Some pros and cons of six sigma: an academic perspective

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Abstract

Six sigma is a powerful business strategy that employs a disciplined approach to tackle process variability using the application of statistical and non-statistical tools and techniques in a rigorous manner. This paper examines the pros and cons of six sigma in a detailed manner. This is followed by a section about the future of six sigma and its links to statistical thinking. It is believed that, although the total package may change, the applications of six sigma will continue to grow in the forthcoming years, due to the existence of sound principles of statistical thinking within the six sigma strategy.

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Introduction

Six sigma is a business strategy that seeks to identify and eliminate causes of errors or defects or failures in business processes by focusing on outputs that are critical to customers (Snee, 1999). It is also a measure of quality that strives for near elimination of defects using the application of statistical methods. A defect is defined as anything which could lead to customer dissatisfaction. The fundamental objective of the six sigma methodology is the implementation of a measurement-based strategy that focuses on process improvement and variation reduction. A number of papers and books have been published showing the fundamentals of six sigma, such as, what is six sigma (Hoerl, 1998; Breyfogle III, 1999; Harry and Schroeder, 1999), why do we need six sigma (Snee, 2000; Pande *et al.*, 2001), what makes six sigma different from other quality initiatives (Pyzdek, 2001; Snee and Hoerl, 2003), six sigma deployment (Keller, 2001; Adams *et al.*, 2003), critical success factors of six sigma implementation (Antony and Banuelas, 2002), six sigma project selection process (Snee, 2002) and organisational infrastructure required for implementing six sigma (Adams *et al.*, 2003; Snee and Hoerl, 2003).

I personally have experienced that senior management in many organisations view six sigma as another quality improvement initiative or flavour of the month in their list. I am often told by many engineers and managers, in small and big companies, that there is nothing really new in six sigma compared to other quality initiatives we have witnessed in the past. In response, I often ask a simple question to people in organisations who practise TQM, "what do you understand by the term TQM?". I often get many varying answers to this question. However if I ask a bunch of six sigma practitioners, "what do you know of the term six sigma?", I often get an answer which means more or less the same thing and concurs with what I would have expected. The following aspects of the six sigma strategy are not accentuated in previous quality improvement initiatives:

- Six sigma strategy places a clear focus on achieving measurable and quantifiable financial returns to the bottom-line of an organisation. No six sigma project is approved unless the bottom-line impact has been clearly identified and defined.
- Six sigma strategy places an unprecedented importance on strong and passionate leadership and the support required for its successful deployment.
- Six sigma methodology of problem solving integrates the human elements (culture

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change, customer focus, belt system infrastructure, etc.) and process elements (process management, statistical analysis of process data, measurement system analysis, etc.) of improvement.

- Six sigma methodology utilises the tools and techniques for fixing problems in business processes in a sequential and disciplined fashion. Each tool and technique within the six sigma methodology has a role to play and when, where, why and how these tools or techniques should be applied is the difference between success and failure of a six sigma project.
- Six sigma creates an infrastructure of champions, master black belts (MBBs), black belts (BBs) and green belts (GBs) that lead, deploy and implement the approach.
- Six sigma emphasises the importance of data and decision making based on facts and data rather than assumptions and hunches! Six sigma forces people to put measurements in place. Measurement must be considered as a part of the culture change.
- Six sigma utilises the concept of statistical thinking and encourages the application of well-proven statistical tools and techniques for defect reduction through process variability reduction methods (e.g. statistical process control and design of experiments).

Just like any other quality improvement initiatives we have seen in the past, six sigma has its own limitations. The following are some of the limitations of six sigma which create opportunities for future research:

- The challenge of having quality data available, especially in processes where no data is available to begin with (sometimes this task could take the largest proportion of the project time).
- In some cases, there is frustration as the solutions driven by the data are expensive and only a small part of the solution is implemented at the end.
- The right selection and prioritisation of projects is one of the critical success factors of a six sigma program. The prioritisation of projects in many organisations is still based on pure subjective judgement. Very few powerful tools are available for prioritising projects and this should be major thrust for research in the future.
- The statistical definition of six sigma is 3.4 defects or failures per million opportunities. In service processes, a defect may be defined as anything which does not meet customer needs or expectations. It would be illogical to assume that all defects are equally good when we calculate the sigma capability level of a process. For instance, a defect in a hospital could be a wrong admission procedure, lack of training required by a staff member, misbehaviour of staff members, unwillingness to help patients when they have specific queries, etc.
- The calculation of defect rates or error rates is based on the assumption of normality. The calculation of defect rates for non-normal situations is not yet properly addressed in the current literature of six sigma.
- Due to dynamic market demands, the critical-to-quality characteristics (CTQs) of today would not necessarily be meaningful tomorrow. All CTQs should be critically examined at all times and refined as necessary (Goh, 2002).
- Very little research has been done on the optimisation of multiple CTQs in six sigma projects.
- Assumption of 1.5 sigma shift for all service processes does not make much sense. This particular issue should be the major thrust for future research, as a small shift in sigma could lead to erroneous defect calculations.
- Non-standardisation procedures in the certification process of black belts and green belts is another limitation. This means not all black belts or green belts are equally capable. Research has shown that the skills and expertise developed by black belts are inconsistent across companies and are dependent to a great extent on the certifying body. For more information on this aspect, readers are advised to refer to Hoerl (2001). Black belts believe they know all the practical aspects of advanced quality improvement methods such as design of experiments, robust design, response surface methodology, statistical process control and reliability, when in fact they have barely scratched the surface.
- The start-up cost for institutionalising six sigma into a corporate culture can be a significant investment. This particular feature would discourage many small and medium size enterprises from the introduction, development and implementation of six sigma strategy.
- Six sigma can easily digress into a bureaucratic exercise if the focus is on such things as the number of trained black belts and green belts, number of projects completed, etc. instead of bottom-line savings.
- There is an overselling of six sigma by too many consulting firms. Many of them claim expertise in six sigma when they barely

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understand the tools and techniques and the six sigma roadmap.

- The relationship between cost of poor quality (COPQ) and process sigma quality level requires more justification.
- The linkage between six sigma and organisational culture and learning is not addressed properly in the existing literature.
- The "five sigma" wall proposed in Mikel Harry's book, *Six Sigma: The Breakthrough Management Strategy Revolutionising the World's Top Corporations*, is questionable. Companies might redesign their processes well before even four sigma quality level. Moreover, it is illogical to assume that the "five sigma" wall approach is valid for all processes (manufacturing, service or transactional). Moreover, the decision of re-design efforts over continuous improvement depends on a number of other variables such as risk, technology, cost, customer demands, time, complexity, etc.

What does the future hold for six sigma?

In my opinion, six sigma will be around as long as the projects yield measurable or quantifiable bottom-line results in monetary or financial terms. When six sigma projects stop yielding bottom-line results, it might disappear. I also feel that while six sigma will evolve in the forthcoming years, there are some core elements or principles within six sigma that will be maintained, irrespective of the "next big thing". One of the real dangers of six sigma is to do with the capability of black belts (the so-called technical experts) who tackle challenging projects in organisations. We cannot simply assume that all black belts are equally good and their capabilities vary enormously across industries (manufacturing or service), depending a great deal on the certifying body. Another danger is the attitude of many senior managers in organisations that six sigma is "an instant pudding" solving all their ever-lasting problems.

I also believe that the six sigma toolkit will continue to add new tools, especially from other disciplines such as healthcare, finance, sales and marketing. Having a core set of tools and techniques is an advantage of six sigma that brings speed to fix problems and its ease of accessibility to black belts and green belts.

I would like to raise the point that six sigma does provide an effective means for deploying and implementing statistical thinking (Snee, 1990; 2002) which is based on the following three rudimentary principles:

(1) All work occurs in a system of interconnected processes.
(2) Variation exists in all processes.
(3) Understanding and analysing the variation are keys to success.

Statistical thinking can also be defined as thought processes, which recognise that variation is all around us and present in everything we do. All work is a series of interconnected processes, and identifying, characterising, quantifying, controlling and reducing variation provide opportunities for improvement (Snee, 1990). The above principles of statistical thinking within six sigma are robust and therefore it is fair to say that six sigma will continue to grow in the forthcoming years. In other words, statistical thinking may be used to create a culture that should be deeply embedded in every employee within any organisation embarking on six sigma programs. However the total package may change in the evolutionary process. It is important to remember that six sigma has a better record than total quality management (TQM) and business process re-engineering (BPR), since its inception in the mid-late 1980s. The ever-changing need to improve will no doubt create needs to improve the existing six sigma methodology and hence develop better products and provide better services in the future. As a final note, the author believes that companies implementing or contemplating embarking on six sigma programs should not view it as an advertising banner for promotional purposes.

Conclusion

Six Sigma as a powerful business strategy has been well recognised as an imperative for achieving and sustaining operational and service excellence. While the original focus of six sigma was on manufacturing, today it has been widely accepted in both service and transactional processes. This paper highlights the pros and cons of six sigma from the viewpoint of an academician. Although the total package may change as part of the evolutionary process, the core principles of six sigma will continue to grow in the future. Six sigma has made a huge impact on industry and yet the academic community lags behind in its understanding of this powerful strategy. It will therefore be incumbent on academic fraternity to provide well-grounded theories to explain the phenomena of six sigma. In other words, six sigma lacks a theoretical underpinning and hence it is our responsibility as academicians to bridge the gap between the theory and practice of six sigma.

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