year to year (Brynjolfsson & Hitt, 1996). Employee count is less volatile in the short-term, but would make ratios sensitive to firm labor-capital mix. For example, high value of a ratio may reflect replacement of labor with IT; in this case, companies that appear to be inefficient users of IT resources may in fact be quite successful at replacing clerical tasks with cost-effective IT solutions. One work-around is to group and compare ratios by industry, as different industries may have different labor-capital mix. As explained by Catherine Hellebaut, ERP & IT Leader at 3M (CIO Network, 2015):

IT Cost to Sales is definitely the correct KPI [Key Performance Indicator] but the numbers are very different by industry (e.g., 6%–12% for banks, between 1.5% and 2.5% in industry, less than 1% in the construction industry, etc.

While a variety of numerators and denominators have been used in practice (e.g., Bartels, 2007) and research (e.g., Bharadwaj, Bharadwaj, & Konsynski, 1999; Han & Mithas, 2013; Qu, Oh,

Table 1. Numerator and denominator variables

IT cost variables	Organizational size variables
<u>Commonly used:</u> <ul style="list-style-type: none"> ● IT Spend (and its categories: hardware, software, personnel, etc.) ● IT Budget (and its categories) 	<u>Commonly used:</u> <ul style="list-style-type: none"> ● Revenue ● Employees ● Operating Expense
<u>Less commonly used:</u> <ul style="list-style-type: none"> ● Operating IT Budget ● IT Stock (and its categories) 	<u>Less commonly used:</u> <ul style="list-style-type: none"> ● Assets ● Selling, General, & Administrative Expense

& Pinsonneault, 2010; Thouin, Hoffman, & Ford, 2009), the ratio of IT Spend to Revenue seems to be the most widely employed for several reasons. First, this ratio closely corresponds to the way executives think about their organization's cost structure. In other words, it is easier for an executive to conceptualize IT spending in terms of proportion of revenue as compared to proportion of operating expense or per-employee basis. Consequently, data collection is simpler. Second, the value of this ratio may have immediate managerial implications, as explained by Estaban Tejada, Commercial Manager at Seguros Monterrey New York Life (CIO Network, 2015):

The way we measure IT spending is a ratio between IT cost and net sales. This is a good indicator because if your company is [enjoying] more revenue then you may increase your IT spending to support new business units, staff, etc.

3. The practice of IT cost benchmarking

Cross-sectional analysis of IT cost is the most common form of benchmarking using IT managerial control ratios. Under this approach, an organization's IT managerial control ratio is compared either to an industry average or to results of companies whose IT is purported—by IT market research firms (e.g., Forrester Research, Gartner Research) or publications (e.g., *Information Week*)—to be best in class. The ratio data is obtained through self-reports from senior IT managers. Alternatively, managers may be asked only for IT expense dollar amounts/numbers; the research firms then turn to external data sources (e.g., Compustat) to obtain values for organization size (e.g., revenue, operating expense, number of employees). Participating organizations are chosen either via random sampling across industries or from a set of companies identified as best-in-class IT organizations (e.g., in the case of *Information Week* 500 survey). The ratio data is then categorized into industry groups, with averages computed for each industry (see Table 2). The most commonly used averages are:

- *Median ratio*: the value of a ratio within an industry sample that is split into two equally sized groups.
- *Mean ratio*: the value of a ratio obtained by calculating the mean of the ratios within a sample.

Table 2. Ratios in benchmarking

Organization	Ratio(s)	Industry Standard
Forrester	IT Budget/Revenue	Median
Gartner	IT Budget/Revenue; IT Budget/Operating Expense	Mean
<i>Information Week</i>	IT Budget/ Revenue	Mean, Median

Senior IT executives, or perhaps their superiors, can compare these industry norms or ratio standards to the IT managerial control ratios of their organizations. Being significantly below the industry average may justify increased IT expenditures, while being above may motivate cost-cutting initiatives. The exact approach to IT cost benchmarking may be granular and sophisticated, depending on the company and the analytical capabilities of its CIO. For example, Noel Thomas, a Chief Technology Officer at London's Trinity College, uses multiple ratios (e.g., IT spending as a percentage of revenue, IT spending as a percentage of operating expense) to analyze performance between organizational units, across industry, and over time for IT costs split into two categories: investments and maintenance expense (CIO Network, 2015). Yet at the heart of this analysis is comparison of organizational ratios to those of peers or industry averages.

