Rationale for the Integration of Lean and Six Sigma

Dr. Michael S. Jordan

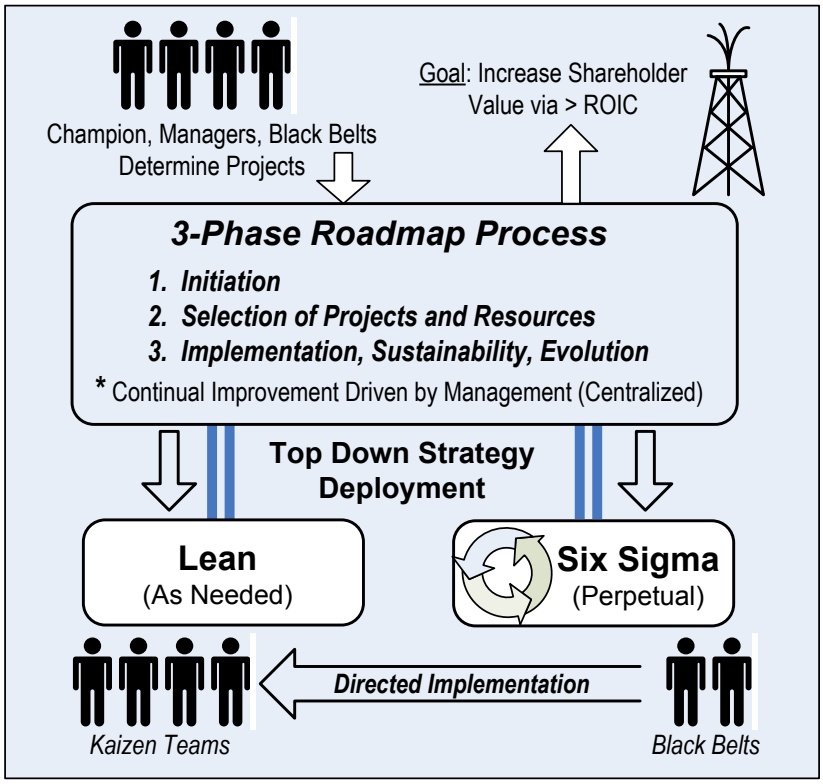
Lean and Six Sigma improvement methodologies are individually being used by many companies today with good results. However, it is a generally accepted premise that Lean and Six Sigma both have certain gaps with respect to addressing all aspects of operational and strategic improvement. This signifies a shift in the conventional thinking that a single improvement methodology can be the total solution for driving enterprise performance.

The "Lean Six Sigma" approach was proposed by Michael George (the George Group) around the year 2002. The proposition is to consolidate Lean and Six Sigma into a unified improvement system. The value proposition is that Lean Six Sigma drives total business performance faster using both methodologies rather than using just one of them. Although there appears to be a consensus that Lean and Six Sigma can be used together to accelerate business performance, there is uncertainty about how to structure this collaboration.

Lean Six Sigma brings Lean and Six Sigma together on two levels. At the first level (methodology), Lean and Six Sigma are consolidated under a single system. Although the two methodologies remain separate, the Lean Six Sigma "system" is created by integrating the two methodologies to a three-phase roadmap process. The process functions as a superstructure to join the methodologies. This three-way join relates Lean and Six Sigma methodologies to each other without the need to directly integrate the two methodologies. In this system, Lean is wrapped around the Six Sigma framework.

The roadmap superstructure is linked to business success drivers with a primary emphasis on shareholder value creation. Operational improvements are identified and evaluated on the basis on how the improvement would increase Net Present Value (NPV). NPV, in turn, drives the primary measure of shareholder value—*Return on Invested Capital (ROIC)*. See Figure 1.

Figure 1. *Strategically-Focused Top Down Approach – The George Group Model*



This is an "ad hoc integration" or a "blending" of Lean and Six Sigma because, at a distance, the two methodologies appear to be integrated or combined even though they are not. Because direct integration of Lean and Six Sigma would be too complicated, the George Group created a new system by integrating the two methodologies to a superstructure that serves as the join point. The superstructure defines a roadmap, processes, and guiding principles for how Lean and Six Sigma are to be used together to drive shareholder value.

