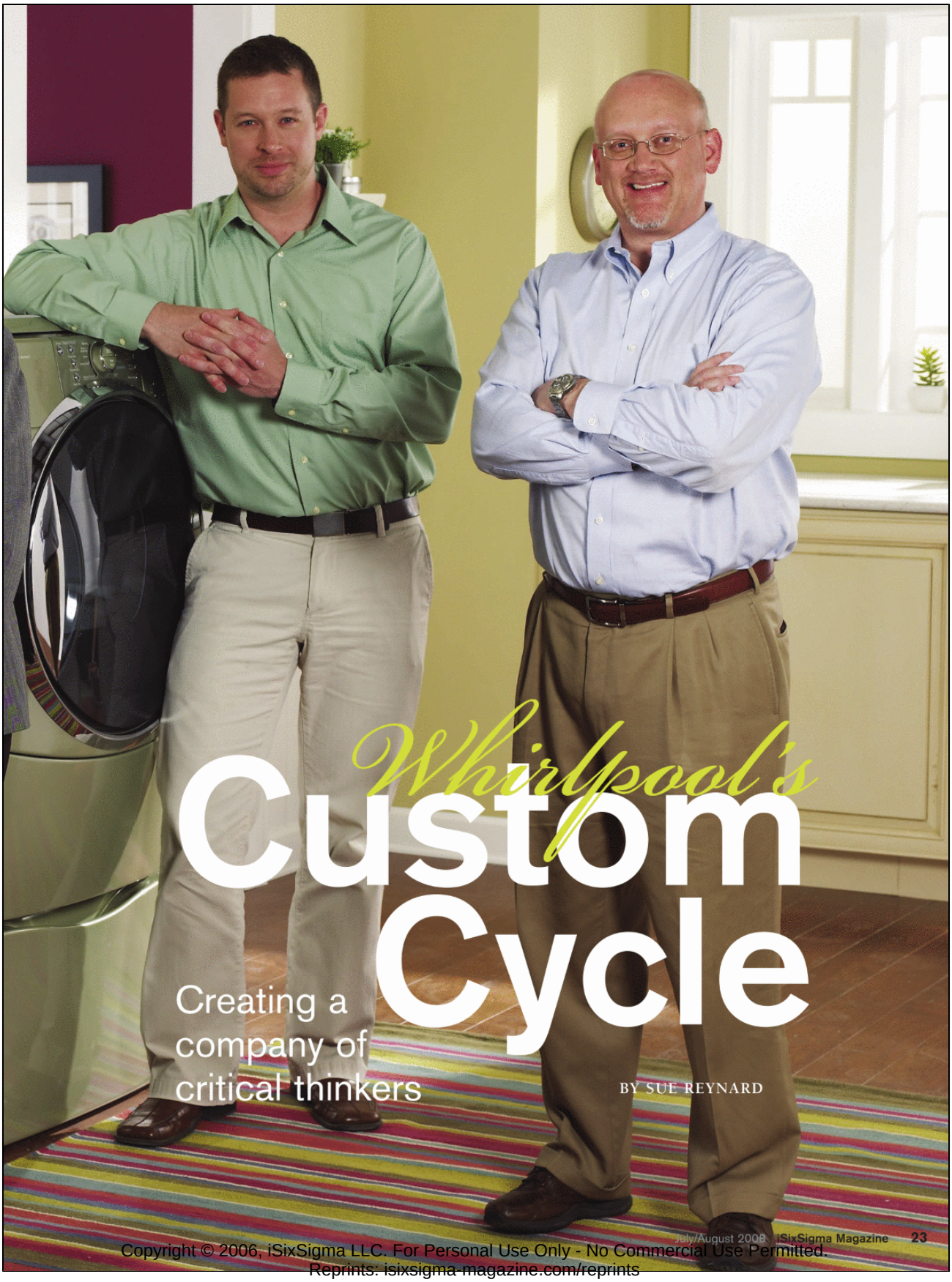

Whirlpool's Custom Cycle

Creating a company of critical thinkers

BY SUE REYNARD

In the past 11 years, Whirlpool has dramatically increased its rate of introducing new products and new features in all its product lines.

When the world's largest manufacturer of home appliances deployed Six Sigma in 1996, it made the strategic decision not to use a DMAIC-based model. Instead, Whirlpool Corp. adopted the Plan, Do, Study, Act (PDSA) cycle, reasoning that the older, more flexible improvement approach was a better fit for its operations.