4. Assumptions in IT spending benchmarking

Validity of the cross-sectional benchmarking approach relies on three key assumptions. The *distribution assumption* surmises that the cross-sectional distribution of IT managerial control ratios within an industry is normal. The *proportionality assumption* presumes that the relationship between numerator and denominator in IT managerial control ratios is strictly proportional. And the *approximation assumption* expects that the relationship between numerator and denominator within an industry can be adequately approximated with the proportional specification implied by mean and median estimates of the norm. Our research shows, however, that these key assumptions are violated in one of the most widely used samples of IT managerial control ratios (Barnes, 1987; Lev & Sunder, 1979; Whittington, 1980). The following three subsections explain the assumptions and how they can lead to erroneous results in benchmarking.

4.1. Distribution assumption

A normal probability distribution is depicted by a symmetric, bell-shaped curve (see Figure 1). A symmetric probability distribution is important for benchmarking. If a probability distribution is not symmetric, the mean ratio does not divide an industry sample into two equivalent groups and adequately represent the norm. In the case of a positively skewed probability distribution there will be more cases below the mean than above the mean (see Figure 2); similarly, a negatively skewed probability distribution will see more cases above the mean. Thus, the degree to which mean represents the norm in a case of skewed data distribution is questionable.

While the median ratio provides a better comparison standard for skewed distributions, it is not without problems. First, the median ratio may not represent the most common ratio in the sample.

Second, equal deviations from the median in different directions are likely to be associated with different probabilities. While the median ratio—as compared to the mean ratio—may be a better representation of an industry norm, distribution still must be taken into account.

Kurtosis, defined as the degree of ‘peakedness’ of a data distribution, must also be considered. A distribution with a high degree of peakedness has a positive kurtosis (see Figure 3), while the kurtosis of a ‘flat’ probability distribution is negative (see Figure 4).

In establishing an industry norm, kurtosis typically presents less problems than an asymmetric probability distribution. For a peaked yet symmetric distribution, the industry norm can be unambiguously defined with an average value (e.g., mean). Still, for a distribution with a peak, minor deviations from the norm will be associated with a major deviation in frequency (i.e., probability)

