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By Mikel Harry, Ph.D., and
Richard Schroeder

The Breakthrough Management Strategy Revolutionizing the World's Top Corporations

SIX SIGMA

THE SUMMARY IN BRIEF

The Six Sigma Breakthrough Strategy is one of the most compelling and successful management strategies of the last quarter century. Using examples of successful implementation of the Six Sigma Breakthrough Strategy at such companies as General Electric, AlliedSignal and Polaroid, Mikel Harry, Ph.D., and Richard Schroeder (both of the Six Sigma Academy, Inc.) lay out in detail the theory and practice of achieving the astounding level of quality (3.4 defects per million opportunities) at the heart of this approach.

The Six Sigma Breakthrough Strategy is compelling and successful because it focuses on business processes and the components that comprise those processes. Among the lessons the authors impart in this summary are the following:

- What factors and business needs lead companies to implement Six Sigma.
- How to benchmark performance and use statistically constructed metrics to measure progress.
- How to break down a process into its elemental components, then find and correct the disconnects and variables that lead to errors, problems and dissatisfaction.
- How to structure your Six Sigma project teams, from the top down, and motivate them to succeed in their project-related endeavors.
- How to implement the Breakthrough Strategy at the business, operations and process levels.
- How to prepare your organization for the challenges, changes and ultimate rewards of Six Sigma.

There are also confirmations of Six Sigma's worth by no less a pair of executive-level experts than GE's Jack Welch and AlliedSignal's Lawrence Bossidy. They, among others, both note that in spite of the tremendous effort required to achieve Six Sigma quality, the Breakthrough Strategy is well worth every drop of sweat, every moment of frustration, every minute of training it requires.

The rewards of extreme quality can be yours, too. Turn the page to begin the process ...



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SIX SIGMA

by Mikel Harry and Richard Schroeder

— THE COMPLETE SUMMARY

Why Six Sigma?

What drives companies to implement Six Sigma? Quality alone is not the most important motivating factor. Six Sigma is about improving profitability — each sigma shift provides a 10 percent net income improvement (see “The Cost of Quality” table below), a 20 percent margin improvement, and a 10 to 30 percent capital reduction.

Why Else Do Companies Implement Six Sigma?

It Sets Different Standards. Past definitions of quality focused on *conformance to standards* as companies strived to create products and services that fell within certain specification limits. If companies produced quality products and services, their performance standards were correct regardless of how those standards were met — even, for example, if a part had been reworked extensively to meet the standard. Six Sigma broadens the definition of quality to include (for both company and customer) expected standards of *economic value* — for example, the costs to produce a product — and *practical utility*.

It’s Process-Oriented. Companies use thousands of processes (activities that take an input, add value to it, and produce an output) to create their products and services. Those processes can be industrial (involving machinery coming in physical contact with delivery materials) or commercial (involving human intervention,

What Is Six Sigma?

- It is a business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction.

- It guides companies into making fewer mistakes in everything they do, from filling out purchase orders to manufacturing airplane engines, eliminating lapses in quality at the earliest possible occurrence.

- It doesn’t merely detect and correct errors; it provides specific methods to recreate processes so that errors never arise in the first place.

such as processing payroll or orders, that support industrial processes). Six Sigma creates specific improvement goals for every process within an organization, allowing companies to understand and incorporate new technologies for improved process performance.

It Stands for Quality. For some companies, the cost to deliver a quality product can account for as much as 40 percent of the sales price. For a company whose annual revenues are \$100 million, and whose operating income is \$10 million, the cost of quality is approximately 25 percent of revenue, or \$25 million. If that company could reduce its cost of achieving quality by 20 percent, it could increase its operating income by \$5 million — or 50 percent of current operating income. No wonder former Motorola CEO Bob Galvin was once quoted as saying that leaders must take quality to a personal level in order to create lasting improvements. ■

The Cost of Quality

Sigma Level	Defects Per Million Opportunities	Cost of Quality
2	308,537 (Noncompetitive companies)	Not applicable
3	66,807	25 - 40% of sales
4	6,210 (Industry average)	15 -25% of sales
5	233	5 -15% of sales
6	3.4 (World class)	<1 of sales

Each sigma shift provides a 10 percent net income improvement.

The author: Mikel Harry is founder and CEO of the Six Sigma Academy, Inc. Richard Schroeder is president of the Six Sigma Academy. They implement Six Sigma programs at major corporations around the world.

