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The Lean Six Sigma Benchmark Report

September 2006

Executive Summary

Six Sigma is an integrated, disciplined approach for reducing defects and producing measurable financial results. With its roots in statistical engineering, the Six Sigma concept embodies a data driven methodology focused on driving down process variation so that no more than 3.4 defects are produced per million opportunities. It has long been associated with Lean Manufacturing. While Lean serves to eliminate waste, Six Sigma reduces process variability in striving for perfection.

Pressures to adopt Six Sigma are primarily driven by the need to improve operational performance in order to reduce costs and push financial results to the bottom line. While over 50% of respondents in Aberdeen's *Lean Six Sigma* survey, as well as in past studies, indicated Six Sigma programs were implemented, we found less than 16% of "Six Sigma" companies and less than 8% of all respondents are holding true to the rigorous program with the stringent quality goal, structured problem-solving approach, dedicated training and prioritized projects that are the hallmark of the original Six Sigma philosophies.

Key Business Value Findings

Adapting to the rigors of Six Sigma requires significant culture change for most companies and many find it a challenge. Companies are finding innovative ways to address this issue along with the usual training programs and by attempting to introduce change gradually. However, training needs to reach the mind, heart and soul of a company and must be an ongoing effort.

Not all challenges are cultural though. With its statistical engineering heritage, Six Sigma methodologies are indeed dependent on data, so data collection can present significant obstacles. Automated data collection and Information Technology (IT) solutions can play a key role in resolving these obstacles, yet findings indicate insufficient use of automation and analytics to support Six Sigma activities.

"The key to success is the commitment of leadership. Saying it and doing it are 2 separate things. It's when they put the funding in place that it really takes hold."

-George Beres, Operational Excellence Champion and Six Sigma Black Belt, Glaxo SmithKline

Implications & Analysis

As a result, enterprises are not achieving the anticipated goals of Six Sigma programs. Such factors leave Aberdeen to conservatively estimate that ***industry is missing out on billions of dollars in potential savings, sales, and profits each year through ineffective application of Six Sigma tools and methodologies.***

Recommendations for Action

Companies should evaluate their processes to ensure they effectively accomplish the following:

- Apply metrics of DPMO (Defects Per Million Opportunities) across all business processes, not just manufactured products and parts.
- Identify and prioritize business impact projects according to anticipated savings and improved throughput. Look first for low hanging fruit and act now for immediate benefit.
- Identify process and project owners who will accept ownership of and accountability for the improvement process.
- These process owners must uncover methodologies that lead to continuous improvement. This discovery process is an important aspect of developing ownership of improvement and driving to real results.
- Integrate data collection with analysis – connect (potentially disparate) sources of data and alarm users

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Chapter One: **Issue at Hand**

Key Takeaways

- Less than 16% of companies with Six Sigma initiatives are holding fast to the rigorous programs of "true" Six Sigma
- On average participants with "true" Six Sigma produced 40% more savings than the general population including those with less rigorous programs.
- Focusing on quality metrics, including defect rates, leads the way to financial results

Six Sigma is an integrated, disciplined approach for reducing defects and producing measurable financial results. With its roots in statistical engineering, the Six Sigma concept embodies a data driven methodology focused on driving down process variation so that no more than 3.4 defects are produced per million opportunities. It has long been associated with Lean Manufacturing. While Lean serves to eliminate waste, Six Sigma reduces process variability in striving for perfection.

Lean Six Sigma has emerged most recently as organizations strive to meet the quality objectives defined by their customers. It combines the principles of Lean with the best practices of Six Sigma. The result is a methodology that serves to improve processes, eliminate product or process defects and to reduce cycle times and accelerate processes.

Competitive Framework Key

The Aberdeen Competitive Framework defines enterprises as falling into one of the three following levels of practices and performance:

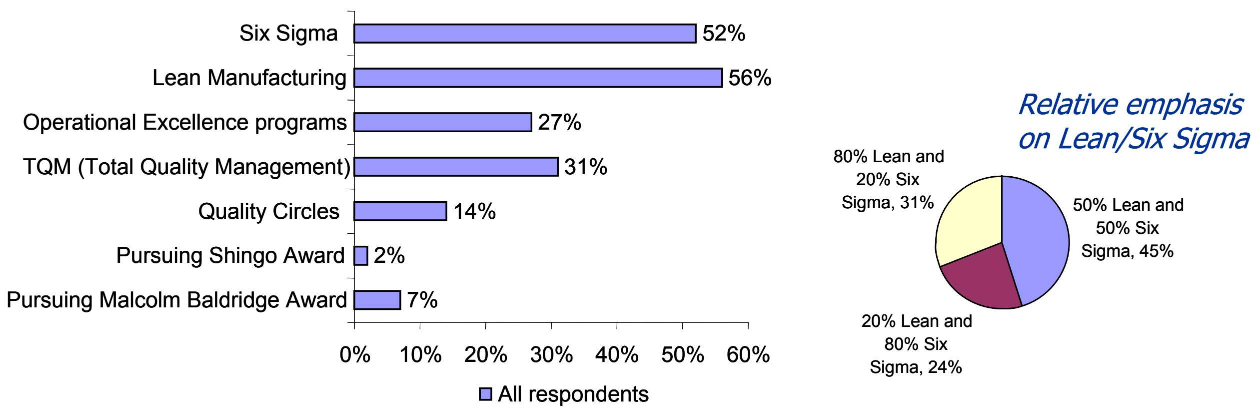
Laggards (30%) —practices that are significantly behind the average of the industry

Industry norm (50%) —practices that represent the average or norm

Best in class (20%) —practices that are the best currently being employed and significantly superior to the industry norm

As Lean Six Sigma has grown more ubiquitous over the past several years, has the concept been watered down? Has it become just another "quality system?" How tightly are the two concepts linked? In a Lean Six Sigma survey conducted in late August and early September of 2006, Aberdeen found companies engaged in a variety of quality related initiatives (see Figure 1).