Figure 1. Normal probability distribution

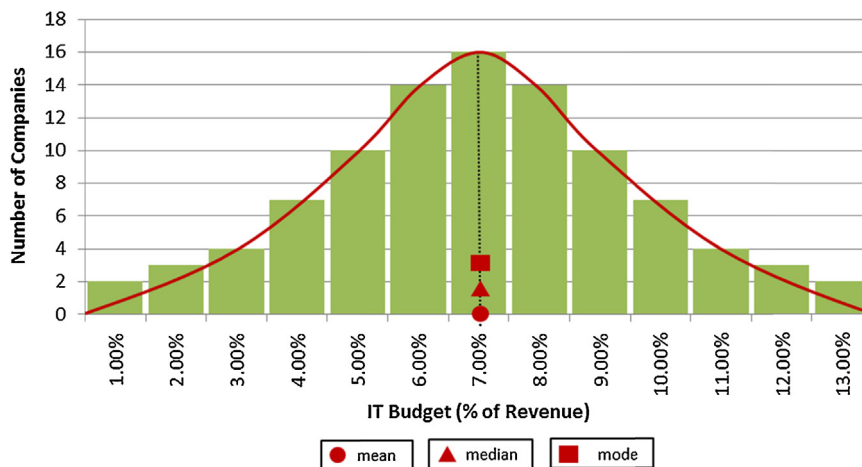


Figure 2. Positively skewed probability distribution

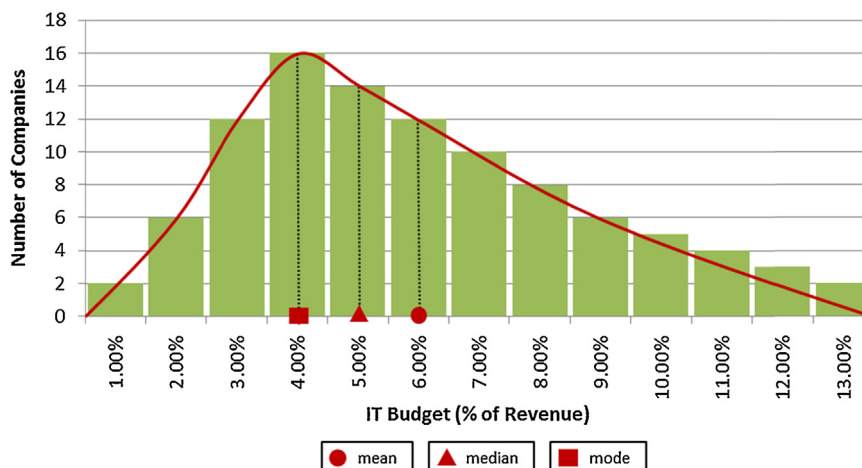


Figure 3. Probability distribution with positive kurtosis

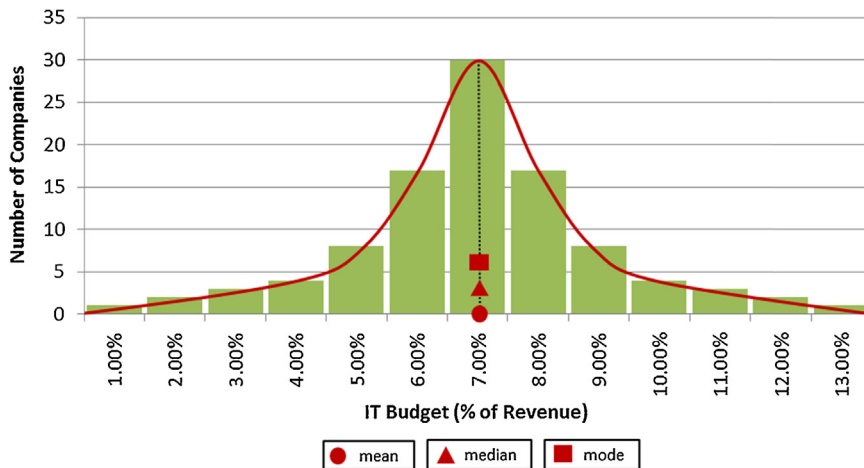
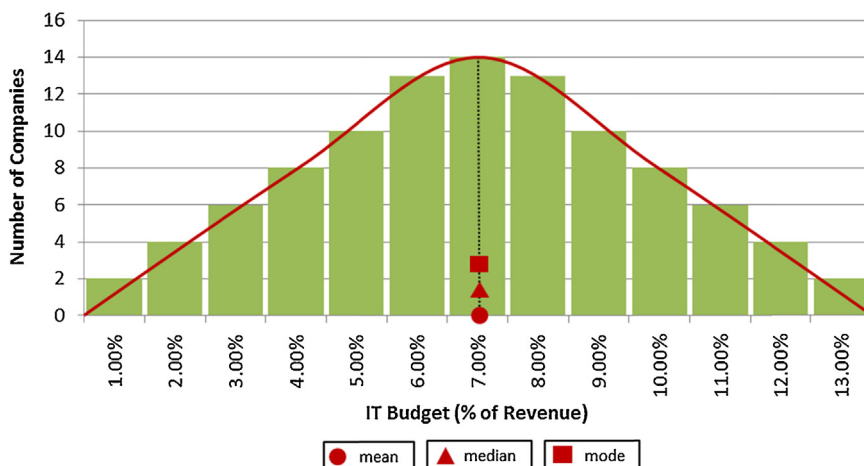


Figure 4. Probability distribution with negative kurtosis



associated with a particular ratio. In this scenario, being slightly below or above the mean could put a company into the category of either an extremely low or extremely high IT spender. Contrary to what a user of the ratio might conclude, a small deviation from the norm does not necessarily provide compelling evidence that organizational IT spending is in line with the industry norm.