Lean Six Sigma brings Lean and Six Sigma together on a second level— *integration of all the individual tools*. The tools of both methodologies are combined into a single CI toolset. The toolset is then integrated around the DMAIC framework which serves as a guide for using the tools. In Lean Six Sigma, the combined tools are collectively referred to as "DMAIC tools".

Lean Six Sigma places primary emphasis on the individual tools rather than on the Lean and Six Sigma methodologies. The methodologies are abbreviated and serve to reference when and why individuals should be used. This is the trade-off that Lean Six Sigma must accept. Both Lean and Six Sigma individually are very robust improvement systems. One could spend years learning just one of the systems. When two complex methodologies are combined under a single system, the complexity of the combination increases off the

scale. To make this work, Lean Six Sigma must focus on the individual tools in order to be practical.

From a marketing perspective, this has been a very successful strategy for the George Group network. Lean Six Sigma is appealing to senior managers because it offers a way to rationalize operational improvements in terms of shareholder value creation. Thus, Lean Six Sigma is a very marketable package that easily gains the endorsement and support of senior management.

While the concept of Lean Six Sigma has intrigued many, the improvement system is not widely accessible. Training and consulting organizations outside of the George Group network are few. To date, there has been no grass roots effort to clarify, expand, or modify the Lean Six Sigma system as initially delineated by the George Group in 2002. The subsequent books and articles written by others on Lean Six Sigma discuss the virtues of the value proposition, but offer nothing new.

Lean Six Sigma was never intended to be a "gift to the world". The George Group introduced Lean Six Sigma as a way to market a new strategic performance improvement system to senior managers. This strategy has paid off big. To be clear, Lean Six Sigma is the visionary view of one consulting company for harnessing the benefits of combining Lean and Six Sigma to accelerate Continual Improvement. Lean Six Sigma should be considered a "work in progress".

Lean Six Sigma has been slow to evolve because it has "fallen between the cracks". Neither Lean nor Six Sigma is an academic discipline, so there is no drive for University initiatives (unlike Lean initiatives at MIT). A non-profit oriented organization has not emerged to promote grass roots collaboration for the purpose of making Lean Six Sigma more accessible. A search of U.S. Patent and Trademark Office records indicates that there are no patents protecting the Lean Six Sigma methodology. The name "Lean Six Sigma" is not even protected.

The market demand for Lean Six Sigma tools and services has been growing since 2004 and continues on a steady incline. Consulting organizations have been scrambling to exploit the market opportunity. Due to the lack of theoretical and methodological rigor, the default approach to Lean Six Sigma is to coordinate the individual tools of Lean and Six Sigma.

For organizations that predominantly sell Lean services, Lean Six Sigma means incorporating Six Sigma tools into the Lean toolset. The tools enable Lean practitioners to identify complex sources of process variation that elude Lean tools. Process variation in the Lean context is another form of waste that needs to be eliminated. Thus, one could argue that adding some Six Sigma tools to Lean is a case of simply expanding the Lean toolset, not the methodology. That is, the Sigma tools help Lean do what it does even better.

Six Sigma consultants incorporate Lean tools into the DMAIC framework. Six Sigma benefits because the Lean tools enable practitioners to target and eliminate forms of waste that create process variation. Additionally, Lean tools fill a big gap in DMAIC by enabling more traction during the implement phase. Six Sigma is known to be lacking when it comes to implementing improvements. Again, adding Lean tools to Six Sigma is a case of expanding the Six Sigma toolset, not necessarily the methodology. Lean tools help Six Sigma do what it does even better.

The first evolutionary step in combining Lean and Six Sigma for accelerated results has been achieved by integrating the tools. There is obvious benefit to doing this. The cross pollination via the tools extends the reach of each methodology helping each to be more effective in what each already does. Today, the common understanding of Lean Six Sigma is at this level which is the current industry best practice.