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The Players in Six Sigma

Before we examine the Six Sigma Breakthrough Strategy in detail, let us first review the different players in your company who will be involved in the process.

The inverted pyramid is a powerful metaphor for the support Six Sigma requires to succeed. At the bottom of the pyramid, supporting and balancing the structure, is the executive leadership, whose vision and values form the foundation, and without whose commitment the entire enterprise would crumble. At the top of the pyramid is the customer, around whose expectations Six Sigma quality is built. Between the executives and customers are the four types of players in Six Sigma: champions, master black belts, black belts and green belts.

Champions

These key leaders fall under two categories: Deployment Champions (who function in executive capacities, with the added responsibility of nurturing Six Sigma) and Project Champions (who function at the business unit level and nurture Six Sigma at the project level). These individuals organize and lead the initialization, deployment and implementation of Six Sigma — choosing the specific projects and implementing the required strategies and tactics.

Master Black Belts

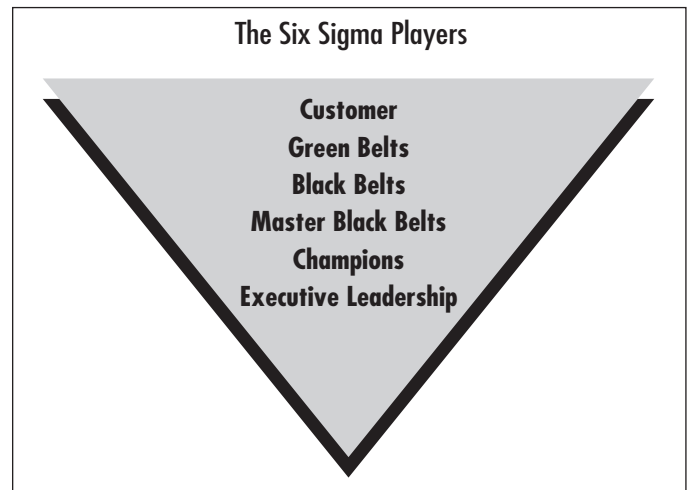
These individuals are selected by Champions to act as

AlliedSignal: Six Sigma Players in Action

AlliedSignal's Champions have created an infrastructure that supports Six Sigma training and deployment company-wide. Champion candidates must attend three and a half days of Six Sigma executive overview and participate in the traditional four-month Black Belt training process. Master Black Belts are selected from the best of the Black Belts; each Master Black Belt, in turn, must train and mentor 10 Black Belts. Those 10 Black Belts are then asked to train and mentor 10 Green Belts.

As a result, Six Sigma has been deployed across the company in a rapid fashion. Until 1998, Green Belt training was an optional program available to interested parties. The company has since made it a requirement for all salaried employees to undergo the 26 hours of training required for Green Belt certification.

This move to mandatory participation and the improvements that have resulted from the rapid Six Sigma deployment have helped AlliedSignal save \$1.5 billion since the program was implemented in 1994.



in-house experts for disseminating the Breakthrough Strategy knowledge throughout the organization. They devote 100 percent of their time to Six Sigma — training and coaching Black Belts and Green Belts and communicating overall progress and status of projects within their areas or businesses.

Black Belts

These individuals, working under the tutelage of a Master Black Belt, apply the tools and knowledge of Six Sigma to specific projects. Like Master Black Belts, Black Belts devote 100 percent of their time to Six Sigma projects. They undergo extensive training in statistics and problem-solving techniques, and should pass that knowledge on by training 100 Green Belts every year. Indeed, the bulk of executing the Breakthrough Strategy falls to Black Belts.

Green Belts

These employees execute Six Sigma as a part of their overall jobs. Although focused on the day-to-day projects that comprise their work, they are still given two primary tasks under the Breakthrough Strategy: deploying the success of Six Sigma techniques and leading small-scale improvement projects within their respective areas.

Breakthrough Strategy Training

Training for roles under the Breakthrough Strategy need not be limited to people within your organization; you can also leverage the training to improve your business partnerships. At GE's Travel Center, a unique cross-training program enables collaborative Six Sigma training between Travel Center management and managers at Carlson-Wagonlit Travel, the company that handles GE's company travel. A Carlson-Wagonlit executive achieved Champion status, then worked closely with the Travel Center's Master Black Belt to train Black Belts and Green Belts at both companies, cementing their business relationship, not to mention their collective commitment to quality. ■

The Six Sigma Breakthrough Strategy

There are eight phases involved in applying the Breakthrough Strategy to achieve Six Sigma performance in a process, division or company: **Recognize, Define, Measure, Analyze, Improve, Control, Standardize** and **Integrate**.