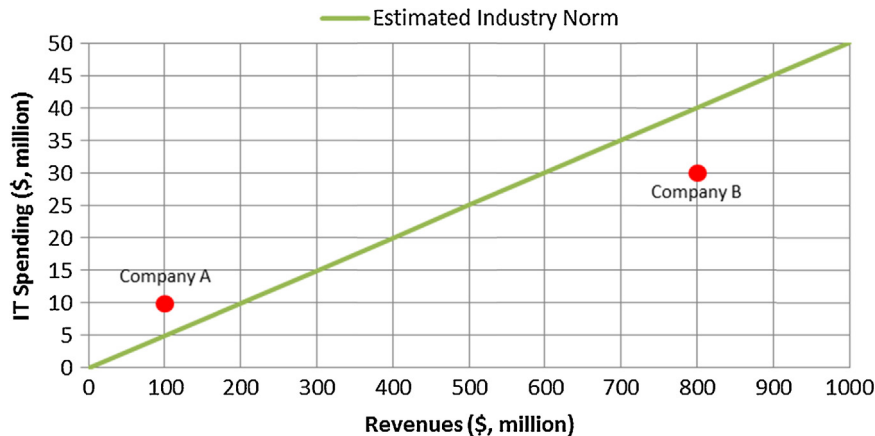
4.2. Proportionality assumption

Another benchmarking assumption is that the relationship between numerator and denominator is strictly proportional. This occurs when the numerator (IT cost variable) is a constant percentage of the denominator (organizational size variable) across an industry sample. Graphically, a proportional relationship can be represented by a straight line (see Figure 5).

The industry norm set by mean and median imply a strictly proportional relationship between numerator and denominator. Let’s assume that the mean ratio of IT Spend relative to Revenue is 0.05. In this scenario, 5% of company revenue is spent on IT (Figure 5). A company spending more than 5% (Company A) or less than 5% (Company B) of its revenue on IT deviates from the proportionality relationship suggested by the mean ratio.

While a strictly proportional relationship between numerator and denominator is implied by the industry norm, in practice the relationship may deviate from proportionality in two ways. First, the presence of a constant term in the relationship between a numerator and denominator might be explained by the presence of fixed costs associated with maintaining an IT infrastructure; for instance, regardless of revenue changes from month to month or year to year, a company must spend a baseline

Figure 5. Graphical representation of proportionality



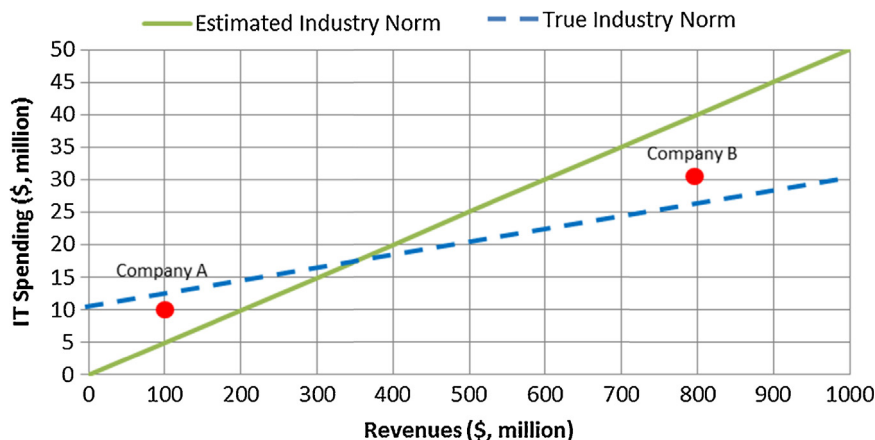
amount on IT just to keep the lights on. Second, a non-linear relationship between a numerator and denominator may be explained by economies of scale; for example, once money is spent on developing a software application for one business unit, copies of this software can be shared with other units without incurring significant additional costs.