The George Group and a few other consulting organizations market and implement Lean Six Sigma as a strategic performance improvement system for increasing shareholder value. Many other Six Sigma organizations are beginning to fold some aspects of Lean into their Six Sigma projects. Incorporating Lean tools into the DMAIC framework is straightforward. This extends the reach of Six Sigma, but tends to marginalize Lean. What they miss, however, is the benefit of the Lean methodology—*the identification and elimination of all forms of waste perpetuated by a grass roots culture oriented towards "go do it" process improvement.*

Lean organizations are typically not oriented towards implementing Lean Six Sigma as a strategic performance management system. Because Lean is anchored in factory operations, the focus is on swiftly eliminating visible waste initiated at the local level. In Lean, the strategic significance of eliminating waste is axiomatic—*eliminating waste drives the value stream towards perfection*. Thus, Lean practitioners make assumptions about the strategic significance of eliminating waste from processes. Lean practitioners may include some aspects of Six Sigma during Value Stream Mapping and Kaizen events. This extends Lean while marginalizing Six Sigma. What they miss is the benefit of Six Sigma Methodology—*the ability to relate and prioritize operational improvements to strategic value drivers.*

Integrating the individual tools of Lean and Six Sigma is not the same thing as using both Lean and Six Sigma methodologies. Methodologies are improvement systems based on a foundation of theory. Tools are implements of methodology. It is possible that using complimentary methodologies can be produce synergistic results. However, acquiring additional tools simply extends the capabilities of an individual methodology.

As previously mentioned, there is a consensus that Lean and Six Sigma methodologies individually have certain gaps with respect to being the "total solution" for achieving Continuous Improvement. Using Lean or Sigma alone and extending one with the tools of the other will improve results. But the benefits quickly reach a point of diminishing returns. Improving the Lean or Six Sigma methodology will not fill the gaps that each

methodology has because these gaps are at the methodology level, not the tool level. Using both methodologies together can make the gaps that each has are irrelevant.

The Emerging Synchronized Approach

An alternative to the George Lean Six Sigma approach has very recently been proposed that views Lean and Six Sigma systems working in tandem. That is, the two improvement systems are used individually AND in a coordinated way to drive CI. The idea is to deploy Lean and Six Sigma in a loosely coupled and sequential way (synchronized). In contrast, the Lean Six Sigma approach proposed by the George Group combines Lean and Six Sigma into a single initiative, which is tightly coupled and combined (consolidated).

A synchronized approach deploys Lean first to eliminate waste in a process. Eliminating waste reduces common cause variation or "noise" from the process making it easier to identify less obvious sources of special cause variation. When Lean is implemented first, Black Belts can save a significant amount of time finding qualified Six Sigma projects. Standardization practices used by Lean make it easier to collect meaningful data. When it comes time for implementation, Lean is already in place to make it happen.

Although Lean and Six Sigma are independently used in the organization, the Synchronized approach promotes collaboration between the methodologies. When Black Belts identify improvement opportunities that do not qualify as Six Sigma projects, they hand off the information to Lean teams for further investigation. Conversely, when Lean teams uncover potential improvement opportunities that are beyond the scope of Lean, the information is handed off to Black Belts for further study.

Lean training is given to all employees. Six Sigma training is given to a few employees who have the special skills required. There is a continuing effort to identify and eliminate visible waste everywhere in the company. If waste is identified, then it is targeted for elimination. Lean efforts are not tied to or contingent upon a Six Sigma project.

Main points—

- The discipline of Continuous Improvement is what integrates all performance methodologies including Lean and Six Sigma.

- Each methodology makes a critical contribution to Continuous Improvement.

- That the emphasis needs to be on the methodology, not just to tools. Rigid application of tools can result in loosing sight of the business priorities which can, in turn, lead to poor results.

- Use Lean and Six Sigma sequentially—Lean to eliminate waste in a process, Six Sigma to focus on the process problems that are not obvious. Whole projects can be spun off, or parts of a Six Sigma project may be Lean, or vice versa.

- Although Lean and Six Sigma are working independently, there is collaboration between Lean and Six Sigma practitioners/teams

The Business Integration Approach

The proposed model for integrating Lean and Six Sigma methodologies accepts the premise of the synchronized approach. However, it is recognized that the synchronized model is deficient with respect to how to align improvement opportunities with the strategic objectives of the organization—*a requisite for the Lean Six Sigma value proposition.* Although the architects of this model make it clear that all improvements must be strategically focused to have measurable impact at the enterprise level, they do not delineate a structure or the dynamics for doing so.

