

Considering the utility of Altman's Z-score as a strategic assessment and performance management tool

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Even though the “metrics wars” of the past decade have subsided[1], corporate strategists remain avidly interested in effective new performance management tools and techniques. Given the ongoing popularity of the subject, and how well covered it has been in both the practical and academic literature, it is impressive that authors Robert B. Carton and Charles W. Hofer offer fresh insights in their new book *Measuring Organizational Performance – Metrics for Entrepreneurship and Strategic Management Research* (Northampton, MA: Edward Elgar, 2006). Because this work is aimed only at academicians it will likely not receive widespread attention from business practitioners. This is unfortunate because the book contains a number of findings – especially the results of their research into performance measurement models – that deserve the attention of corporate leaders as well as their academic allies.

Z-score, strategic assessment and performance management

The core of *Measuring Organizational Performance* is a detailed statistical study, which looked at a variety of widely used performance metrics – such as return on equity (ROE), return on assets (ROA), residual income (or economic profit), the growth rate of sales, cash flow and expenses – to determine which ones “provided the greatest relative information about the market-adjusted return to shareholders”[2]. Surprisingly, the metric that tested the highest was neither a profitability metric nor a growth metric; it was a financial distress metric – the change in the Altman Bankruptcy Predictor, widely known as the Z-score[3].

This is unexpected because, though the Z-score model has been a well accepted financial distress model for almost four decades, strategists generally haven't discovered its potential as a performance management tool.

New York University Finance Professor Edward I. Altman introduced the Z-score model in 1968[4]. Very simply, Altman utilized a statistical technique called discriminate analysis to create a financial distress prediction model. Significantly, Altman utilized basic financial ratios as inputs to his model, which made it inherently practical (unlike so much of modern academic finance theory). The current general form of the model is shown below:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5 \quad (1)$$

where

Z = Z-score.

X_1 = working capital/total assets.

X_2 = retained earnings/total assets.

X_3 = earnings before interest and taxes/total assets.

X_4 = market value of equity/book value of total liabilities.

X_5 = sales/total assets.



“Though the Z-score model has been a well accepted financial distress model for almost four decades, strategists generally haven’t discovered its potential as a performance management tool.”

The criteria used to interpret the Z-score are as follows:

Safe Zone = $Z > 2.99$ (the firm is not at risk of financial distress),
Distress Zone = $Z < 1.81$ (the firm will likely go bankrupt), and
Grey Zone = $1.81 \leq Z \leq 2.99$ (the firm is at risk of financial distress if Z is between 1.81 and 2.99).

The Z-score can be modified for non-publicly held firms as shown below:

$$Z = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4 \quad (2)$$

where

X_1 = working capital/total assets.
 X_2 = retained earnings/total assets.
 X_3 = earnings before interest and taxes/total assets.
 X_4 = net worth/total liabilities.

The criteria used to interpret the revised model are:

Safe Zone = $Z > 2.60$,
Distress Zone = $Z < 1.10$, and
Grey Zone = $1.10 \leq Z \leq 2.60$.

Altman’s Z-score has been immensely influential in areas such as credit risk analysis, distressed investing[5], M&A target analysis, and turnaround management but it has generally not been associated with performance management or even with value-based management. Perhaps managers need reminding that Robert S. Kaplan and David P. Norton noted “survival” – avoiding either takeover or bankruptcy – as the first financial goal in the example contained in their seminal paper on the Balanced Scorecard[6]. While the immediate outlook for survival of an enterprise can be a difficult variable to measure (for example, Kaplan and Norton utilized the relatively generic “cash flow” as the survival metric in their example)[7] the likelihood of an enterprise’s survival as reflected by its relative level of financial distress can be easily assessed with the Z-score. Carton and Hofer are one of the few to make this connection in a performance management context[8], and the first – as far as we are aware – to have statistically tested it. Given the strength of these authors’ findings, we researched the utilization of Altman’s Z-score in a strategic and performance management context and came across an intriguing case study by Altman and James K. La Fleur, the CEO of GTI Corporation, which they published 25 years ago. It’s worth revisiting in detail here.

