

Six Sigma Deployment Success According to Shareholder Value

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Abstract

Companies often look for a “recipe for success” with the latest management initiatives such as Lean, Total Quality Management, and Business Process Reengineering. Companies often judge success by bottom line results. These results can be measured by evaluating shareholder value, which is commonly known as the wealth the company brings to the shareholder. Six Sigma, which boasts bottom line results, has become a popular management initiative that has created success for some companies and failure for others. This paper will utilize the methodology popularized by Jim Collins’ book Good to Great to evaluate Six Sigma deployment and the financial impact this management initiative has on companies. Results seek to evaluate the companies that have successfully deployed Six Sigma, other similar companies that have unsuccessfully deployed Six Sigma, and companies in the same industry realm that have never deployed Six Sigma.

Keywords Six Sigma, lean manufacturing, engineering management

1. Introduction

Companies often look for a “recipe for success” with the latest management initiatives such as Lean, Total Quality Management, and Business Process Reengineering. With these initiatives, companies hope to achieve success in their industry as well as success when the stock market is down. There are several ways that companies measure success, such as profit, price of the stock, and other various financial metrics. The impact on financials is a critical evaluation of the accomplishment of a management initiative. Six Sigma is a popular management strategy that affects the quality of a company’s product. Although companies usually take on these management strategies to benefit themselves financially, shareholders are also affected by these management initiatives. Shareholder value is commonly known as the wealth the company brings to the shareholder. A way to measure this wealth is to evaluate the return on equity (ROE), which measures a “corporation’s profitability by revealing how much profit a company generates with the money shareholders have invested” [1]. Shareholders are interested to know what the profit of their invested money is. In a recent article in the Wall Street Journal titled “Where Process-Improvement Projects Go Wrong,” Dr. Chakravorty explores the reasons behind Six Sigma program failures [2]. An astounding “60% of all corporate Six Sigma initiatives fail to yield the desired results” [2]. An explanation is needed for why some companies are successful in their Six Sigma implementation while others are not. A similar study of the evaluation of a company’s success was conducted by Jim Collins in his management book Good to Great.

1.1 Good to Great

In Good to Great, several companies were researched to identify the characteristics that help a company transition from short-lived success to long-term results. Jim Collins identifies seven characteristics demonstrated by the companies that achieve long-term results: Level 5 Leadership, First Who...Then What, Confront the Brutal Facts, The Hedgehog Concept, A Culture of Discipline, Technology Accelerators, and the Flywheel and the Doom Loop [3]. These characteristics are common attributes that Collins found in the companies that shifted from good

companies to great companies. Each quality was determined through extensive research and interviews from key executives of the companies.

The methodology for evaluating successful companies and their characteristics was very systematic. Companies and comparison companies were chosen based on their cumulative returns and were observed over the same period of time to determine which companies transitioned from good to great [3]. Collins and his team heavily researched the companies to find comparable characteristics within the successful companies and the unsuccessful companies. Using a similar methodology of employing financial metrics to evaluate companies that transition from short-term to long-term achievement, this study will evaluate the success of companies that implement Six Sigma.

1.2 Six Sigma

Six Sigma has become a popular management strategy that has provided success for some companies and failure for others. According to Roger Schroeder, who compared field data to literature, Six Sigma is defined as “an organized, parallel-meso structure to reduce variation in organizational processes by using improvement specialists, a structured method, and performance metrics with the aim of achieving strategic objectives” [4]. The Six Sigma initiative is a customer-focused strategy that centers on improving quality while lowering costs. The methodology followed varies depending on the undertaken project, but the standard operational Six Sigma methodology is known as DMAIC. This methodology represents the five phases of Six Sigma: define, measure, analyze, improve, and control. Six Sigma takes a process that is operating at a three sigma level and increases the process to function at a much higher level by reducing defects to 3.4 defects per million opportunities, which in turn reduces the cost of poor quality. The most important benefit of this strategy is the impact Six Sigma has on financial results. A typical Six Sigma project saves a minimum of \$100,000. These projects last no more than 120 days; however, several of these projects can be carried out for a greater time length. By improving cost of quality to a six sigma level, revenue is no longer wasted on non-value-added projects, which drives profits to increase [5]. Researchers suggest that generally companies that incorporate Six Sigma in their management strategy typically see benefits within the first year of implementation. The financial success of Six Sigma does not begin to materialize until after 18 months in a continual improvement implementation. While an aggressive deployment sees benefits in 6 to 12 months, most companies realize benefits somewhere between 6 to 18 months [6].