The proposed model incorporates the synchronized model as an integrated tactical engine for accelerating continuous improvement (CI). Using Lean and Six Sigma methodologies in this way is highly leveraged in the sense that certain synergies are harnessed between the two methodologies. However, for this to work, Lean and Six Sigma efforts must coordinate around the organization's strategy for creating profitable value. The thread that ties Lean and Six Sigma together in a loosely coupled context is a focus on strategy implementation. Without a coordinated strategic focus, synergy is not possible because it is the clarification of what operations needs to do to better drive strategic outcomes that produces the synergy.

The proposed model is a strategically focused, bottom-up approach to operational performance improvement that combines the power of Lean and Six Sigma methodologies. Bottom-up means that every one in the company must clearly understand how their operation (in the factory or office) contributes to the company's strategy for profitable value creation. The direction for everyone is value stream perfection. This means that strategic priorities need to be communicated at every operational level. This is accomplished by aligning all operational performance measures to the company's strategy. Performance measures drive behavior and clearly communicate what the strategic priorities are. This makes it easier (faster) to identify improvement opportunities.

A simplified Balanced Scorecard (BSC) framework runs through the core of the proposed model that serves to focus all improvement opportunities on desired strategic outcomes. The premise is that all improvement opportunities are not equal with respect to achieving business success. Some organizations have already developed a proprietary methodology for cascading strategically focused performance measures through operations. The methodology known as the "Innovation Dashboard" or the "Operational Performance

Dashboard" installs a linked hierarchy of performance measures known as a "metric tree" for the purpose of aligning operations to strategic intent. See Figures 2 and 3.

Figure 2. *Strategically Focused Bottom Up Approach – The Proposed Model*

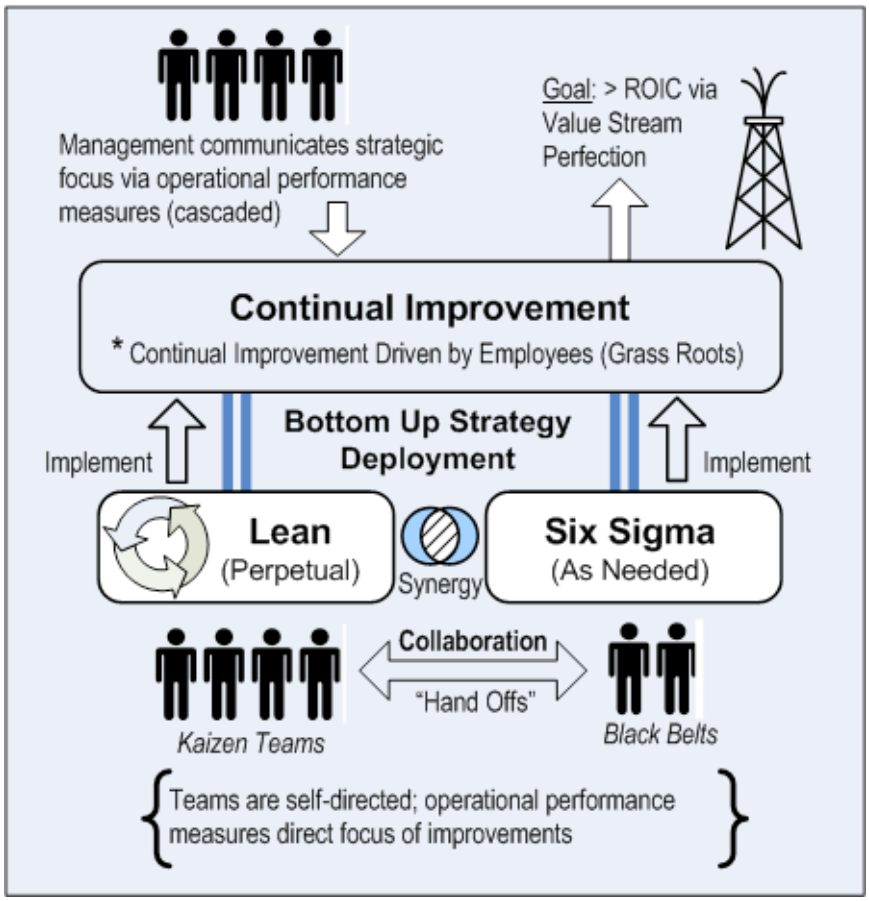
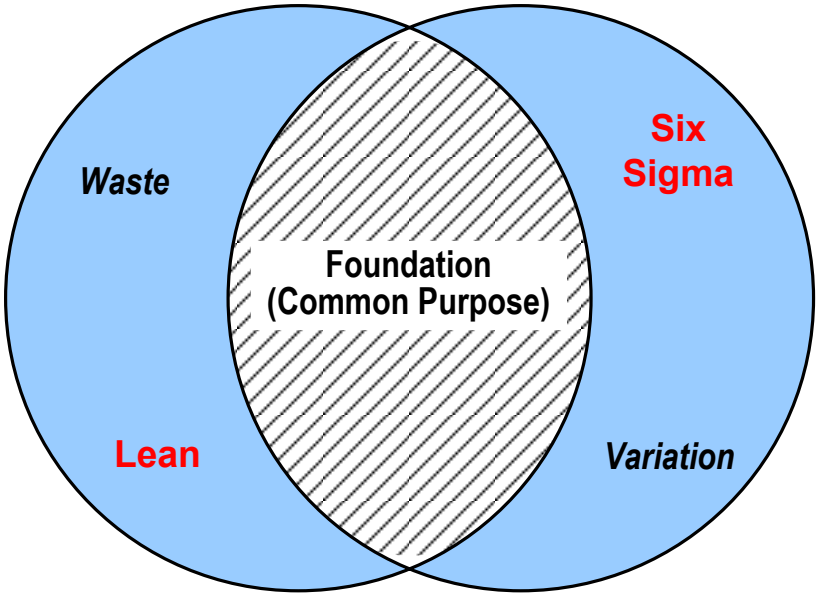