The GTI Corporation case[9]

By way of background, during the 1960s the GTI Corporation (GTI) was an electronic components manufacturing firm. Early in that decade, GTI embarked on a powerful growth strategy that was significantly financed with debt, which was a relatively common strategy at the time. However, as the US economy slowed between 1969 and 1972, debt heavy firms such as GTI experienced difficulty servicing their debt.

In May of 1975, GTI’s financial difficulties passed a relatively critical threshold: erroneous information was inadvertently reported to the American Stock Exchange, where the



enterprise's stock was listed. This discovery prompted the President of GTI to resign, and that opened the way for the appointment of board member James K. La Fleur as the new Chairman and Chief Executive Officer. La Fleur's appointment came with a mandate to resolve GTI's difficulties and to improve its performance.

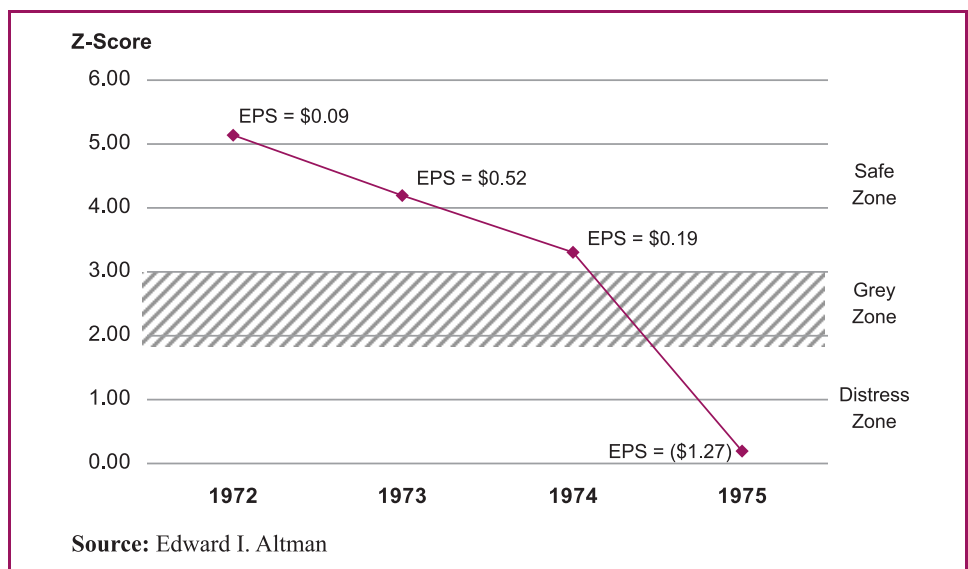
Prior to his appointment, La Fleur served on the audit committee of GTI's board. Given this background, he was well positioned to manage the firm "by the numbers," which is a frequently utilized approach when the strategic objective is to dramatically improve performance. This type of approach can be supported through the use of formal models to screen potential initiatives, and to track performance over time. During his review of GTI's performance, La Fleur recalled an article on the Z-score, which he decided to utilize in his analysis. What he likely saw when he inserted GTI's financial data from 1972 to 1975 into the Z-score model has been recreated here in Exhibit 1.