Figure 1: Lean and Six Sigma Programs Co-exist



Source: Aberdeen Group, September 2006

Aberdeen's Definition of "True " Six Sigma

- Have a formal Six Sigma Program
- Adopted DMAIC methodology
- Require Black Belts to Produce Results for Certification
- Require Business Impact Projects to be Validated by Finance

A significant percentage of survey participants (52%) claim to be implementing Six Sigma and even more (56%) have embraced Lean Manufacturing. Thirty seven percent of participants had both Lean and Six Sigma initiatives while 20% had embraced Lean without Six Sigma (not shown). Of those with both, two thirds integrate the two programs, but the emphasis on each varies (also in Figure 1).

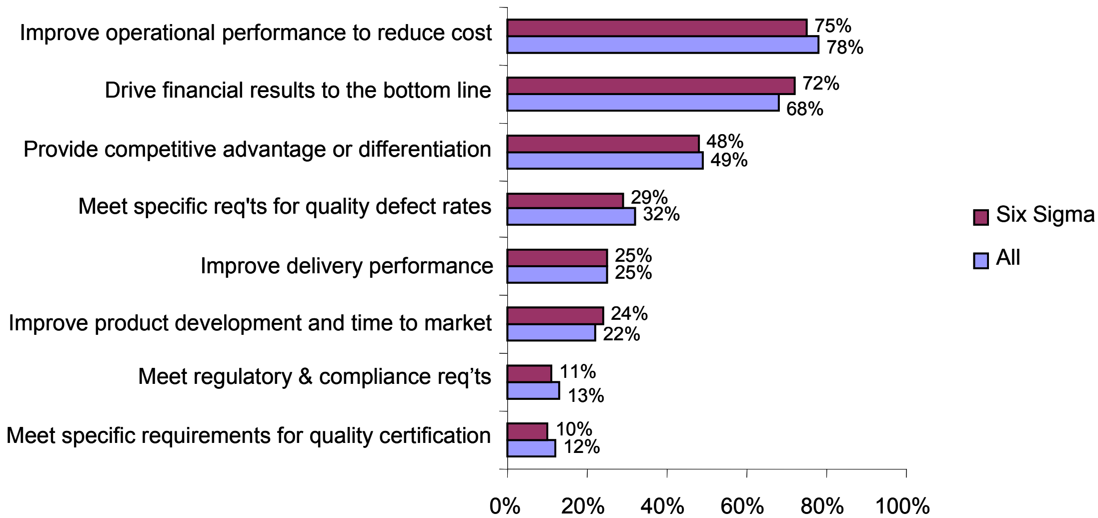
However, less than 16% of "Six Sigma" companies are holding true to the rigorous program with the stringent quality goal, structured problem-solving approach, dedicated training and prioritized projects that are the hallmark of the original Six Sigma philosophies. As a result, the expected results are varied with "true" Six Sigma practitioners rivaling Best in Class in terms of both defect rates and financial outcomes. Those with less rigorous programs are falling far short of expected results. ***On average participants with "true" Six Sigma produced 40% more savings than the general population including all with Six Sigma programs.***

What is Six Sigma?

Literally, Six Sigma is a statistical measure that refers to the number of standard deviations away from the mean (or average) point in a bell shaped curve. In manufacturing, the naturally occurring variations in processes will tend to fall under this bell shape, also known as a normal distribution. Achieving Six Sigma quality translates to producing no more than 3.4 defects per one million parts processed – not an easy accomplishment. In many industries 99% good quality is viewed as an exceptionally good measure, but in others, such as medical devices and aerospace and defense, even a 1% defect rate means people may die. In Six Sigma terms, Best in Class means 99.99966% good quality. But Six Sigma is more than just about defect rates.

It's All About the Bottom Line

Figure 2: Pressures Driving Quality Initiatives



Source: Aberdeen Group, September 2006

Whether driving Six Sigma programs or other quality initiatives, it is clear that the key business drivers revolve primarily around the bottom line, although in striving for competitive advantage, many also seek to impact the top line as well (see Figure 2). While quality metrics, including defect rates, may appear to take a back seat to producing financial results, most quality programs are built around the principle that assumes striving for zero defects can reduce absolute product costs by as much as 20 to 30%.

Has Six Sigma Penetrated the Enterprise?

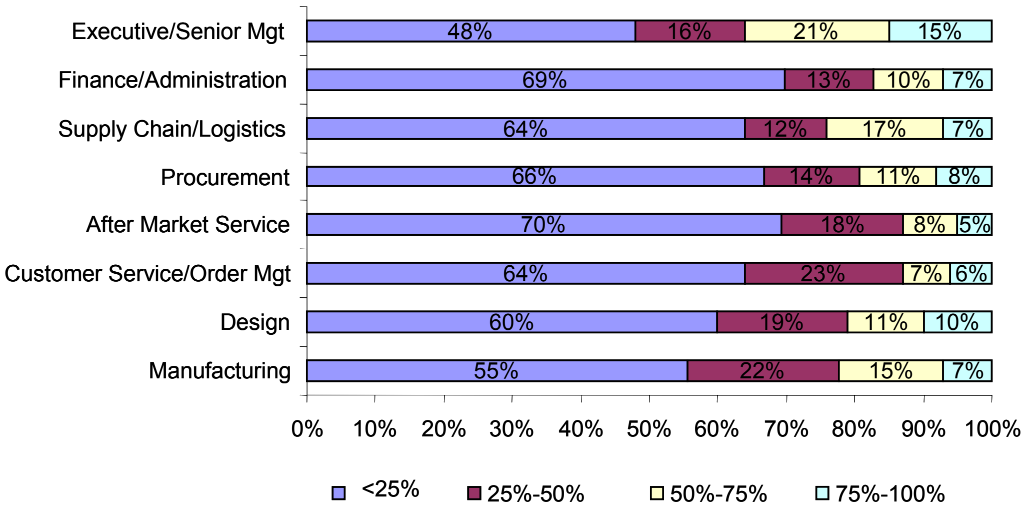
If companies are indeed deploying Six Sigma programs, one would expect commitment, training and business improvement projects to infiltrate throughout the organization. But this isn't happening with any great consistency (Figure 3). Granted, not all of these companies are veterans at Six Sigma, but the majority of our participants (61%) have had these programs in place for more than 2 years and 17% have had them in place for more than 15 years.