1.3 Lean Six Sigma

Lean methodologies have been around much longer than Six Sigma. This approach was heavily used by Henry Ford and has roots in the Toyota Production System [7]. Lean concepts focus on eliminating waste and have shown significant success in manufacturing. The lean philosophy consists of many concepts such as 5S (sorting, straighten, sweeping, standardizing, and sustaining) and just-in-time (JIT) production. As Six Sigma has evolved, many companies have added a lean aspect to their management strategy in this Lean Six Sigma. The combination of lean and six sigma leads to a common principle: “The activities that cause the customer’s critical-to-quality issues and create the longest time delays in any process offer the greatest opportunity for improvement in cost, quality, capital, and lead time” [5]. The methodology of Lean Six Sigma is the same as operational Six Sigma, but it incorporates lean tools as well.

1.4 Use of Lean Six Sigma for Company Growth and Compliance

Six Sigma’s focus is very similar to the criteria of top quality awards and ISO standards. One such quality award is known as the Malcolm Baldrige National Quality Award (MBNQA). The Malcolm Baldrige National Quality Award (MBNQA) is “given by the President of the United States to businesses [...] that apply and are judged to be outstanding in seven areas: leadership; strategic planning; customer and market focus; measurement, analysis, and knowledge management; workforce focus; process management; and results” [8]. The award focuses on the different perspectives of quality that make a business successful. To qualify for this award is almost as prestigious as winning the award. Using the Baldrige model coupled with Six Sigma “helps firms achieve higher levels of performance and customer satisfaction in each Baldrige category” [9].

Companies utilize Six Sigma as a strategy to explore business and meet future required standards such as ISO 9000, specifically ISO 9000:2008, and ISO 14000, which are two important quality standards. These standards are not required by governments, but adhering to these standards and registering for certification demonstrate a company’s need for excellent quality. Moreover, certification of these standards is recognized internationally. The ISO 9000 series consists of five specifications “designed to ensure all aspects of a business affecting product or service quality

are addressed in the organization's quality program, and they are formally structured and documented in auditable form" [10].

The ISO 14000 standard focuses on regulating as well as improving the environmental impact of the processes of a company and setting environmental goals that can be achieved by approaching the objectives systematically [11]. Similarly to quality management techniques, it is important to strategically plan how processes can be environmentally friendly. Benefits of ISO 14000 include "reduced cost of waste management, savings in consumption of energy and materials, lower distribution costs, improved corporate image among regulators, customers and the public, and framework for continual improvement of environmental performance" [12]. Not only will registering for the standard assist in the improvement of quality management, but it will show other companies, as well as customers, that the quality of a product is affected by environmental factors as well.

1.5 Previous Study

Previously, an initial study was conducted with the team at the University of Nebraska-Lincoln. This study sought to determine some of the underlying factors that affect a company's deployment of Six Sigma and determine long-term success. The approximate implementation dates were determined through articles and book references. The study showed that Six Sigma affects the stock market price by increasing the individual stock share value. Many Six Sigma companies see an increase in stock price value as opposed to sharp declines seen by the general market during the period studied. Conclusions can be drawn that Six Sigma helps companies withstand financial stresses on the market. Six Sigma companies seemed to have fared much better than their counterpart companies, which do not deploy this initiative; these comparison companies saw a much smaller increase or even larger decreases in stock prices during the same period of study due to lack of management strategies to aid their financial situations [13].

For the companies that implemented Six Sigma, there existed a financial difference between companies that have been successful and unsuccessful in their deployment. Sixty-four percent of companies, deemed "successful" in our study, saw profits increase over a 100% increase in profits after the implementation of Six Sigma. Many of these companies were experiencing declining profits prior to implementation, and they completely reversed the decline with Six Sigma deployment. Thirty-six percent of unsuccessful Six Sigma companies showed a significant decrease in profits, and sixty-four percent of unsuccessful companies showed only a minor decrease in profits. Additionally, eighty-one percent of these unsuccessful companies had previously demonstrated an increase in profits prior to the addition of Six Sigma. The research determined that three main characteristics impacted performance: quality awards and standards (MBNQA criteria, ISO 9000 and 14000 certifications), mission statement inclusion of Six Sigma stated core-values, and inclusion lean tenets in Six Sigma process. Six Sigma core-values revolve around customers, lowering costs, and improving quality. In this study, we build upon our previous research by evaluating the financial impacts of the aforementioned successful and unsuccessful companies [13].

2. Study Methodology

The current study evaluates different industries to determine if return on equity (ROE) and earnings per share (EPS) are a good metric for evaluating a company's success with Six Sigma in response to shareholder value.

2.1 Population Sample (Representative Companies)

To evaluate the effects of Six Sigma deployment, seventy-five companies are to be chosen from Fortune 500, an annual list compiled and published by *Fortune* of the top 500 public companies in America. To contrast companies that are successful, unsuccessful, and a control group, this study identified three companies from each industry: two companies that implemented Six Sigma and one that did not. The ten industries currently being utilized are shown in Table 1.

