# Increasing Customer Satisfaction, Internal Yield and Quality Through Process Transparency and Improvement

## *Who needs Lean Six Sigma?*

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## Introduction

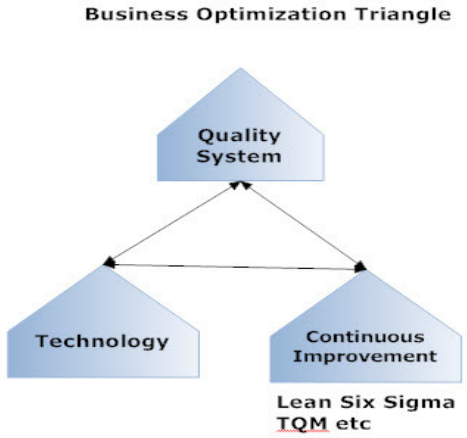
Lean Six Sigma is the preferred process improvement methodology of the day, yet there have been a number of recurring issues during implementation. Eight of the most common of these are addressed here with a modified approach recommended for each in order to maximize customer satisfaction, yield and quality. For those needing a Lean Six Sigma primer a PEMG white paper is also forthcoming.

## 1. "Lean and Six Sigma stifle innovation"

L6S is concerned with continuous improvement of the existing system. Although the benefits can be large, it is *EVOLUTIONARY* improvement. If you want revolutionary improvement you have to change the regime, a different matter, but both are important. To make a business the best it can be there is a need to balance new development, a robust quality system and a Continuous Improvement (CI) philosophy.

L6S should be focused, not broadcast indiscriminately, and R&D should use what makes sense from the L6S toolset without shackling innovation. There are a number of L6S and related tools relevant to new products and ideas, focused on incorporating quality and economy into the design before it hits the floor: Excuse all the acronyms.

- **DFSS (Design for Six Sigma)**
- **DFM (Design for Manufacturing)**
- **FMEA (Failure Mode Effects Analysis)**



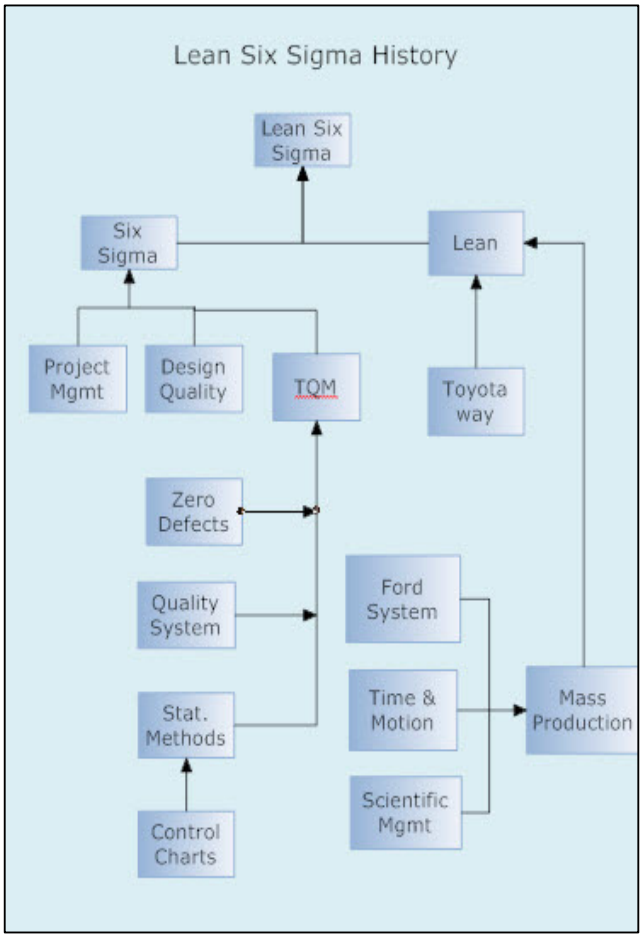

- **Taguchi methods / Robust designs**
- **Value engineering**

To distinguish revolution from evolution a separate organizational unit is necessary for development so that the overall L6S environment does not dampen innovation.
No doubt, engineering product knowledge is essential, but so many small companies fail to maximize their profit by focusing only on the science and prototype design of their products, failing to control their manufacturing or establishing a CI culture.

## 2. "L6S is just repackaging of basic industrial engineering, quality control and project management".

There's some truth to this as there is a natural tendency in business to recycle good ideas and pitch them once more to the market to make money. However, the reality is that the

utilization of these good practices is still very sporadically applied in many businesses. Sometimes, executives, not wanting to be seen as taken in by the latest "big thing" don't allow themselves to see the forest for the trees and the baby goes out with the bathwater. As we will see later, there are options in how to implement L6S and it doesn't have to be the whole enchilada at one sitting. That's enough proverbial clichés for now!