Figure 3. *Synchronizing Lean and Six Sigma Enables Method Synergy*



- **Eliminating waste reduces common cause variation or "noise" in the process which makes it easier (faster) for Black Belts to identify and implement high impact Six Sigma projects.**

- **Six Sigma looks at the variation in the whole process and provides feedback to local operators (factory & office) on their effectiveness relative to the strategic focus. This helps operators quickly identify high impact improvement opportunities which accelerates the elimination of waste.**

The Benefits Of Combining Lean and Six Sigma

Lean practitioners can benefit from Six Sigma to solve complex problems that cannot be solved using just Lean approaches. Lean organizations are in the perfect position to capitalize on all of the benefits of Six Sigma, as most companies trying to implement Six Sigma alone (or first) suffer from a lack of employee buy-in, and successful Lean organization have overcome this problem.

Here are the benefits, organized by DMAIC—

General

- No one improvement methodology will deliver process perfection; Lean or Six Sigma alone will leave many "dollars on the table"

- Training Lean experts in basic Six Sigma concepts and tools (as Green Belts) will enable them to know when to bring in a Black Belt to facilitate a Six Sigma opportunity. (Likewise, training Six Sigma Green Belts and Black belts in Lean will enable them to use Lean tools when appropriate and know when to bring in Lean experts.)

Define

- Many Six Sigma implementations fail due to a lack of employee support. However, organizations employing Lean successfully can overcome these barriers and capitalize on the benefits, as follows—

- Introducing cultural change with Six Sigma is more difficult than with Lean. However, initial Lean projects can be selected that are important to employees, and this builds a groundswell of support and acceptance of change - regardless of the methodology. Lean worker involvement is extremely powerful, as it allows employees to see their suggestions get implemented.

- Eliminating clutter and disorganization through 5S can create very rapid Six Sigma improvement opportunities

- Many Continuous Improvement (CI) opportunities are overlooked or positioned low on priority lists because the projected dollar value does not measure up to Six Sigma criteria. Lean Six Sigma organizations have the best of both.