Deviations from proportionality can lead to wrong inferences and unsound investments in IT. Consider Figure 6. In this example, the industry norm is set by a proportional relationship represented by a straight line implying that, on average, a company should spend 5% of its revenue on IT. But the true relationship is depicted by the dashed line that intercepts the IT spending axis at \$10 million, thus recognizing the fixed costs of maintaining the IT function. Company A is classified as being above the industry norm, but the true relationship between numerator and denominator suggests that the position is, in fact, below the industry norm. Meanwhile, Company B is classified as being below the industry norm, while the true numerator/denominator relationship

suggests that the position is, in fact, above the industry norm. Thus, completely contrary interpretations are possible regarding where a company stands.

Another type of deviation from proportionality is a curvilinear relationship between numerator and denominator. In the presence of economies of scale, the relationship between numerator and denominator of an IT managerial control ratio may be characterized by a curve, as illustrated in Figure 7. Here, the proportion of revenue spent on IT is decreasing with a company's sales. But the industry norm is still set by the line implying a strictly proportional relationship. In this case, Company A may be incorrectly classified as having IT spending above the industry norm, while in fact its IT spending is below the level it should be in light of the true relationship between the numerator and denominator. Similarly, Company B will be incorrectly classified as being below the industry norm, while in reality it is above the true industry norm set by the curve. Once again, completely contrary interpretations are possible.

Figure 6. Presence of a constant term



4.3. Approximation assumption

The third assumption underpinning IT spending benchmarking takes for granted that the standard set, with the help of a mean or median ratio, approximates the true relationship between numerator and denominator within an industry. Consider Figure 8; here, the standard set by the solid, straight line shows that on average, companies spend 5% of their revenue on IT. While the true estimate of the relationship between IT Spend and Revenue is represented by the dashed, curved line, the solid, straight line provides an adequate approximation of the true relationship.

This assumption differs from the specification assumption. Even if the form of the relationship between a numerator and denominator implied by mean or median estimate is correct, the relationship implied by mean or median estimate may not be a good approximation of the true relationship between numerator and denominator. For example, in

Figure 9 the relationship implied by the mean estimate and the true relationships are both proportional (i.e., represented with straight lines). Yet, the exact proportions are different—something that may lead to conflicting interpretations as to where Company B stands in relation to the industry norm.

5. Our findings in relation to the three assumptions

To test the three assumptions, we used an annual survey of senior IT executives conducted by an IT research firm. The survey contains responses regarding IT Budget/Revenue ratios from a sample of approximately 3000 organizations located in Europe, Asia, and North America. The ratios sample was subjected to a multi-method test for each of the three assumptions. We found that all three assumptions were violated. More specifically:

Figure 7. Curvilinear relationship

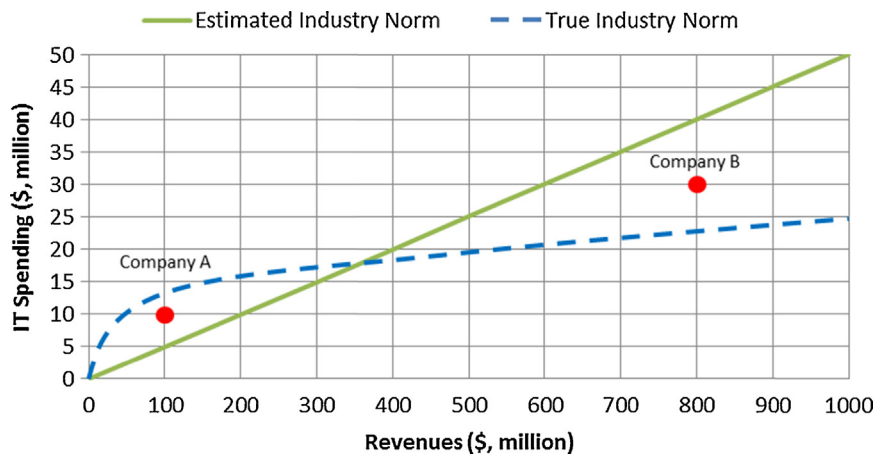


Figure 8. True vs. estimated relationship—Insignificant discrepancy

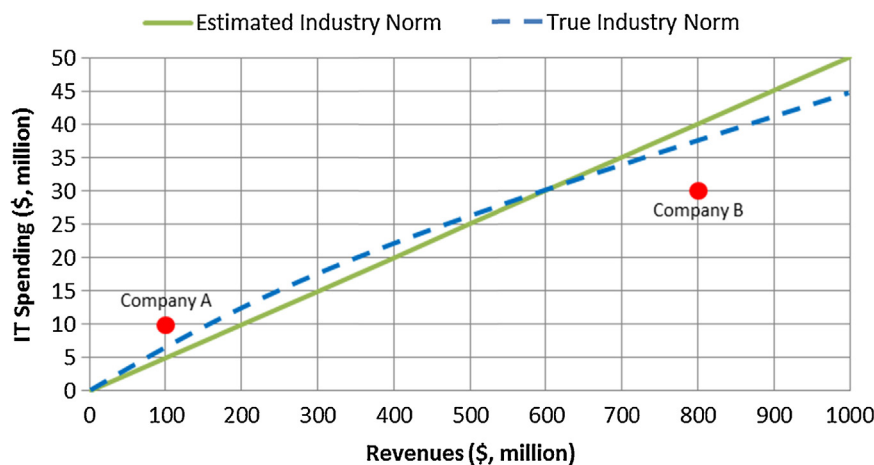


Figure 9. True vs. estimated relationship—Significant discrepancy

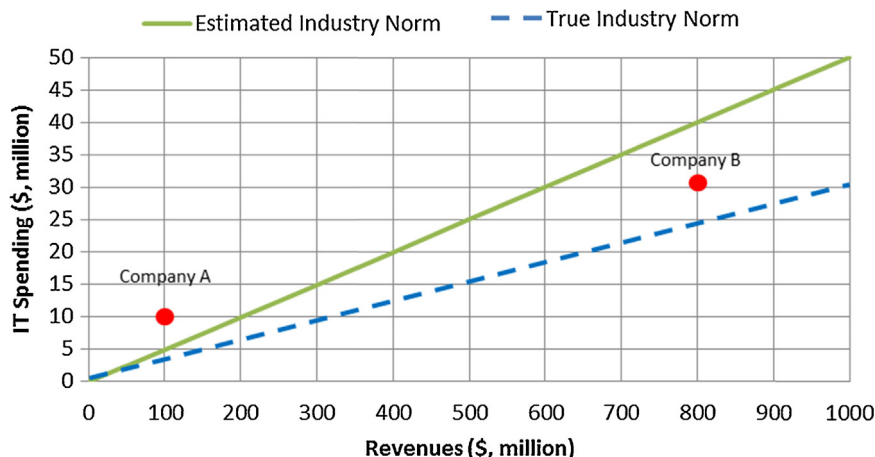
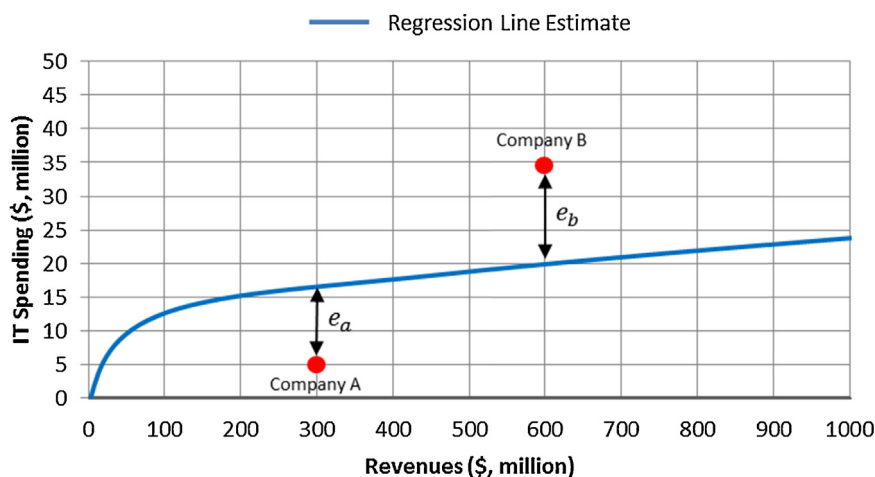