Another indication of the pervasiveness of Six Sigma is the number of business impact projects active across various functional areas. While a third sit squarely in

> "We went after the best. We took plant managers and individuals who managed quality across the North American continent. They became our Black Belts. It takes time, but after 2 years we had a breakthrough."
>
> -Jonathan Squire, Hexion Specialty Chemicals, Inc

manufacturing, we did find that in most companies Six Sigma projects were active across the entire organization (see Table 1), indicating that companies do recognize the potential for business process improvement outside of manufacturing, but have not yet thoroughly entrenched Six Sigma in the culture across the enterprise.

Figure 3: How Pervasive is Training Throughout the Organization?



Source: Aberdeen Group, September 2006

Table 1: Six Sigma projects active across the organization

Business Impact Projects	% of Projects
Manufacturing	34%
Design	16%
Customer Service/Order Management	8%
After Market Service	6%
Procurement	10%
Supply Chain/Logistics management	12%
Finance/Administration	14%

Chapter Two: Key Business Value Findings

Key Takeaways

- Training, DMAIC methodologies, standardization of work and elimination of non-value add are key first steps in implementing Six Sigma.
- Companies find innovative ways to address cultural challenges
- IT solutions remain largely untapped as a response to challenges

Given the pressures faced by manufacturers today to improve operational performance and reduce costs, it was no surprise to find strategic actions concentrating on the reduction of non-value added costs and standardization of work processes, mirroring Lean first steps. Aberdeen's Lean Six Sigma survey queried participants on strategic actions in two ways. First they were asked to identify the **first three** strategic actions taken in implementing, not only Six Sigma, but any quality initiatives. Secondly they were asked to identify **all** activity in which their company was currently engaged. Four strategic actions came out on top as **key first steps**:

- *Establish a company wide training and certification program (47%)*
- *Adopt Six Sigma DMAIC methodology: Define, Measure, Analyze, Improve, Control (43%)*
- *Standardize work processes (41%)*
- *Reduce non-value added manufacturing and supply chain costs (39%)*

Yet in terms of continued efforts, a multi-pronged strategy is clearly required (Figure 4). The continuation of efforts aimed at *reducing non-value added steps (76%)* and *standardizing work processes (74%)* appear to be almost universal. Six Sigma's approach to *identifying and prioritizing business impact projects* along with the structured problem solving *DMAIC methodology* were also quite pervasive at 66% and 60% respectively even though these responses reflect all participants, not just those with Six Sigma programs.

PACE Key — For more detailed description see Appendix A

Aberdeen applies a methodology to benchmark research that evaluates the business pressures, actions, capabilities, and enablers (PACE) that indicate corporate behavior in specific business processes. These terms are defined as follows:

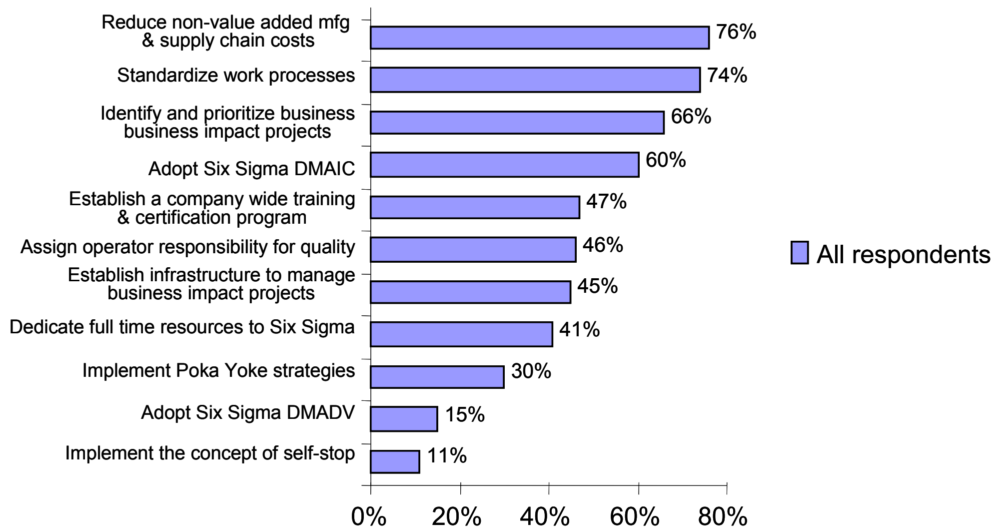
Pressures — external forces that impact an organization's market position, competitiveness, or business operations

Actions — the strategic approaches that an organization takes in response to industry pressures

Capabilities — the business process competencies required to execute corporate strategy

Enablers — the key functionality of technology solutions required to support the organization's enabling business practices

Figure 4: Strategic Actions in Response to Pressures



Source: Aberdeen Group, September, 2006

Challenges and Responses

"We eased people into the process. We asked, culturally, what could we stomach here? What could we apply and sustain? We simplified our approach and eliminated formal certification. We use the DMAIC model but most of our staff doesn't know it by that name."

-Charles King, Director of Continuous Improvement and Master Black Belt, Kaman Industrial Technologies

Adapting to the rigors of Six Sigma requires significant culture change for most companies and many find it a challenge. In fact this was reported as the top challenge faced by our participants. In addition, other challenges noted can also be categorized as "soft" issues, if not directly related to cultural concerns. Challenges arising from *resistance from knowledge workers and middle managers* can in fact be an off-shoot of underlying resistance to change and are often culturally based. In addition, the challenge to keep top management focused after initial stages of the program is further evidence that senior managers and executives have not yet internalized and accepted the necessary cultural shift.