Each phase is designed to ensure the methodical and disciplined application of the Strategy, the correct definition and execution of Six Sigma projects, and the incorporation of results in day-to-day business endeavors.

These eight components of the strategy fall into one of four categories:

Identification. The *Recognize* and *Define* phases fall under this category, in which companies begin to understand the fundamental concepts of Six Sigma and recognize the Breakthrough Strategy as a problem-solving methodology with a unique set of tools. These phases allow companies to recognize how their processes affect profitability, then define what the critical-to-business processes are. The key component for companies to address in these two phases is variation across processes — how much of an impact variation has on results in terms of cost, cycle time and defect rates.

Characterization. *Measure* and *Analyze* fall into this category, which considers where a process is at the time it is measured and points to the goals to which a company should aspire by establishing baselines and benchmarks — thus providing a starting point for measuring improvements. Leadership creates an action plan to close the gap between current and desired processes, in order to meet goals for a particular product or service. It entails breaking down every product into its key characteristics, creating a detailed description of every step in a process, and measuring short- and long-term process capabilities.

Optimization. This category (comprised of the *Improve* and *Control* phases) identifies the steps required to improve a process and reduce the major sources of variation. Key process variables are identified through statistically designed experiments, and the “vital few” that have greatest impact are isolated. The knowledge gained from these steps is then used to improve and control a process, ultimately improving profitability, customer satisfaction and shareholder value.

Institutionalization. The *Standardize* and *Integrate* phases that comprise the Institutionalization stage address the integration of Six Sigma into the way a business is managed on a day-to-day basis. More than just a focus of projects through to completion, this stage offers a way to step back and look at how collective results of smaller projects affect the large, high-level processes that run the day-to-day business. ■

The Three Levels of Breakthrough: Business, Operations and Process

Almost every organization can be broken down into three basic levels. The highest level is the *business* level — the umbrella level that encompasses everything related to the company. The next level is the *operations* level, while the lowest level is the *process* level.

The success of Six Sigma is defined as the extent to which it transforms each level of an organization to improve that organization’s overall quality and profitability. The fluidity of the methodology allows it to work up and down the different levels of the organization.

The Breakthrough Strategy is applied to each level of the organization as follows:

Business Level

The business-level application of the Breakthrough Strategy focuses on making significant improvements to the informational and economic systems used to steer your business, such as customer feedback or supplier quality. It requires a three- to five-year commitment from executive leadership to consistently do the following:

- **Recognize the true states of your business.** Do you really know the states (or conditions) of your business — for example, how well your company is doing in customer service (see box below)? You cannot

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Business “States” and the Systems that Support Them

The states of your business are the global business conditions created by the systems used to guide and manage your business. For example, you might focus on the state of your company’s customer satisfaction. Customer satisfaction depends on 1) delivering a product or service that is free of defects; 2) delivering a product or service on schedule; and 3) delivering a product or service at the lowest possible price.

Each of these elements of customer satisfaction can be linked to specific systems in your company. For example, to deliver defect-free products or services, you need reliable quality measurement systems. Reliable scheduling systems are required to deliver products on schedule. Finally, good accounting and management systems are needed to deliver products or services at the lowest costs.

With Six Sigma, you’ll identify the business states you need to improve, then work on the underlying business systems that will lead to that improvement.

The Three Levels of Breakthrough: Business, Operations and Process

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improve what you do not measure; identifying the various states of your business help you properly focus on what must be improved.

- **Define what plans must be in place to realize improvement of each state.** Creatively consider how to achieve a higher level of performance and relate those things to customer satisfaction.

- **Measure the business systems that support the plans.** Know what you need to measure and how to properly measure it, and get executive commitment to pursue the correct measurements.

- **Analyze the gaps in system performance and benchmarks.** Diagnose capability measures and assess performance gaps, through analyzing benchmarks and uncovering the “secrets” of how businesses operate at higher sigma levels.

- **Improve system elements to achieve performance goals.** Define your measuring system, collect the necessary data, analyze that data and prioritize your efforts for improvement.

- **Control system-level characteristics that are critical to value.** Monitor those efforts and their elements over a period of time, conducting regular “audits” of performance and controlling these critical-to-value characteristics.

- **Standardize the systems that prove to be best-in-class.** Compare the optimal performance of your business systems with similar examples elsewhere. When appropriate, apply these findings to other business units, capitalizing on the potential savings of your system-level analysis and control.