### 3. "Why should I be concerned about 3.4 defects per million opportunities when my yield is only 90%?"

Actually, it's worse than this, the 3.4 DPMO actually includes a big allowance for long-term process drift (specifically, a drift in the average of 1.5 x the standard deviation, but that's another discussion). Excluding this very questionable allowance the DPMO for 6 Sigma capability drops to 0.002! Pretty impressive, but, in my opinion, it's over kill. The real benefit in applying L6S is in reducing defects and waste, while optimizing throughput and minimizing inventory. Although Motorola and GE may choose to chase the ultimate capability of true Six Sigma, and Toyota the rigid discipline of TPS, you do not need to follow like sheep. In fact, the best you can do may be limited by your available technology or organization structure.

At the risk of using a cliché, L6S is a process or journey, not a program. Not starting out on the journey, however, is a mistake as you will remain unaware of how poor your quality is and how much waste you're generating as a percentage of total output. So, after carefully considering what creates "value" for your business, and what are the key process parameters to satisfy your customers and increase profitability, perform the initial characterization using L6S methodology. After this, appropriate targets for improvement can be set: For example, in the quality area the first priority is to establish >3 sigma capability for critical parameters. As a further step, a 4.5 sigma level goal could be established while, again, focusing on the key parameters. When working in the 3-4.5 sigma area you won't need all the heavy duty statistical ammunition Six Sigma provides, but you will repeatedly use a small set of tools such as:

Brainstorming, Cause/Effect diagrams, Pareto charts, Capability analysis, Control charts, Hypothesis testing, Analysis of variance.

### 4. "Too much infrastructure and money up front"

Many L6S commercial programs focus, heavily, on company-wide training and black and green belt certification. That is one way to go, if executive management is fully engaged and understands how to couple high level business planning to L6S, but there are other ways and, in particular, small companies may not have the resources to even consider this path. One route is to tackle an initial project using a "Simple Lean Sigma" approach overseen by a consultant, the focus being achieving results not L6S certification.

- 1 day management training class on L6S principles.
- Management workshop to select and rank potential projects and identify performance indicators including $.
- 3 day stripped-down version of green belt training given to key team members.
- Selection of team leader who would run the project in tandem with the consultant and would be targeted for black belt training.
- Selection of a management champion who would be the interface between the project and the executive team.
- Final project selection with a time frame to completion set at a maximum of two months, and team size no more than seven.
- Application of the DMAIC (Define/Measure/Analyze/Improve/Control) process, using the tools highlighted in blue above, with others as needed.

- Update to the project champion and management every 2 weeks reporting, quantitatively, on the progress of performance indicators, where the team is in the DMAIC process, plus findings to date and any obstacles not resolved by the team, champion and consultant.
- Final presentation and report focusing on the bottom line results and $ saved.

Assuming a positive result, further projects can be identified and initiated. However, once this occurs, there is a need for several people with black belt capability and so formal black belt training and certification should be considered before expanding much further. For the highly self-motivated this can be done through personal study and use of ASQ (American Society of Quality) resources, but mentorship is needed through a consultant or via the more typical four week $7000 training courses offered by many companies. Choose carefully! All "Black Belt Certifications" are not equal, with ASQ's remaining the benchmark for those available to the general public.

Putting aside the infrastructure issues above, applying L6S tools on paper costs little so use of structured problem solving and statistically valid methods can pay for themselves quickly, especially when low hanging fruit is there for the picking. Where the process equipment is large, sophisticated and expensive, the cost component can be significant when applying lean layout and autonomation (Jidoka). Therefore, in these cases, it's very preferable to design-in smart automation and work cells, rather than have to do it later. Still, there is a great deal that can be done while minimizing capital expense.

## 5. "Lean Six Sigma ignores the human element and reduces jobs to rote following of procedures"

Certainly, lean and six sigma are reductionist techniques, breaking down processes to their smallest units to analyze and control them, but this is nothing unusual, in fact it is a fundamental aspect of the scientific method. These days, products and processes have such demanding performance characteristics that every variable needs some level of control and, so, manufacturing can no longer be a place where craftsmanship is valued. Process knowledge and experience is still very important, but should be directed to process improvement and response to upsets. New ideas are highly valued but they cannot be horded and kept for personal use but, rather, assimilated into a new, improved method after discussion within the group.
The Toyota way of smart automation allows the process to run on its own while everything in under control, alerting a person when an abnormal event occurs. The use of control charts follows exactly the same philosophy.
How L6S impacts people is not dictated solely by its content, but also by the human resources environment in the company. If management values its people as key resources and has established an atmosphere of respect, inclusion and education then L6S will fit naturally and positively into the HR picture. If the management style lacks these positive elements, then L6S can be interpreted as a serious additional burden to the folks running the line and will likely fail.
And, by the way, if you tie L6S implementation to headcount reduction your efforts will be dead in the water. If your organization is fat, you'd better make cuts before you start, or hope to utilize the excess manpower in the increased business arising from your larger capacity, reduced cycle time and cost and improved quality!