Manufacturers are responding to this challenge with training programs and by attempting to introduce change gradually. However, training needs to reach the mind, heart and soul of a company and must be an on-going effort. Assigning senior management champions who are accountable for quantifiable results will produce the desired effect only if those executives have bought into the program. Outside consultants can be helpful in the transition, particularly in easing into the new culture and establishing repeatable business processes.

Not all challenges are cultural though. With its roots in statistical engineering, Six Sigma methodologies, particularly in the Analysis phase of DMAIC is indeed dependent on data, so the inability to collect data can present significant obstacles. And unless the data is "clean," the next phase of the DMAIC methodology – the Improve phase – can be derailed. Excessive time spent "scrubbing" the data can also present a barrier to achieving desired results. Automated data collection and Information Technology (IT) solutions can play a key role in resolving these obstacles, yet these choices did not figure prominently in participants planned responses.

"It's not an easy program, but here it's the real thing. We have transitioned from relying on anecdotal experience and intuition to a culture of data-driven decision-making."

-Jonathan Squire, Hexion Specialty Chemicals, Inc

Table 2: Quality Related Challenges and Responses

Challenges	% Selected	Responses to Challenges	% Selected
1. Significant culture change required	68%	1. Train employees	68%
2. Data Collection challenges	44%	2. Introduce change gradually	49%
3. Resistance from knowledge workers and middle management	28%	3. Assign senior management champions accountable for quantifiable results	44%
4. Continued commitment from top management after initial stage	26%	4. Engage Outside consultants	33%
5. Sustained company-wide training and certification program	20%	5. Deploy IT solutions in support of quality initiatives	27%
6. Cost of training and certification programs	20%	6. Recruit qualified/certified individuals from outside the company	25%
7. Excessive time spent "scrubbing" data	19%	7. Implement automated data collection	19%

Source: Aberdeen Group, September, 2006

Benefits

In all cases, significant cost savings can be derived from quality efforts. Over half of respondents realized *reduced costs from eliminating non-value added work (53%),* a full 50% achieved *dramatic reductions in cycle time and costs,* and 40% *reduced rework costs.* In addition, 45% gained intangible value from *improved customer satisfaction*.

'True' Six Sigma deployments averaged 40% more savings achieved to date and 65% more savings per project.

On average, “true” Six Sigma implementations produced approximately $1.3 million in savings, as compared to $938,661 across all companies with Six Sigma programs, ***representing 40% better results.*** Individual projects at these “true” Six Sigma firms produced an average savings of almost $238,000, representing a 65% boost over the average across all Six Sigma companies at $144,000.

Chapter Three:
Implications & Analysis

Key Takeaways

- True six sigma quality is an elusive goal
- Certifications fall far short of original objectives
- What you measure makes a difference
- IT solutions play a key role in performance improvement

As shown in Table 3, survey respondents fell into one of three categories – Laggard, Industry Average, or Best in Class — based on their characteristics in four key categories: (1) process (scope and consistency of quality initiatives); (2) organization (corporate focus/philosophy); (3) knowledge (extent and effectiveness of training); and (4) technology (scope of automation of data collection, IT solutions and productivity tools). In addition, Aberdeen's competitive framework also considered actual savings generated from Six Sigma efforts.

In each of these categories, survey results show that the firms exhibiting best-in-class Six Sigma characteristics also enjoy best-in-class defect rates and financial savings.

Table 3: Six Sigma Competitive Framework

	Laggards	Industry Average	Best in Class
Process	• Training in process, beginning small scale pilots	• Small scale pilots completed and/or one or more business units involved	• Consistently applied enterprise wide
Organization	• Six Sigma is viewed as another management fad fostering the attitude, "this too will pass."	• Seen as a set of tools to cut costs and improve processes	• A rigorous commitment to managing for quantifiable results which is entrenched in the culture of the company

	Laggards	Industry Average	Best in Class
Knowledge	• Knowledge is limited; Black Belts and Master Black Belts are outside consultants; some training may have occurred or is in process	• At least one certified Black Belt; some Green Belt training done	• Appropriate number of Green and Black Belts trained; champions in place for all projects
Technology	• Spreadsheets and manual processes predominate	• SPC tools are used by individuals on PC's; selected quality, performance management and other IT solutions implemented	• IT solutions are used throughout the DMAIC/DMADV or other processes and in managing manufacturing performance

Source: Aberdeen Group, September, 2006

Process and Organization

Six Sigma is first a philosophy that focuses attention on those criteria that the *customer really cares about.* The philosophy strives for breakthrough improvements, using data-driven metrics to control inputs and processes to yield predictable products and processes. Best in Class companies have consistently applied Six Sigma principles and philosophies across the organization. While over half of the respondents to the Lean Six Sigma survey claimed to have a Six Sigma program in place, Aberdeen applied a more strict definition of Six Sigma to determine a separate class of deployment.

The criteria for classification as "true" Six Sigma included the following "must haves":

- Must have a formal Six Sigma Program
- Must have adopted DMAIC (Define, Measure Analyze, Improve, Control) methodology
- Must require Black Belts to Produce Results for Certification. Simply demonstrating a body of knowledge was not sufficient without having completed business impact projects that generated real savings to the company. Best in Class criteria for "true" Six Sigma required full completion of two projects, or a single project which generated savings of $500,000 or more.
- Must require business impact projects to be formally validated by Finance

Aberdeen found less than 16% of those with Six Sigma programs satisfied this criteria.

Knowledge

Commitment to Six Sigma requires commitment to training. While efforts can begin with small scale pilots, in order to reap the full benefits of these programs, the philosophy must spread virally throughout the organization. In initial stages, goals are set for Green Belt, Black Belt and Master Black Belt certifications.