Table 1: Companies

Industry	Six Sigma Company 1	Six Sigma Company 2	Comparison Companies
Diversified Financials	General Electric	Aon	Fannie Mae
Health Care: Insurance & Managed Care	CIGNA	Coventry Health Care	WellPoint
Aerospace & Defense	Boeing	Honeywell	United Technologies
Chemicals	Dow Chemical	Dupont	PPG Industries
Construction & Farm Machinery	Caterpillar	AGCO	Terex
Motor Vehicles & Parts	Johnson Controls	Ford	Navistar Intl.
General Merchandisers	Macy's	Target	J.C. Penney Corp.
Network & Other Communications Equipment	Motorola	Corning	Harris Corp.
Specialty Retailers	Home Depot	Circuit City	Costco Wholesale
Electronics, Electrical Equipment	General Cable	Whirlpool	Harman Intl. Industries

The implementation dates were found in order to determine a period to study the effects of Six Sigma deployment. These dates are the approximate dates of implementation found in different articles discussing their implementation. Since the financial benefits of Six Sigma are usually realized after three years, a period of five years after implementation will be studied to analyze the long-term financial benefits. The implementation dates of the Six Sigma companies that are currently in the study are shown in Table 2.

Table 2: Implementation Dates of Current Six Sigma Companies in Study in Ascending Order

Company	Implementation Date	Company	Implementation Date
Motorola	1986	Circuit City	2001
Corning	1994	AON	2002
General Electric	1995	General Cable	2002
Whirlpool	1997	Plexus	2002
Boeing	1999	CIGNA	2003
Dow Chemical	1999	Dupont	1999
Johnson Controls	1999	Caterpillar	2000
Macy's	2001	Ford	2000
Home Depot	2001	Coventry Health Care	2003
Terex	2001	Target	2004

Implementation dates range from 1986 (date of creation of Six Sigma) to 2004. No companies who implemented Six Sigma after 2004 were studied because a five year period of study after implementation would be impossible.

2.2 Measurement Criteria

To determine financial impact we will analyze the differences in the financial data of the companies in the study. We utilized the metric return on equity (ROE), which is measured by using earnings after taxes divided by shareholder equity. We chose this metric because it represents shareholder value and can easily be found for public companies. We utilize three different ROE values for each company in our investigation: ROE at implementation, ROE five years prior to implementation, and ROE five years after implementation. We will use two study periods to demonstrate pre and post Six Sigma performance. We determine the inflection points by evaluating the ROE values. An example of the two study periods can be found in Figure 1.

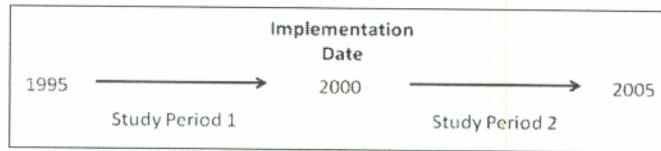


Figure 1: Two study periods if implementation date is 2000

In order to determine whether a difference exists between the financial results of companies that implemented Six Sigma and companies that did not, a one-sided paired two sample for means t-test is constructed at an alpha level of 0.05. We have determined an initial set of successful, unsuccessful, and comparison companies, which is shown Table 3.

Table 3: Six Sigma Companies with Comparison Companies and Range of Study

Industry	Six Sigma Company	Comparison Company	Range of Study
Diversified Financials	General Electric	Fannie Mae	1990-2000
Health Care: Insurance & Managed Care	CIGNA	WellPoint	1998-2008
Aerospace & Defense	Boeing	United Technologies	1994-2004
Chemicals	Dow Chemical	PPG Industries	1994-2004
Construction & Farm Machinery	Caterpillar	Terex	1995-2005
Computer Peripherals	EMC	Western Digital	1995-2005
Motor Vehicles & Parts	Johnson Controls	Navistar Intl.	1995-2005
General Merchandisers	Macy's	J.C. Penney Corp.	1996-2006
Network & Other Communications Equipment	Motorola	Harris Corp.	1981-1991
Specialty Retailers	Home Depot	Costco Wholesale	1996-2006
Electronics, Electrical Equipment	Whirlpool	Harman Intl. Industries	1992-2002

The difference between the rates of change over Study Period 1 and over Study Period 2 of each Six Sigma company chosen and the difference between the rates of change over Study Period 1 and over Study Period 2 of the comparison company will be found in order to construct the one-sided paired two sample for means t-test. A one-sided t-test was chosen to show that the average difference of the ROE rates of change of Six Sigma companies is significantly greater than those of companies that do not implement Six Sigma. Results of this t-test should demonstrate a greater impact on Six Sigma companies' ROE. This statistical test has the following hypotheses:

$$H_0: u_s \leq u_n$$

$$H_a: u_s > u_n$$

Where,

u_s is the average difference of the rate of change of ROE over Study Period 1 and the rate of change of ROE over Study Period 2 of Six Sigma companies, and

u_n is the average difference of the rate of change of ROE over Study Period 1 and the rate of change of ROE over Study Period 2 of comparison companies.