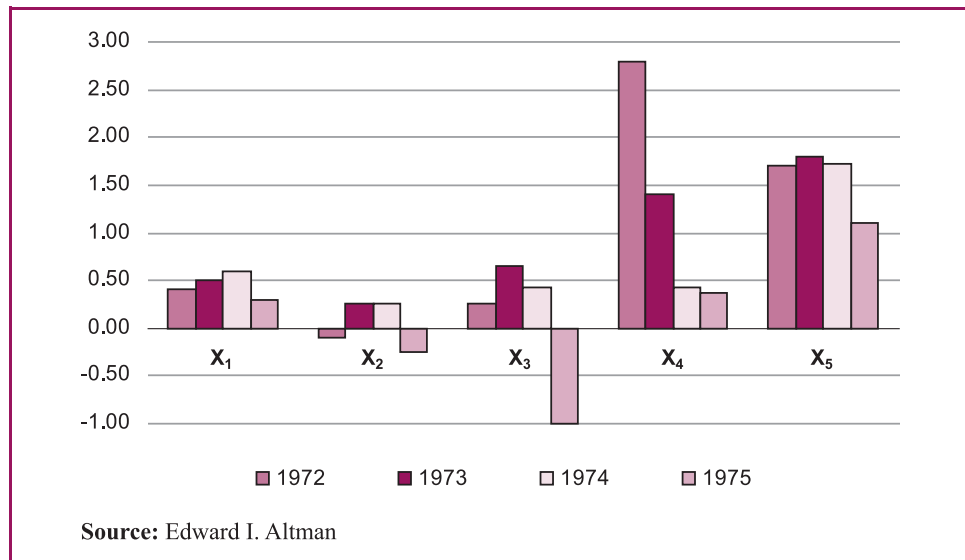
As can be seen from this exhibit, from 1974 to 1975 GTI's Z-score plunged into the Distress Zone from the Safe Zone. This was extremely troubling to La Fleur as the Z-score has up to a 95 percent accuracy rate predicting bankruptcy "based on data from approximately one year prior to failure"[10]. The exhibit also shows that, even though GTI's Z-score declined from 1972 to 1973, its earnings per share (EPS) during that same period of time increased rather dramatically from \$0.09 to \$0.52. The following year (1974), however, both GTI's Z-score and its EPS declined but at \$0.19 its EPS were still much higher than they had been in 1972. This suggests that, over time, the change in Z-score better reflected GTI's condition than the change in EPS did. (Carton and Hofer, the authors of *Measuring Organizational Performance*, did not include EPS growth in their study, but they did include operating cash flow. It's noteworthy that the change in cash flow over time did not test as significantly as the change in Z-score did)[11].

Identifying the drivers of Z-score change, positive or negative, is an exercise that can include a review of the Z-score factors over time. A profile of GTI's Z-score factors from 1972 to 1975 is presented in Exhibit 2.

Profiles such as this one demonstrate the performance insight that can be gained from a study of the Z-score over time. However, La Fleur decided to take Z-score analysis a step further; specifically, he planned to use the model as a screening device with which to "work backwards" to strategic initiatives that would improve GTI's performance as measured by the Z-score[12]. In other words, La Fleur planned to use the Z-score as both a strategic assessment and performance management tool to resolve GTI's difficulties, and to create value for its shareholders. To demonstrate how one can begin to accomplish this, consider

Exhibit 1 GTI Corporation Z-score (1972-1975)





the composition of the X_1 factor in equation (1) above (which is the ratio of working capital/total assets). While analyzing GTI's working capital La Fleur discovered that its inventory management processes were suboptimal; therefore, initiatives were designed to improve those processes with the results being monitored by the Z-score.

Additionally, in an effort to increase operating earnings (thereby increasing the numerator of the X_3 factor in equation (1)) La Fleur trimmed staff, and then solicited the input of GTI's employees in the formulation of initiatives designed to resolve some of the enterprise's performance issues. Involving employees in the initiative formulation process, a cutting-edge practice in 1981, ensured buy-in upfront, thereby increasing the probability of a successful implementation.

Initiatives such as the ones described above improved GTI's performance as reflected by incremental Z-score improvement. However, given the extent of GTI's difficulties and the extent to which those difficulties were generated from an uneconomic growth strategy, divestiture was clearly an option for La Fleur to consider. Additionally, and from a strategic perspective, as four of the Z-score's five factors in equation (1) – as well as three of the four factors in equation (2) – contain total assets as the denominator, divesting uneconomic assets can materially and substantially drive Z-score improvement. After further analysis, La Fleur concluded that GTI's Crystal Base business unit was both capital intensive and at risk of coming under competitive pressure, which is a potent combination for any enterprise experiencing performance difficulties. Based on this assessment, and the analysis that Crystal Base's quartz crystal product line was not core to GTI's electronic components business, he decided that it was a candidate for divestment. Therefore, in late 1976 GTI sold Crystal Base for \$1,348,000 in cash and notes, the cash being used to pay down debt[13].