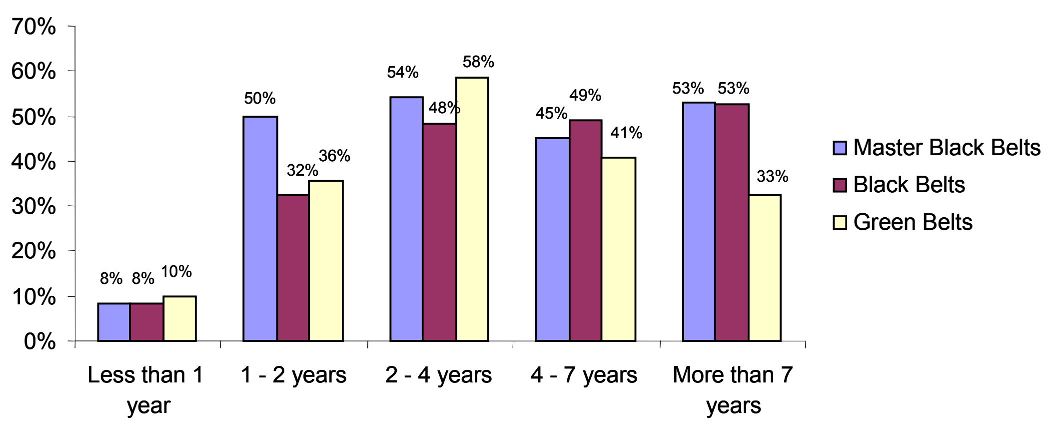
Indeed, almost none of our respondents had achieved their goals for these certifications. (Figure 5) Our findings show companies take 1-2 years to reach the halfway mark on goals for Master Black Belts, and were able to improve and sustain this level of achievement for two more years before we started to see a drop off. Master Black Belt status is a very marketable commodity, and companies are quite likely to recruit this talent into their organizations instead of, or in addition to, grooming them from within. Therefore it is not unusual to see these individuals lured away from their current position.

> "The key to success is the commitment of leadership. Saying it and doing it are 2 separate things. It's when they put the funding in place that it really takes hold."
>
> -George Beres, Operational Excellence Champion and Six Sigma Black Belt, Glaxo SmithKline

The achievement of Black Belt goals rose more steadily through the first 10 years, but still fell short of initial objectives. And yet through follow-up interviews with "true" Six Sigma companies, with the appropriate level of commitment, achievement of certification goals are indeed within reach. Yet commitment comes in many forms and proper funding for training is essential.

Green belt certifications peak at 58% in the 2 – 4 year range and then falter. Initial training programs are partially effective but as attrition occurs, new employees are not necessarily trained and while companies are likely to recruit Black Belts and Master Black Belts from outside the company, Green Belts generally are certified from within the rank and file.

Figure 5: Level of Certifications: Expected versus Actual



Source: Aberdeen Group, September 2006

Key Performance Indicators

Six Sigma is also about quality levels. These programs aim for near perfection. To achieve Six Sigma, a process must not produce more than 3.4 defects per million.

Table 4: Sigma Value translated to number of defects

Sigma	% Good Quality	% Defects	PPM (defective) parts per million
2	69.1%	30.9%	308,537
3	93.3%	6.7%	66,807
4	99.4%	0.64%	6,210
5	99.98%	0.02%	233
6	99.9997%	0.00034%	3.4

Source: Aberdeen Group, September 2006

Survey respondents use a variety of quality performance measurements (Figure 6), with "true" Six Sigma participants, not unexpectedly, measuring more and using more sophisticated metrics. While many of these metrics seem to focus on manufactured parts, true Six Sigma disciples understand these metrics can apply universally. Whether you measure bad parts coming off an assembly line, or errors made in processing orders, a process is a process and a defect is a defect.

While on average, none of our categories of respondents achieved true six sigma quality, those companies that measure PPM and DPMO achieved better performance than

"No, we are not a manufacturer, but of course we measure DPMO. A process is a process is a process"

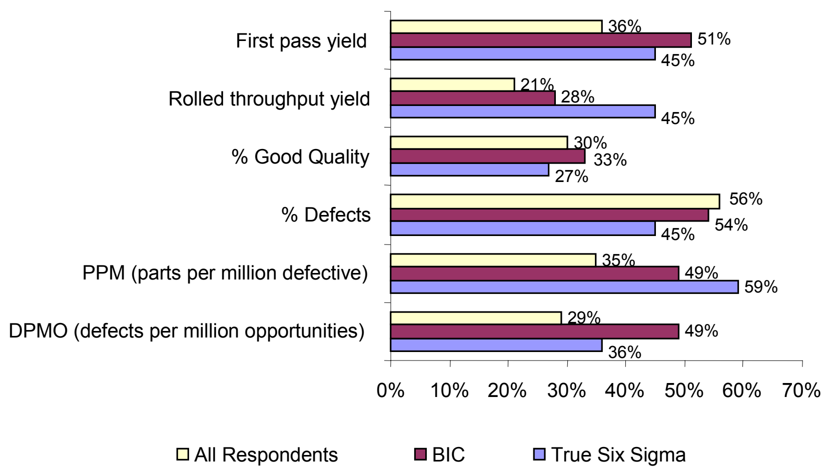
- Charles King, Director of Continuous Improvement, Kaman Industrial Technologies

"It is not unusual to see an apparent drop in performance during early stages of Six Sigma programs once performance begins to be measured correctly"

- Glenn Jutras, Six Sigma Black Belt, Manager of Audits and Approvals, FM Global those which simply measure defect rates in terms of "% good" or "% defective."

However, the percent improvement is extremely impressive across the board and particularly in measuring DPMO. In general our "true" Six Sigma participants achieve Best in Class (defined as approximately the top 20% of our respondents) performance, but on average have yet to reach six sigma levels. Yet those who measure DPMO are very close to five sigma performance (Table 5).