2.3 Criteria of Success

After determining Six Sigma is a financial impact, an analysis will be conducted to evaluate whether one company is more successful in their Six Sigma deployment than the other. To uncover whether there is a difference between successful Six Sigma companies and unsuccessful Six Sigma companies, a standard for success must be established. A company is successful if it satisfies two sets of conditions:

Condition 1:

- i. The company sees an increase in ROE per period in Study Period 2.
- ii. The percent increase in ROE per Study Period 2 exceeds the ROE per Study Period 1.

Condition 2: (Future)

- i. The company sees an increase in earnings per share in Study Period 2.
- ii. The percent increase in earnings per share in Study Period 2 exceeds the earnings per share in Study Period 1.

2.4 Identify Characteristics

Once successful and unsuccessful Six Sigma companies are established, the study will explore the underlying factors that lead to successful Six Sigma deployment. Three characteristics will be studied: quality awards and standards, number of employees, and lean philosophy. An ANOVA test will be constructed to see which characteristics significantly affect the success of Six Sigma deployment. To determine how much these characteristics affect the Six Sigma deployment, interviews will be conducted with the Six Sigma companies. The first characteristic evaluated will involve awards and ISO standards that demonstrate quality and continual improvement. To establish a score for each company, four aspects of awards and ISO standards will be studied: won

a Malcolm Baldrige National Quality Award (MBNQA), apply and follow the MBNQA criteria, are certified or follow the ISO 9000 standard, and are certified or follow the ISO 14000 standard. A score will be calculated by determining weights for these aspects, assigning one point if an aspect is met, and then summing the weighted values. The second characteristic involves number of employees. Any management strategy's success depends on the involvement of the employees, so the number of employees may affect the success of deployment because with a large number of employees, employee involvement is harder to achieve. The final characteristic to be explored is whether the company implemented a lean philosophy along with Six Sigma. Each company will be given a point if they deployed Six Sigma coupled with lean thinking.

3. Conclusion

Six Sigma is a management strategy that many companies utilize in order to impact their financial results. This impact is important to companies, but shareholders may want to know how this management strategy affects their investment. While so many companies embrace the Six Sigma culture, not all truly reap the benefits of this initiative. Similar to the study conducted by Dr. Chakravorty, this study will explore the reasons Six Sigma fails with respect to the shareholders. These people invest their money trusting that companies will provide high returns. This study will evaluate how Six Sigma impacts return on equity (ROE) and earnings per share as well as identify the factors that lead some Six Sigma companies to bring their shareholders wealth while others are unsuccessful in their attempts.

References

1. "Return on Equity – ROE", Investopedia, 2009,<<http://www.investopedia.com/terms/r/returnonequity.asp>>
2. Chakravorty, S. S., 2010. "Where Process-Improvement Projects Go Wrong." The Wall Street Journal.
3. Collins, J., 2001, Good to Great. New York, NY: HarperCollins Publishers Inc.
4. Schroeder, R. G., Linderman, K., Liedtke, C., and Choo, A.S., 2008, "Six Sigma: Definition and underlying theory," Journal of Operations Management, 4, 536-554.
5. George, M. L., 2002, Lean Six Sigma: combining Six Sigma quality with lean speed. McGraw-Hill Companies, Inc., 4-31.
6. Snicker, R., 2004, Implementing Six Sigma: A Planning Guide for Executive Teams. Oriel Inc.
7. Holweg, M., 2007, "The genealogy of lean production," Journal of Operations Management, 25(2), 420-437.
8. "Frequently Asked Questions about the Malcolm Baldrige National Quality Award" 2009, National Institute of Standards and Technology. <http://www.nist.gov/public_affairs/factsheet/baldfaqs.htm>.
9. Mellat-Parast, M., Jones, E., and Adams, S., 2007, Six Sigma and Baldrige: A Quality Alliance. Quality Principles.
10. Cater, D.J., and Pasqualone, R.G., 1995, "ISO 9000--A Perspective on a Global Quality Standard." IEEE Transactions on Industry Applications, 31, 61-67.
11. "ISO 14000 essentials". 2009. International Organization for Standardization. <http://www.iso.org/iso/iso_catalogue/management_standards/iso_9000_iso_14000/iso_14000_essentials.htm>.
12. "Business benefits of ISO 14000". 2009, International Organization for Standardization. http://www.iso.org/iso/iso_catalogue/management_standards/iso_9000_iso_14000/business_benefits_of_is_o_14001.htm>.
13. Garza, A., and Jones, E., 2010, "Six Sigma Deployment Success According to Profit," White Paper University of Nebraska-Lincoln.