Measure

- Low-hanging fruit sometimes masks defect and variability problems that require hard data. Once again, doing Lean first creates Six Sigma opportunities

- Removal of "low-hanging fruit" or waste makes it easier to focus on root causes in Six Sigma projects.

- Removal of waste (e.g., process simplification, removal of process steps, eliminating delays) reduces common cause variation, before tackling more complex causes.

- Using Lean to remove low-hanging fruit quickly can serve as a springboard for transitioning to Six Sigma.

- The most common Six Sigma tool used by Lean practitioners is the control chart. Powerful computer software is now available to make this easy, and control charts can provide a great deal of useful information to a Lean team to address during a Kaizen event.

- The "Eight types of waste" can be very beneficial to Six Sigma practitioners at this stage of the DMAIC process.

Analyze

- Applying the rigor of Six Sigma to "low hanging fruit" opportunities makes no sense. Nor does it serve any purpose to select an extremely severe defect, repeatability problem, or variation problem and attempt to find the root cause, validate it, and determine the perfect state using only Lean tools. Attempting to correct extremely difficult issues with the quick hitting, waste-focused methodology of Lean rarely works for problems with root causes that are buried under a mound of detailed knowledge (e.g., interactions) that no one can fathom.

- Rearranging the layout reduces wasted motion, and allows the Six Sigma team to see the process steps in order, exposing process flaws.

Improve

- Lean Kaizen events can demonstrate real positive change during or immediately after the 3-5 day event, encouraging action on more complex issues

- Implementing Lean first provides faster Six Sigma results (weeks vs. months or years)

- Lean improvements often lead to other improvement opportunities (of all kinds)

- Six Sigma opportunities are often identified during Kaizen events, especially during Value-Stream Mapping activities

- Six Sigma lacks strong implementation tools, and practice with Lean Kaizen events builds both implementation skills and confidence.

- Employees involved in Lean are less likely to be skeptical of Six Sigma projects, and less prone to sabotaging a Six Sigma project.

- Lean involves everyone, so that more people are involved in pursuing small and continuous improvements, which complements the Six Sigma improvement process.

- More involved workers will find a way to modify a Six Sigma solution or find another way to make it work, if first they do not succeed.

- Nothing is more powerful than the sight of a top-level manager on his hand and knees scrubbing a floor. This will motivate others to take on challenging improvement opportunities.

- As Lean organizations mature, project results tend to get smaller; Six Sigma can propel this motion forward

Control

- Creating standardized work will accelerate the speed of a Six Sigma project, reduce process variability, and facilitate training

- Standard work will also improve throughput without increasing speed.

Other Benefits

- Both look for a way to create perfection in a process - lean through visual awareness and trial and error, and 6 Sigma through qualitative brainstorming tools and analysis of data, and both rely on VOC to drive the effort.

- As a result, with both, there is greater momentum for continuous improvement, and greater employee support.

- Employees will also be more receptive to a Six Sigma approach when it is appropriate as a result of their more active involvement in CI

- Lean should be employed for projects that do not meet the minimum criteria or are too small for Six Sigma consideration.

- The effort on Six Sigma projects can then be focused on a smaller number of meaningful opportunities

- Lean can only take you so far; Six Sigma is needed for more complex issues.

- Lean requires less management involvement.

- Lean is harder to "sell" to Finance and Engineering personnel due to data limitations. Six Sigma makes more sense to them.

References

[1-36]