- **Integrate best-in-class systems into the strategic planning framework.** Roll the improvements out to all pertinent business units, folding these improvements into critical business strategies and tying the initiative to compensation as an incentive for full cooperation.

Operations Level

The Breakthrough Strategy helps expose “operational issues” for what they are: a collection of higher-level problems that become confounded. The Strategy helps break apart the “issue” into its components, allowing you to define problems, formulate plans and take positive actions. The Project Champion’s role in this effort is as follows:

- **Recognize operational issues that link to key business systems.** Often, the tactical solution to an operational issue is masked by the underlying support system. For example, imagine a company’s quality information system (QIS) which provides statistical data on product defects. The problem is that the defects are not identified

The Importance of Benchmarking

Six Sigma makes ample use of benchmarking — a continuous practice of comparing your organization’s processes with those of your competitors, noting what it takes to be the best and what it takes to get there. Companies must determine which type of benchmarking they wish to perform:

- **Internal:** Comparing common processes among diverse functions within a single company (for example, how effectively orders are processed).

- **Competitive:** Looking at direct competitors and their processes, measuring levels of customer loyalty, customer service and market share. This reveals what customers value most about your goods and services and how well your customers think you are doing in the areas that matter most to them.

- **Functional:** Focusing on the process itself, and organizations with similar processes, regardless of industry.

until after the fact. Thus, while specific problems can be fixed, defects continue to appear sporadically over time. The company will not be able to improve its quality until it has identified the systemic problem: a QIS that delivers a posteriori data. Once it recognizes that the issue is system-dependent, it can find a solution (for example, an in-process quality measurement system).

- **Define Six Sigma projects to resolve operational issues.** Choose projects carefully. Six Sigma projects are usually identified and selected based on whether the project will save costs, is connected to operational issues with larger critical-to-quality (CTQ) issues, is connected to the operation of a business support system, and can proceed in a time-efficient manner.

- **Measure performance of Six Sigma projects.** Quantitatively gauge how well projects progress, in both an absolute and a relative sense, collecting and analyzing data at the appropriate business levels.

- **Analyze project performance in relation to operational goals.** Compare the performance of a number of Black Belt projects with the operational goals of your business, and investigate the relationship between cycle time and quality.

- **Improve the Six Sigma project management system.** Say, for example, that a business is tracking the savings generated by a project. At this point, it might start comparing projected and actual project costs. Or it might want to track other variables, such as net savings or project completion time.

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The Three Levels of Breakthrough: Business, Operations and Process

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● **Control inputs to the project management system.** Institute regular audits of the project management system, ensuring standards are established and consistently met.

● **Standardize best-in-class management system practices.** Once you have uncovered a best-in-class management practice, make it a standard and transfer that standard to all relevant sectors in the business.

● **Integrate standardized Six Sigma practices into policies and procedures.** Institutionalize your Six Sigma practice into the fabric of day-to-day operations, interweaving the practice into operating policies and procedures and reinforcing them through rewards and recognition.

Process Level

Black Belts focus on processes, working to recognize poor processes that result in problems, additional costs and eroded quality. Their role in applying the Breakthrough Strategy is as follows:

● **Recognize functional problems that link to operational issues.** Break down errors in an effort to recognize the interrelated problems that cause them. Note the hierarchical nature of these process problems — in other words, how *process* problems connect to *operational* issues, which are, in turn, tied to support systems that link to *business* issues such as customer satisfaction and profitability.

● **Define processes that contribute to the functional problems.** Determine whether the functional problems you have are related to products, services or transactions. Create process maps, breaking down necessary processes into individual steps, events or activities, to effectively search for solutions to problems.

● **Measure the capability of each process that offers operational leverage.** Express how well each process is performing, in the form of a measurement, noting the CTQ characteristics of each element, and its impact on the business.

● **Analyze the data to assess prevalent patterns and trends.** Determine the relationships between the variable factors in the process and determine the direction of improvements.

● **Improve the key product/service characteristics created by the key processes.** The Black Belt must focus on CTQ characteristics inherent in a product or service and then find ways to improve the capability of those characteristics. This is done by screening for variables that have the greatest process impact and establishing operating specifications for each.

● **Control the process variables that exert undue**

influence. Process improvement is sustained by implementing measures that control the key variables. Note the difference between controlling the variables and merely monitoring them — you must address these variables *before* they contribute to problems, not after the fact.