Figure 6: Quality Metrics in Use



Source: Aberdeen Group, September 2006

Table 5: Quality Performance

Before	True Six Sigma	BIC	All
DPMO (defects per million opportunities)	22,027	18,303	67,302
PPM (parts per million defective)·	3,412	6,957	18,446
% Defects	13	9	13
% Good Quality	81	84	86
Rolled throughput yield (%)	68	81	73
First pass yield (%)	80	82	85

After	True Six Sigma	BIC	All
DPMO (defects per million opportunities)	306	589	4,789
PPM (parts per million defective)·	1,486	1,780	12,417
% Defects	6	2	9
% Good Quality	98	94	93
Rolled throughput yield (%)	90	95	83
First pass yield (%)	93	91	87

Source: Aberdeen Group, September 2006

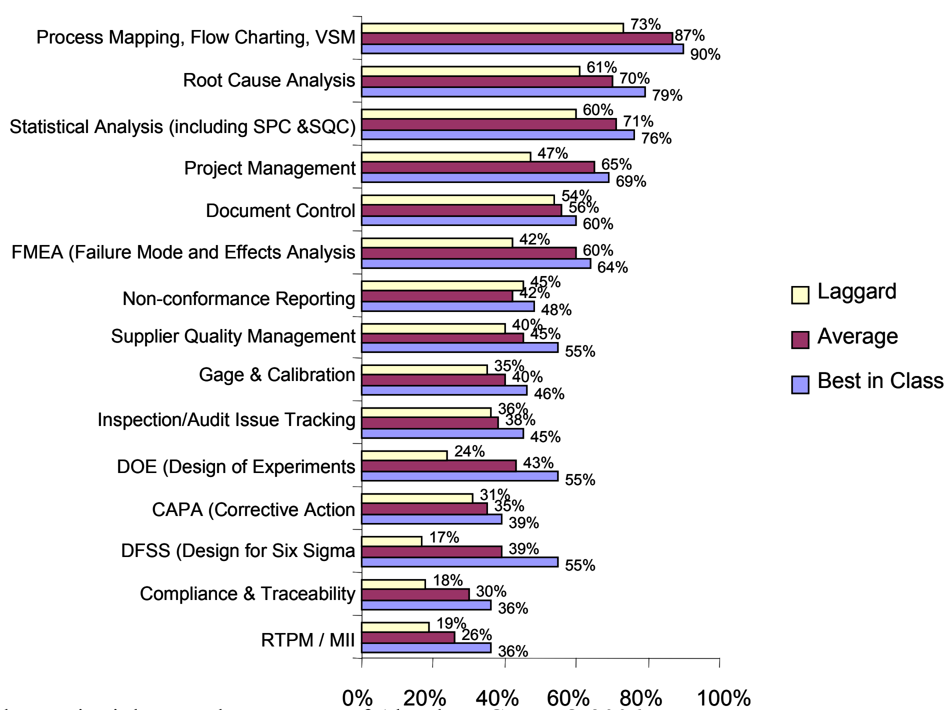
Current quality levels will be somewhat dependent on the maturity of the Six Sigma program yet these results are still somewhat disappointing and leave plenty of room for improvement. The average performance of "true" Six Sigma respondents that use "% defects" (6%) is downright shocking, al though a couple of contributing factors are at play. First of all, note the level of improvement. This category did, on average, reduce defects by 7%, an impressive achievement in of itself. In addition, with the rigorous application of Six Sigma, it is not unusual to uncover flawed approaches to data capture and performance reporting, resulting in an early dip in reported performance.

> "We focus on metrics critical to the customer. We process the inputs to these critical metrics using Hertzler's DMS (Defect Management System) & SPC (Statistical Process Control) software. This has helped us improve performance without throwing excessive resources at a problem."
>
> -Karen Carter, Director of Operational Excellence, Micropump

Technology Usage

Figure 7 implies a direct correlation between the application of technology and Best in Class performance. In all categories of IT solution with the exception of one (nonconformance reporting), the rate of adoption increases with performance. While the quality professionals in our reader community will be quick to point out this does not definitively prove cause and effect, the relationship is quite clear. Those who adequately stock their Six Sigma tool kit with relevant technology perform better.

Figure 7: Technology Adoption



Technology Enablers

A wide variety of tools are available to assist in the implementation of both Lean and Six Sigma, but for purposes of focus, this report will highlight those intrinsic specifically to Six Sigma. For further expansion of the technology enablers of Lean Manufacturing and its role throughout the supply chain, please refer to Aberdeen's *The Lean Supply Chain Report,* September 2006.

Process Planning: Process Mapping, Flowcharting, Value Stream Mapping

Value Stream Mapping has long been associated with Lean while Process Mapping is a Six Sigma staple. Some will argue they are the same and some will adamantly insist they are different. We grouped them together for purposes of assessing technology adoption and found it to be the tool most widely adopted across our entire base of participants, in spite of the fact that just over half were engaged with Lean and/or Six Sigma. This was also surprising since many Lean purists will argue that value stream mapping is a paper and pencil tool and many Six Sigma disciples perform process mapping in Excel or Power Point.

Therefore, in follow up interviews we confirmed that Excel and PowerPoint are indeed the "technologies" many use for this process. While obviously this is serving the purpose to a certain extent, both provide limited assistance in providing an automated visual framework to connect data to processes and provide little assistance in centralizing the management of the process mapping or enabling collaboration.

"We began using iGrafx's FlowCharter as a result of our search for a better tool – one that was easier to use. Everyone in the Lean Six Sigma community uses it. Ninety nine percent of what Green Belts do is process characterization and stabilization. What they do in FlowCharter builds a foundation for the Black Belts and Master Black Belts to use for simulations in iGrafx Process."