## 6. "Lean Six Sigma gets buried in the numbers and statistical methods and so misses the big picture"

It can, if you let it. Adequate management attention must be given at the very beginning of the process to identify the right projects that deal with important, quantifiable problems that can be, realistically, attacked by a team. It is also important that champions and team leader/black belts be intensely focused on the bottom line, and not be sidetracked into having fun with the latest statistical methods. Following the Simple Sigma approach described above with its use of basic tools and management check-ins will help to keep things grounded. Thirdly, any team must include process experts and they must be allowed to openly critique the team's direction. However, any unresolved debate must come down to "show me the data". In the end, opinions don't count. Since most initial team members will lack L6S education, some are going to feel threatened by the new, information-driven situation. To deal with this, team members must be exposed to green belt level training as early as possible and directly involved in the analysis from the beginning of the project. If their process knowledge is as good as they say it is their opinions will be backed up by the new data. Still, I'd bet good money that they'll also learn a number of new things about their process, as conventional wisdom is often invalid.
Finally, any techniques that transfer to the floor must be carefully designed to be manageable by the people running the process. It's no use designing a complex, non-intuitive control method, even if it is technically 100% correct, if the operator can't easily use it.

## 7. "Our business is different, L6S won't work here"

If management is not committed to L6S, this will be true! Many have said this and yet, one by one, sectors of the economy have found that it is not the case that their type of business is an exception, although modifications of technique are necessary to fit unique characteristics. The issue is not the category of business, but how L6S is implemented.

Product unit based manufacturing has always been the L6S heartland, but it has spread into other manufacturing areas

that previously offered resistance. For example, let's look at control charts:

- Companies that frequently vary their products and have small product batches can be serviced using short run chart techniques.
- In cases where data is frequently sampled and not independent (i.e. auto correlated), time series modeling can be used to determine the relationship between consecutive data and so define an algorithm to predict the process output.
- Machine shops complained in the past that traditional control charts did not work for them. In cases where tool wear is the only significant factor, and the process output has a saw tooth appearance, fitting a uniform distribution, a regular Xbar/R chart doesn't work. The XHi-Lo R chart is championed by "CorrectSPC" for this situation. Where short-term piece to piece variation is very small, and that due to set-up is large, run to run control is used, with within run control either not needed, or handled by closed loop controllers.

More broadly, service and financial industries deal with transactions rather than product units, but there is still a process, and many of the L6S methods and tools are directly applicable. It's easy to understand that the DMAIC method itself and tools such as process mapping, benchmarking, cause/effect diagrams and Pareto charts can be applied to service issues such as cycle time, on-time performance and error rates. Difficulties encountered are the lack of historical data, plus that which is available may be pass/fail (attribute) rather than continuous (thickness, roughness), which reduces analytical power and increases the amount of data needed. Furthermore, non-normal distributions for parameters such as cycle time and outstanding debts are common and require use of non-parametric techniques or data transformation.

The lack of data will slow initial progress, as it will need to be collected, and strong resistance can be expected from those not familiar, or comfortable, in a data-driven environment. In many service companies customer interaction is considered the overwhelmingly dominant factor so L6S is a huge change, dare I say it, a paradigm shift. To counter this, sufficient simple training must be given down to the floor level at the start of the effort, the people executing transactions and talking with customers must be involved and given a voice in the teams, and the methodology and tools used kept as few and straightforward as possible in the initial projects. Service environments are notorious for resisting taking people off the floor for training. If management cannot bite the bullet and allow for this in staffing, the effort will be doomed from the start.

Even the chemical industry has taken on L6S with some success. As with services businesses the problem solving and project methodology is naturally applicable. However, since much of the core process data is continuous or batch, as opposed to the individual "widgets" of manufacturing, the analytical tools need to be modified to fit the data. Chemical processes historically used PID closed loop controllers but these techniques can be married with control charts to produce very intelligent control systems. The three bullets at the beginning of this section #7 all have elements that can be applied to chemical plants.

I'll leave discussion of L6S in Medical and IT for another article, but both are hot spots at the moment.

## 8. "The success rate for L6S implementations is too low"

Since you've made it this far, you should have a good idea why this could be! Of course, not all L6S projects are successful as there are many pitfalls and obstacles to be overcome. Quantitative success rate data is out there and, generally, runs in the 60-80% range, though some bias to the positive side should be suspected. Success criteria vary but, generally, meeting of the $ savings goal is the primary component and not completing the project on schedule is usually not a deal breaker. Following the guidelines in this paper will help you improve your odds further.

**In summary, the key points for L6S success are:**

- Executive management buy-in, training and sustained commitment.
- Accountability of all departments to support the projects.
- Careful project selection in the context of the company business plan.
- Program roll-out tailored to the business' ability to respond.
- Set intermediate sigma goals (3, 4.5) for key parameters.
- Keep it simple at the beginning.
- Utilize a Master Black Belt, or equivalent, at first to guide the effort.
- Tailor statistical methods to the technology involved.
- Monthly progress check-ins with management.
- Don't "punish" people for being involved in L6S.