● **Standardize the methods and processes that produce best-in-class performance.** Promote and standardize the Six Sigma methods that produced optimum results, as well as the optimized processes that result in exceptional performance.

● **Integrate standard methods and processes into the design cycle.** Don't create new processes for every new design or evolution in an existing design; make changes to the design itself to maximize efficiency.

The Breakthrough Strategy is designed to ensure that companies apply its precepts in a disciplined, methodical way; doing so at all levels ensures “leveraged” success. ■

Implementation and Deployment of the Strategy

To achieve Six Sigma, companies must determine how to focus and deploy the Breakthrough Strategy so that

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What Black Belts Need: The Psychology of Six Sigma

Black Belts, who shoulder the bulk of the responsibility for Six Sigma project work, must be properly motivated to reach the levels of achievement expected of them. Here are some ideas:

● **Compensation.** Compensation and reward mechanisms send a message to employees about the worth of the Black Belts to your organization and its Six Sigma endeavors. GE's Jack Welch ties 40 percent of bonus compensation for managers to the intensity of their efforts and measurable progress toward Six Sigma quality in their operations.

● **Promise of Promotion.** GE's ranks of general managers, directors and vice presidents are full of Six Sigma leaders — Black Belts who proved their worth to the organization and were rewarded accordingly.

● **Recognition.** Motivation is highest when success is acknowledged. Verbal and written recognition is inexpensive and simple, whether done privately or in an open and public manner.

● **Permission to Fail.** Most Six Sigma-conscious CEOs view mistakes as tools for the personal growth of both the Champion or Black Belt, and the organization, as it works toward Six Sigma status.

Implementation and Deployment of the Strategy

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key business priorities and strategy issues are sufficiently addressed. The approach that one company takes in this endeavor might differ from the approach another takes, but one component is constant: All implementation and deployment strategies must flow down from the executive leadership. Six Sigma is not a “grassroots” initiative.

Among the many factors you will need to address prior to implementation and deployment are dependencies, structure, focus and project selection.

Deployment Dependencies

Successful implementation of the Breakthrough Strategy depends on an interaction of several principles, among them:

- Active, visible, top-down leadership.
- Metrics that accurately track the progress of the initiative, weaving accountability throughout and providing a tangible picture of the company’s efforts.
- Internal and external benchmarking that provides an honest assessment of the organization’s true market position (the recognition of which may be termed a “significant emotional event”).
- “Stretch” goals that focus on significantly changing, rather than “tweaking,” existing processes.
- Sufficient and pertinent training at all levels of the organization.
- Champions and Black Belts that promote and carry out the initiatives at all levels of the organization.

Creating Focus

How a company decides to focus its Six Sigma projects directly influences the way Six Sigma is deployed. Companies can focus their efforts on any number of factors, including the following:

- **Cost Savings.** Using this factor, a company can determine the number of projects it needs to complete to save a specific dollar amount. There are limitations inherent to this approach; it is, for example, difficult to establish a new mindset about quality within the company when the dollar figure is the focus.
- **Deliverables.** Identify the product family or system that is both of utmost importance to your company, as well as being the greatest cause of poor customer satisfaction. The danger in this focus is that your defects become more important than the processes or systems that create the product.
- **Processes.** This is the best way to attack the root causes of defects and customer concerns. It requires strong cross-functional coordination — correcting a

GE: A Six Sigma Success Story

When GE CEO Jack Welch first considered implementing the Breakthrough Strategy in 1996, he discovered the company’s operations were running at somewhere between three and four sigma, or about 35,000 defects per million — a number consistent with the defect levels at most successful companies. At a company the size of GE, that translated to a cost of \$7 billion to \$10 billion each year in scrap, reworking of parts, and correction of inefficiencies.

Welch committed the company to reaching Six Sigma status (3.4 defects per million) by the year 2000. Recognizing that the initiative would go nowhere without training and vision, he committed an astounding \$450 million in 1996 and 1997 to train 5,000 executives and managers and 80,000 engineers and other employees in the Breakthrough Strategy. Welch also made Six Sigma training a requirement for any kind of advancement at GE.

The company used Six Sigma strategies to poll customers on the most critical-to-quality (CTQ) measurements of their business. It also used the Breakthrough Strategy to raise the quality of their service divisions, such as Capital Services (where Six Sigma efforts helped achieve a 62 percent reduction in turnaround time for repairs) and international divisions like GE Aircraft Engines (the Canadian division that reduced border delays by 50 percent through following the Breakthrough Strategy).