-Tom Trace, Lean Six Sigma Master Black Belt, Brunswick Boat Group

Statistical Analysis

These solutions span a broad range of functions including Statistical Process Control (SPC), Statistical Quality Control (SQC), Time Series Charts, Histograms and Pareto Graphs, Failure Mode and Effects Analysis (FMEA), Process Capability Analysis, Regression Analysis, Variance Analysis, Time Series Analysis and Forecasting. Many of these are broad enough categories to merit individual discussion, but for our purposes here, these have been grouped because of the role they all play in Six Sigma. The role of statistics is critical to Six Sigma.

"ActiveFactory disseminates data collected from the shop floor via the Intranet to the desktop. Black Belts can watch processes in real time and don't need to be in a control room 3,000 miles away."

-Jonathan Squire, Hexion Specialty Chemicals, Inc

Six Sigma requires data and information for decision-making. Statistics are the vehicle through which information is derived from data. But that statistical analysis is only as good as the data provided. Full benefits are achieved when data collection is automated, integrating "clean" data into the process.

Real-Time Performance Management

While Six Sigma is relevant to all companies, certain technologies have particular application to manufacturing. Best in Class manufacturers understand the value of bridging the gap between manufacturing operations and the enterprise by leveraging real-time plant floor information to increase the effectiveness of the entire planning and execution process. Next level improvement opportunities are unknown or not well enough understood to bring under control without real time, complete and accurate manufacturing intelligence & cross-functional integration.

Real time dynamic data collection is necessary to support project prioritization, statistical methods, DOE (Design of Experiments) and provide real-time alerts.

> "I had these two high-powered and highly compensated engineers – really two of my best people – spending hours scrubbing data and building data bases to get the information they needed for their projects. We had to deliver benefits from the Lean Six Sigma effort quickly, and we couldn't do it if Black Belts were spending days at a time cleaning up data rather than analyzing it and acting on it. A commercial solution from Hertzler Systems proved to be the best course of action. The company's precious Belt resources now spend their time doing the work of continuous improvement instead of cleaning data or being a shadow IT department."
>
> Jeff Hohman, President, Micropump

Project Management

Six Sigma employs a structured approach to problem-solving and requires the management of projects which have the potential of having significant impact on the business. To maximize the benefits of these projects, it is necessary to provide an infrastructure that facilitates the adoption of Six Sigma across the organization, manage individual projects, share information effectively manage financial information in such a way as to gain acceptance on an enterprise-wide basis. While strictly speaking tools such as spreadsheets and generic desktop tools, and even pencil and paper, can assist in early stages of Six Sigma implementation, standardization and collaboration are necessary to achieve the next level of benefits.

By implementing project management tools that support collaborative efforts and provide workflow automation, Six Sigma practitioners are able to focus on analytical aspects of the methodology to drive to true results.

> "I'm a big believer in OEE and having the right system to capture performance. Just looking at line efficiency and comparing expected to planned doesn't help you understand the whole problem. With the Informance product I can sit anywhere and get a complete picture instantaneously any time.
>
> -George Beres, Operational Excellence Champion, Glaxo-SmithKline

Other Quality Management Tools

There is a wide variety of other technologies that can be informally grouped together as quality management tools. These include Inspection and Audit, Gage and Calibration, Non-conformance Reporting, Compliance and Traceability, Issue Tracking, Revision and Change Management. While many of these are not specific to Six Sigma, they form an important basis from which to manage quality initiatives.

Chapter Four: Recommendations for Action

Key Takeaways

- Best in Class: Integrate data collection with analysis – connect (potentially disparate) sources of data and alarm users
- Average: Apply metrics of DPMO (Defects Per Million Opportunities) across all business processes, not just manufactured products and parts.
- Laggards: Identify process and project owners who will accept ownership of and accountability for the improvement process.

Six Sigma programs have enormous potential for quality improvement and financial savings that can directly impact both the bottom line as well as top line results. But true Six Sigma, whether implemented in conjunction with Lean Manufacturing, or as a stand-alone discipline, requires a rigorous commitment across the entire organization.

Whether a company is looking to initially implement Six Sigma or trying to gradually move its organization from "Laggard" to "Industry Average," or "Industry Average" to "Best in Class," the following actions will help spur the necessary performance improvements:

Laggard Steps to Success

- *Implement a corporate wide training program* to educate employees on the benefits and results of data-driven decision-making. Establish goals and timelines for education and certifications. Bring in outside consultants to guide the process and initially serve as both Master Black Belts and Black Belts.
- *Identify individuals who will be dedicated and trained as Black Belts*. This is not a part time job and requires assignment of some of your best and brightest.
- *Implement DMAIC (Define, Measure, Analyze, Improve, Control) methodologies.* This is a structured, problem-solving approach to phased projects. While many quality initiatives rely on measurement, analysis and improvement, Six Sigma distinguishes itself in the Control phase of the program. Determine long term control measures which will ensure that the contributing factors remain controlled.
- *Identify and prioritize business impact projects according to anticipated savings and improved throughput.* Identify those criteria that are critical to quality in the eye of your customer. Look first for low hanging fruit and act now for immediate benefit. Start with those projects which will yield the best results in the fastest time frame.
- *Identify process and project owners who will accept ownership of and accountability for the improvement process.* These process owners must uncover meth-

odologies that lead to continuous improvement. This discovery process is an important aspect of developing ownership of improvement and driving to real results.

- *Flow chart selected processes*, mapping them from the end result back to initial stages. Much like the value stream mapping intrinsic to Lean Manufacturing, this is the first step in removing non-value added steps in the process. Determine the critical characteristics affecting quality which are upstream from the results. Attempting to manage the end results only will not eliminate costs due to rework, inspection and test.