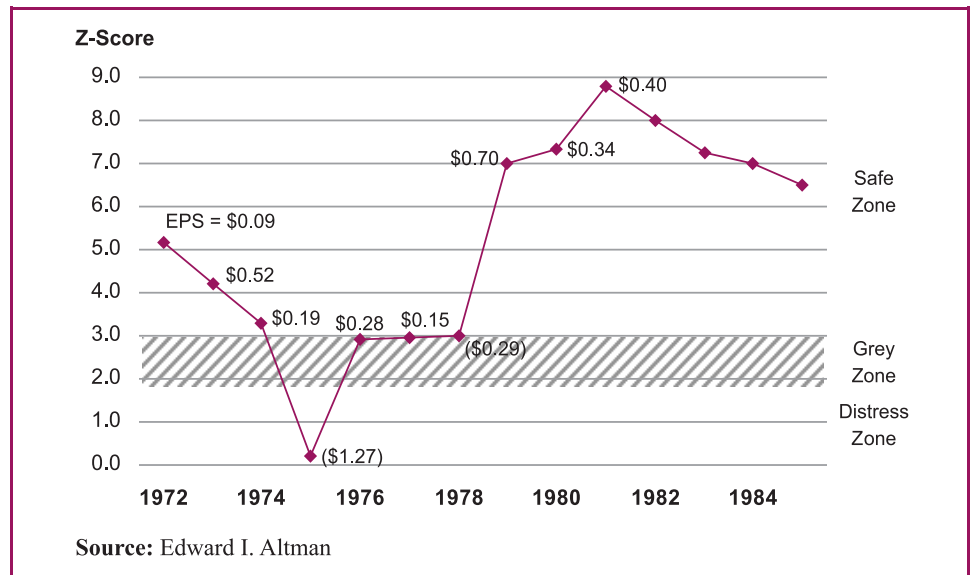
The results of La Fleur's various strategic initiatives as reflected by Z-score improvement were impressive.

As illustrated in Exhibit 3, GTI's Z-score increased dramatically from a low of 0.38 in 1975, which was clearly in the Distress Zone, to 2.95 which was on the border between the Grey Zone and Safe Zone only one year later (in 1976)[14]. GTI's Z-score held at this level for two years until 1978, when it increased a remarkable four points to approximately 7.0, which was well within the Safe Zone. This significant increase, which is also shown in Exhibit 3, was caused by another divestiture that was also motivated by strategic Z-score analysis.

The shareholder value created by La Fleur's initiatives was as impressive as the enterprise's Z-score recovery had been: the market value of GTI's equity increased 57 percent on a



Exhibit 3 GTI Corporation Z-score (1972-1984)



compounded annual basis from the (presumably) 1975 low of \$1,000,000 to the \$15,000,000 high set in 1980[15]. Such results reconcile quite well with Carton and Hofer's finding that the change in Z-score provides substantial relative information about market-adjusted returns shareholders.

To recap

The recently published book *Measuring Organizational Performance – Metrics for Entrepreneurship and Strategic Management Research* (Northampton, MA: Edward Elgar, 2006) by Robert B. Carton and Charles W. Hofer presented significant findings regarding the information quality of Altman's Z-score model relative to market-adjusted returns to shareholders. This finding is corroborated by the GTI case wherein the Z-score was strategically utilized to formulate initiatives specially designed to improve the enterprise's performance as reflected in its Z-score measurement. The success of those initiatives was demonstrated by both dramatic Z-score improvement and impressive shareholder value creation.

In their GTI case study, Altman and La Fleur concluded by stating "that certain predictive models offer opportunities to be used as management tools. Supporting that view, GTI's employment of the Altman Bankruptcy Predictor [or Z-score] has been described as a specific illustration of how an ordinary passive model can be used actively with substantial success"[16]. This type of approach has wide ranging applicability in performance management (and even in risk management), and is supported by Carton and Hofer's statistical findings.

Another insight discussed in their book is the utility of tracking the change in Z-score (as well as other metrics) rather than (or least in addition to) static measurements. The authors explain their reasoning as follows:

Change scores measure a change in the value of an indicator of interest over a period of time, while static measures represent the value of an indicator at a given point in time. In the context of this research, performance is viewed as the creation of value for the unit of analysis, be it an individual, an organization or even society. Creating value implies a change in condition. Therefore, measuring organizational performance at any level involves measuring a change in condition[17].

While rate of change analysis is relatively well known (especially in the field of economics) it is frequently not leveraged as much as it arguably could be in strategy and performance

management, from both a practical and a theoretical perspective. For example, rate of change analysis is hardly discussed in the works of Michael Porter or Kaplan and Norton.