The result: In 1998, revenues rose 11 percent, to \$100 billion; earnings increased 13 percent, to \$9.3 billion; working capital turns rose from 7.4 percent in 1997 to 9.2 percent. Even more encouraging, though, is the company’s continued eagerness to invest in its most important asset — its intellectual capital — and the resulting dedication from its employees to achieve each new challenge and objective.

process in one division almost always has applications for other divisions within the company.

Structural Elements

How a company organizes the personnel involved in Six Sigma projects depends on how it’s focusing its deployment, as well as how Six Sigma is integrated into the organization — whether resources are freed up to focus solely on Six Sigma concerns. There are a number of concerns that must be discussed and decided upon prior to launching Six Sigma projects:

- **Black Belt selection.** Who chooses Black Belts and what criteria must be used? How many Black Belts does the endeavor require? How will Black Belts be recog-

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Implementation and Deployment of the Strategy

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nized and rewarded for their efforts?

- **Project selection.** What criteria must be met to engage or terminate a project? Who will sign off on projects, and what criteria will they use?
- **Metrics.** Which metrics will be standard across the company? What improvement goals will the company set?
- **Coordination.** How will Six Sigma be coordinated with other organizational endeavors?
- **Budget.** How will the company handle budget issues, such as whether the salaries of Black Belts are categorized as direct or indirect costs?
- **Training.** How will the company train its Master Black Belts to deliver Black Belt training? What guidelines will be used for Black Belts to select and/or mentor Green Belts?

Project Selection

The key to good project selection is to identify and improve those performance metrics that will best boost your company's financial success and impact its customer base. Projects can be measured through the following key metrics:

- **Defects Per Million Opportunities**, or the total number of defects per unit divided by the total number of opportunities for defects per unit, multiplied by 1,000,000.
- **Net Cost Savings**, or the verifiable reductions in fixed or variable costs.
- **Cost of Poor Quality**, or the cost (in scrap, rework, warranty claims or returned material) of failing to produce 100 percent quality the first time through.
- **Capacity**, or the number of good units a process is able to produce in a given period of time.
- **Cycle time**, or the length of time it takes to produce a product or service. ■

Preparing an Organization for Six Sigma

One thing Six Sigma mandates above all else is change — the movement from often deeply held behaviors that do not deliver quality to different behaviors that all but guarantee it. This often clashes with company cultures and subcultures that are resistant to change, when the old, paternalistic ways of doing business fall in direct conflict with a new reality. Individuals who have done the same job successfully for many years may feel the need (or the entitlement) to cling to the

Polaroid's Project Selection Criteria: A Snapshot

Polaroid's endeavor to reach Six Sigma quality levels by 2001 is one of the most remarkable case studies in implementation of the Breakthrough Strategy. One reason for this is the criteria by which Polaroid Black Belts (or, in the company's parlance, "Variability Reduction Leaders") select projects. The company breaks its criteria into three primary categories:

- **Low Yield Rate.** When one or more of the company's processes produce low yield on a continual or unpredictable basis.
- **Cost of Poor Quality.** This criterion measures products and processes that require continuous and unusually high levels of inspection or quality-related intervention in order to deliver products or services to the consumer. This factor can be compared against revenues to determine the need for a Six Sigma project.
- **Capacity.** Undercapacity means that a company does not have the facilities, tools or human resources to produce products on time. While this hasn't been a concern for Polaroid to date, the company feels it is an appropriate criterion for selecting a Six Sigma project.

past. If it ain't broke, the thought goes, why fix it?

To achieve Six Sigma, your company must endure extensive psychological changes, entrenching the quality improvement efforts into a progressive corporate culture over an extended period of time (at least five years, as the authors have discovered). Your company might be using traditional metrics (such as first-time or final yield) to measure quality, but those metrics often focus on previous performance, rather than proactively preventing mistakes from recurring.

Six Sigma shows companies how inadequate such metrics are to get to the heart of problems and disconnects that cost significant amounts of money without management even realizing it. Often, it shows companies just how "average" they are.

As is the case with so many other aspects of Six Sigma, one of the best illustrations is that of GE. Jack Welch believes only true believers and visionaries ("A" players, in company parlance) have any business being in leadership positions in GE. In order to get people involved in Six Sigma — to cultivate Green Belts and Black Belts — you must first have forward-thinking executives and senior managers on board in leadership roles, to evangelize the Breakthrough Strategy and motivate people to implement its precepts, and to embrace change at every level. ■