Industry Norm Steps to Success

- *Make every employee data-proficient.* Those who are in any way involved in decision-making must have access to data to drive the decision. Managers must learn to navigate by KPIs (Key Performance Indicators)
- *Apply metrics of DPMO (Defects Per Million Opportunities) across all business processes, not just manufactured products and parts.* This is not a metric only for manufactured parts. A mistake in processing an order is a defect. A design flaw is a defect. A missed delivery is a defect. Any contributing factor that can prevent an order from being a "perfect order" should be viewed as a defect and measured.
- *Expand the scope of Six Sigma beyond the pilot stage and beyond the group/division level to be consistently applied enterprise wide.* Perfect orders result from the entire organization working in lock-step and striving for the same result.
- *If not already in place, institute the concept of self-stop.* Every employee involved in a work process, whether it is an administrative function or a direct manufacturing role must have the knowledge and authority to stop a process before it produces a defect.
- *Provide Six Sigma project teams with the necessary data capture and analysis tools.* Without the proper tools teams spend too much time moving and scrubbing data are prevented from spending the appropriate amount of time analyzing for improvement and control.

Best in Class Next Steps

- *Integrate data collection with analysis* – connect (potentially disparate) sources of data and alarm users before processes produce defects.
- *Remove obstacles that prevent work processes and data from flowing seamlessly across the organization and throughout the supply chain.*

In addition to increased product quality, better delivery and better margins, taking the above steps can directly impact a company's overall costs, revenues, and profitability.

Appendix A: **Research Methodology**

Between August and September 2006, Aberdeen Group examined Lean Six Sigma philosophies, techniques, and technologies of 418 enterprises in aerospace and defense (A&D), automotive, high-tech, industrial products, and other industries.

Responding manufacturing, quality management and operations executives completed an online survey that included questions designed to determine the following:

- How tightly linked are Lean and Six Sigma initiatives?
- Is Six Sigma truly being implemented as the rigorous quality program which becomes entrenched in the culture of a company?
- Is it seen as a set of tools to cut costs and improve processes? Or is it viewed as just another management fad, fostering the attitude of, “this too will pass”?
- What benefits are being reaped from these efforts in terms of cost savings and competitive advantage?
- How well are enabling technologies being utilized? Do quality professionals understand and acknowledge the role software plays in support of these initiatives?

Aberdeen supplemented this online survey effort with telephone interviews with select survey respondents, gathering additional information on Six Sigma programs, strategies, experiences, and results.

The study aimed to identify emerging best practices and provide a framework by which readers could assess their own capabilities.

Responding enterprises included the following:

- ***Job function**:* The research sample included respondents with the following job functions: quality management (12%); manufacturing/operations (21%); supply chain, logistics (7%); IT (7%); business process management (26%), and other (14%).
- ***Job title**:* The research sample included respondents with the following job titles: C-level and VP (18%), Director (32%); Manager (17%); CIO/ IT manager (2%); staff or internal consultant (20%); and other (10%).
- ***Industry**:* The research sample included respondents predominantly from manufacturing industries. High Tech manufacturers represented 29% of the sample, followed by industrial equipment and machinery manufacturers, which accounted for 13% of respondents. Automotive manufacturers represented 11%; Aerospace and defense manufacturers accounted for 11%. Manufacturers of medical devices totaled 8% of respondents, transportation and logistics for 10% and a combination of CPG and Food and beverage accounted for 10%.

- ***Geography**:* Seventy two percent were from North America, 13% were from the Asia-Pacific region and 17% were from EMEA (Europe, Middle East and Africa).
- ***Company size**:* About 41% of respondents were from large enterprises (annual revenues above US$1 billion); 24% were from midsize enterprises (annual revenues between $50 million and $1 billion); and 35% of respondents were from small businesses (annual revenues of $50 million or less).

Solution providers recognized as sponsors of this report were solicited after the fact and had no substantive influence on the direction of the *Lean Six Sigma Benchmark Report*. Their sponsorship has made it possible for Aberdeen Group to make these findings available to readers at no charge.

Table 6: PACE Framework

PACE Key
Aberdeen applies a methodology to benchmark research that evaluates the business pressures, actions, capabilities, and enablers (PACE) that indicate corporate behavior in specific business processes. These terms are defined as follows:
Pressures — external forces that impact an organization's market position, competitiveness, or business operations (e.g., economic, political and regulatory, technology, changing customer preferences, competitive)
Actions — the strategic approaches that an organization takes in response to industry pressures (e.g., align the corporate business model to leverage industry opportunities, such as product/service strategy, target markets, financial strategy, go-to-market, and sales strategy)
Capabilities — the business process competencies required to execute corporate strategy (e.g., skilled people, brand, market positioning, viable products/services, ecosystem partners, financing)
Enablers — the key functionality of technology solutions required to support the organization's enabling business practices (e.g., development platform, applications, network connectivity, user interface, training and support, partner interfaces, data cleansing, and management)

Source: Aberdeen Group, September 2006

Table 7: Relationship between PACE and Competitive Framework

PACE and Competitive Framework How They Interact
Aberdeen research indicates that companies that identify the most impactful pressures and take the most transformational and effective actions are most likely to achieve superior performance. The level of competitive performance that a company achieves is strongly determined by the PACE choices that they make and how well they execute.

Source: Aberdeen Group, September 2006

Table 8: Competitive Framework

Competitive Framework Key
The Aberdeen Competitive Framework defines enterprises as falling into one of the three following levels of FIELD SERVICES practices and performance: *Laggards (30%)* — FIELD SERVICES practices that are significantly behind the average of the industry, and result in below average performance *Industry norm (50%)* — FIELD SERVICES practices that represent the average or norm, and result in average industry performance. *Best in class (20%)* — FIELD SERVICES practices that are the best currently being employed and significantly superior to the industry norm, and result in the top industry performance.

Source: Aberdeen Group, September 2006

Appendix B:
Related Aberdeen Research & Tools

Related Aberdeen research that forms a companion or reference to this report include:

- The Lean Benchmark Report: Closing the Reality Gap
- The Lean Supply Chain Benchmark Report
- Roadmap to Lean Success: Measurement and Control Benchmark Study
- The Manufacturing Performance Management

Information on these and any other Aberdeen publications can be found at www.Aberdeen.com.

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