Figure 10. Regression-based approach to IT cost benchmarking



- The cross-sectional probability distribution of IT managerial control ratios within an industry is not normal; rather, it is characterized by both positive skewness and kurtosis. Thus, CIOs should instead use medians as an approximation of industry norm—but cautiously, given the non-normal probability distributions.
- The relationship between numerator and denominator is not strictly proportional; rather, the relationship is characterized by a curvilinear relationship (similar to that in Figure 7) wherein bigger companies tend to have smaller ratio values. Size may not be adequately controlled for. Thus, companies must be grouped by size for cross-sectional comparisons.
- Neither means nor medians provide an adequate approximation of the relationship between numerator and denominator. On average,

mean-based estimates of company position relative to the norm have a discrepancy of 2.3% of revenue. Median-based estimates of company position relative to the norm have an average discrepancy of 1.2% of revenue. This indicates that a CIO may be off by 1%–2% of revenue when trying to estimate the position of his/her organization relative to the industry norm. For large organizations, this can be a staggering error.

6. Recommendation: Regression analysis as an approach to benchmarking

Given our findings, we suggest use of a regression-based approach to benchmarking (Whittington, 1980). With regression, the true relationship between numerator and denominator within a sample

can be determined. The regression line can be used to estimate a relationship that deviates from strict proportionality (e.g., via the presence of a constant term or a curvilinear relationship). After the regression line is estimated, deviation from the relationship can be measured by residuals (represented with e_a and e_b in Figure 10). A *residual* is the difference between the norm estimated by the regression line and the actual position of a company relative to the norm. Moreover, one of the properties of a correctly specified regression model is that residuals are normally distributed with a mean equal to zero. Thus, the normal probability distribution (see Figure 1) can be used to estimate probabilities associated with deviations from the norm of specific companies. This distribution property of residuals of a correctly specified regression line will address the problems arising from non-normal probability distribution of IT managerial control ratios. Collectively, a regression approach to benchmarking can potentially address problems associated with deviations from all three of the assumptions in benchmarking.

7. Concluding remarks

Because of their simplicity, IT managerial control ratios are used extensively by practitioners to measure and compare organizational IT spending. Despite their popularity, there is often an insufficient understanding of the ratios' properties and the assumptions about them that are relied on in benchmarking IT costs. Our research shows frequent violations of all three assumptions. We do not suggest abandoning these ratios in totality; executives often do not have the time or necessary data for a more rigorous analysis of IT spending. Even recognizing the limitations identified here, these ratios, while imperfect, may be useful instruments; having some data to base an inference on may be better than having no data at all. However, users of these ratios are advised to:

- Use the median rather than the mean as a measure of the industry norm.
- Take into account the underlying probability distribution of IT managerial control ratios.
- Use regression as an alternative to estimating the industry norm and position of a company relative to the industry norm.
- Recognize there may be very valid reasons for even reliably measured deviations from industry

or intra-company IT cost norms, and be prepared to defend them.

Finally, obtaining a reliable estimate of a company's IT costs relative to the industry norm should only be viewed as a first step toward answering a more important question: Are these costs justified? As articulated by BlueCross BlueShield CIO Scott McGlaun (CIO Network, 2015):

Most benchmarks lean toward cost analysis. This is necessary and productive for any business function executive to have his/her arms around an appropriate cost structure. However, this is only half the analysis. CIOs need to pivot from cost-only discussions to value-creation discussions.

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