1. Barbara Wheat, C.M., Mike Carnell, *Leaning into Six Sigma*. 2003: McGraw-Hill.
2. Bertels, T. *Integrating Lean and Six Sigma: The Power of An Integrated Roadmap*. 2005 [cited; Available from: http://www.isixsigma.com/library/content/c030721a.asp.
3. Bicheno, J., *The New Lean Toolbox: Towards Fast, Flexible Flow*. 2004: Picsie Books.
4. Brown, M.G., *Keeping Score: Using the Right Metrics to Drive World-Class Performance*. 1996: AMACOM.
5. Burton, T.T., *The Lean Extended Enterprise*. 2003: J.Ross with APICS.
6. Dettmer, H.W., *Strategic Navigation: A Systems Approach to Business Strategy*. 2003: ASQ Publishing.
7. Devane, T., *Integrating Lean Six Sigma and High-Performance Organizations*. 2004: Pfeiffer.
8. Dirgo, R., *Look Forward: Beyond Lean and Six Sigma*. 2006: J. Ross & the Institute of Aerospace Excellence.
9. Edward D. Arnheiter, J.M. *The Integration of Lean Management and Six Sigma*. 2006 [cited; Available from: http://www.rh.edu/~maleyeff/Papers/LSS.pdf.
10. Flinchbaugh, P.M.a.J. *Bringing Lean Systems Thinking to Six Sigma*. 2006 [cited; Available from: http://www.qualitydigest.com/mar05/articles/05_article.shtml.
11. Frost, R., *Measuring Performance*. 2000: Measurement International.
12. George, M.L., *Lean Six Sigma: Combining Six Sigma Quality with Lean Speed*. 2002: McGraw-Hill.
13. Gupta, P., *Six Sigma Business Scorecard*. 2004: McGraw-Hill.
14. Joe Ficalora, J.C., Julien Renaud. *Combining Lean and Six Sigma Methodologies*. 2004 [cited; 16]. Available from: www.sbtionline.com/files/CombiningLeanandSixSigmaMethodologies.pdf.
15. Kaydos, W., *Operational Performance Measurement: Increasing Total Productivity*. 1999: CRC Press.
16. Keen, P.G.W., *The Process Edge: How Firms Thrive by Getting the Right Process Right*. 1997: HBS Press.
17. Larson, A., *Demystifying Six Sigma*. 2003: Amacom.
18. LTCOL C. E. JOLLEY, U. *Performance Transformation Utilizing Lean and Six Sigma*. 2004 [cited; 34]. Available from: www.ndu.edu/sdcfp/2004reports/McKinsey04Final%20.doc.
19. Mark A. Nash, S.R.P., Sophronia Ward, *Using Lean for Fast Six Sigma Results: A Synchronized Approach*. 2006: Productivity Press.
20. Maskell, B.H., *New Performance Measures*. 1994: Productivity Press.

21. McCarty, M.B.T., *The New Six Sigma*. 2003: Motorola University.
22. Meyer, M.W., *Rethinking Performance Measures: Beyond the Balanced Scorecard*. 2002: Cambridge University Press.
23. Michael George, D.R., Bill Kastle, *What is Lean Six Sigma?* 2004: McGraw-Hill.
24. Michael L. George, D.R., Mark Price, John Maxey, *Lean Six Sigma Pocket Toolbook*. 2005: McGraw-Hill.
25. Peter Hines, R.L., Daniel Jones, Paul Cousins, Nick Rich, *Value Stream Management*. 2000: Prentice Hall.
26. Peter S. Pande, R.P.N., Roland R. Cavanagh, *The Six Sigma Way*. 2000: McGraw-Hill.
27. Robert S. Kaplan, D.P.N., *The Balanced Scorecard: Translating Strategy Into Action*. 1996: HBS Press.
28. Robert S. Kaplan, D.P.N., *The Strategy-Focused Organization*. 2001: HBS Press.
29. Robert Spector, M.W. *The Art of Lean Program Management*. Sept. 2006 [cited; Available from: http://www.manufacturing.net/scm/article/CA6376443.html?nid=2184&rid=1901818785.
30. Rubrich, L., *How to Prevent Lean Implementation Failures*. 2004: WCM Associates.
31. Smith, B. *Lean and Six Sigma: A One-Two Punch*. April 2003 [cited; Available from: http://www.asq.org/pub/qualityprogress/past/0403/qp0403smith.pdf.
32. Thor, C., *Designing Feedback: Performance Measures for Continuous Improvement*. 1998: Crisp Publications.
33. Thor, C.G., *The Measures of Success: Creating a High Performing Organization*. 1994: Wiley.
34. Thrun, W., *Maximizing Profit*. 2003: Productivity Press.
35. Torok, R.M., *Operational Profitability: Systematic Approaches for Continuous Improvement*. 2002: Wiley.
36. Wheeler, D.J., *Understanding Variation: The Key to Managing Chaos*. Second ed. 2000: SPC Press.