Finally, *Measuring Organizational Performance* introduces the authors' own performance measurement models, which also deserve practical consideration. Hopefully, this commentary will help attract attention to this work by the business community.

Questions for further research

The use of Altman's Z-score as a strategic assessment and performance tool presents a number of potential research opportunities:

- First and foremost, because the Z-score is a popular turnaround management tool, more recent case studies of how it could be used in a strategic assessment/performance management context could likely be prepared.
- More detailed studies could be undertaken to validate Carton and Hofer's findings across a range of firms—such as those in distress, those meeting the cost of capital, and high performance firms. Such studies could also test both the change in the Z-score relative to market adjusted returns as well as the change in Z-score relative to the change in market adjusted returns.
- Altman's Z-score is not designed to be applied to financial services firms. Research could therefore be conducted to determine if the change in Risk Based Capital models and/or Capital Adequacy Ratios for financial services firms contain information about market-adjusted return to shareholders. Alternatively, discriminate analysis could be utilized to construct a financial services specific Z-score-like measure.
- Research could also be conducted on the utilization of the Z-score in a value-based management context (which includes incentive compensation considerations).

Notes

1. The term "metrics war" is from: Randy Myers, "Metric wars – marketing battles erupt as Stern Stewart and rivals seek your hearts, minds, & dollars," *CFO Magazine*, October 1996.
2. Robert B. Carton and Charles W. Hofer, *Measuring Organizational Performance – Metrics for Entrepreneurship and Strategic Management Research*, Edward Elgar, Northampton, MA, 2006, p. 176.
3. Statistically, for the three-year high/low sample (with a size of 120 and timeframe of January 1, 1999-December 31, 2002) the variability explained by the change in Altman's Z-score was 0.59 (Adjusted R^2), which was far higher than the study's other measures and is statistically significant (p -value less than 0.01) per Carton and Hofer (2006), cited above, p. 176. In practical language, the change in Z-score provides substantial information about market-adjusted returns for firms similar to those included in the study. Note that those firms did not include financial services firms (Carton and Hofer, 2006, p. 135). For further specifics see *Measuring Organizational Performance*.
4. Edward I. Altman, "Financial ratios, discriminate analysis and the prediction of corporate bankruptcy," *Journal of Finance*, September 1968, pp. 589-609.
5. For information on distressed investing see "Investing in distress: the vultures take wing," *The Economist*, March 31, 2007, pp. 77-80. For an enlightening, and highly entertaining, case study of a distressed investment see Dan Raviv, *Comic Wars*, Broadway Books, New York, NY, 2002, which describes the Marvel Comics distressed investment.
6. Robert S. Kaplan and David P. Norton, "The balanced scorecard," *Harvard Business Review*, January-February 1992, p. 76.
7. *Ibid.*
8. Carton and Hofer (2006), cited above, pp. 78-79 and 94.
9. This section is based on Edward I. Altman and James K. La Fleur, "Managing a return to financial health," *Journal of Business Strategy*, Summer 1981, pp. 31-38, and Michael Ball, "Z factor: rescue by the numbers," *Inc. Magazine*, December 1980, pp. 45-48.
10. Altman and La Fleur (1981), cited above, p. 32.

11. Following note 3 above, for the three-year high/low sample (with a size of 120 and timeframe of January 1, 1999-December 31, 2002) the variability explained by the growth rate of operating cash flow was only 0.02 (Adjusted R^2), which was far lower than the variability explained by the change in Z-score. These results are not as statistically significant (p -value less than 0.10) as those described in note Carton and Hofer, cited above, (2006), p. 176.
12. Ball (1980), cited above, p. 46
13. Altman and La Fleur (1981), cited above, p. 36.
14. *Ibid*, pp. 34 and 36.
15. Data source: Altman and La Fleur (1981), p. 37; the growth calculation is mine.
16. Altman and La Fleur (1981), p. 37.
17. Carton and Hofer (2006), cited above, p. 127. This quote reminds us of another recently published book that focuses on rate of change analysis, but at the macro level rather than micro level: *Ahead of the Curve: A Commonsense Guide to Forecasting Business and Market Cycle* (Boston, MA: HBS Press, 2005) by Joseph H. Ellis.

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