"We can't use improvement techniques that only let us tackle narrowly scoped problems," said Master Black Belt Jennifer Eckroth, who is a senior deployment manager in the transactional improvement program. "We need to be able to develop systems that can address large problems that have a huge potential impact on the future of the company," she explained. "What we really wanted was to develop our engineers as critical thinkers."

PDSA is a key component in Operational Excellence (OpEx), Whirlpool's custom brand of Six Sigma that helped the company rebound from a sluggish period and now helps keep it at the top of the appliance market.

A Needed Breakthrough

"It was a tough operating environment," said John Kerr, general manager of Whirlpool Global Quality, recalling the stress the company was under in the 1990s when economic conditions were much like they are today, with market slowdowns and volume reductions.

"I was an engineer at Whirlpool back in 1995, and it wasn't a lot of fun," agreed Ken Austin, now a Master Black Belt with Global Quality.

Whirlpool did not have a good track record of being able to respond to tight economies. Neither of the company's two biggest metrics – total cost productivity (net improvement in cost year after year) and total cost of quality – had changed significantly in years. "We were in a steady state," Kerr said, "and we couldn't continue that way." The company needed a breakthrough.

"We had a senior VP [vice president] named J.C. Anderson at that time with a lot of credibility," Kerr continued. Anderson did a considerable amount of benchmarking in the field, looking at companies such as AlliedSignal, and then came back with a proposal. "He told our chairman that he recognized we were in tough times but he wanted to make a $10 million investment in Six Sigma, and would guarantee a 10-to-1 return," Kerr said.

Ultimately the chairman agreed – and Whirlpool hasn't looked back.

A Different Approach

But the company's approach to Six Sigma differed in three ways from what might now be considered standard deployment models. First, although a typical four-weeks-over-four-months training model was used for Black Belts,

Company Profile

Company name: Whirlpool Corp.

Headquarters: Benton Harbor, Mich., USA

Founded: 1911

Number of employees: 73,000+

Global presence: North America, Latin America, Europe, Asia and Africa

2007 revenue: $19.4 billion

2006-2007 increase in revenue: 7 percent

Primary business offering: Home appliances

U.S. brands: Whirlpool, Kenmore, KitchenAid, Maytag, Jenn-Air, Amana, Roper, Estate

Website: whirlpoolcorp.com

the course combined both Six Sigma and Design for Six Sigma (DFSS) tools. "We never differentiated DFSS from Six Sigma/OpEx," said Glenn Clark, a senior manager of engineering in the simulation-based design group. "Our approach to learning was to teach people to ask the right questions and then match the tool to the question."

Second, the engineers who were trained to be Black Belts never left their regular jobs. "We followed the advice of our original consultants," Austin said. "They advised us to think of Six Sigma as a mentoring program, as a form of professional development for our staff so they could do their jobs better." What the company did not want was a SWAT team model in which Black Belts are dropped into a work area, solve a problem and then are moved to another area with other problems.

As a consequence, the Black Belt candidates were (and still are) handpicked, and are always considered part of their original departments. "That way our people can take back what they learn and use it in their everyday job," Kerr said.

Kerr credits early and continued management support at all levels of the organization, especially senior management, for Whirlpool's rapid success with OpEx. Every plant leader and technology leader in the company made a personal commitment to support the training and to provide the bandwidth for their people to do their work using the new approach – and they followed through on that commitment.

The final way the company's Six Sigma approach differed was the deliberate decision not to use a DMAIC-based model.

Standard Model Not a Good Fit

In explaining why DMAIC would not meet Whirlpool's needs, Austin said, "At a very simple level there are two different kinds of work – discovery work, where you have questions that need to be answered and knowledge to be gained, versus execution work, where you're converting that knowledge into an outcome. At Whirlpool we see those types of work very different in terms of the tools, techniques and talents they require," he said. "And we focus very heavily on discovery."

The Little Washing Machine That Could

The Whirlpool Corp. traces its origins back to 1911 when two brothers formed the Upton Machine Co. to produce electric, motor-driven wringer washers. Many incarnations and almost a century of growth later, most of the company's early competitors have long since vanished or been brought under the Whirlpool umbrella.

Almost from the beginning, Whirlpool has had a business relationship with Sears, Roebuck & Co., and still produces Sears' private-label appliance brand, Kenmore. In 1986 Whirlpool acquired the KitchenAid brand of high-end appliances, and in 1989 the Roper value-oriented brand.

Also during the 1980s, Whirlpool ventured onto the global stage; today, besides North America, the company has a presence in Latin America, Europe, Asia and Africa. Operational Excellence (OpEx) has been embedded into its operations worldwide, allowing key innovations and processes to be transferred across regions and brands.

In 2006 Whirlpool acquired the Maytag Corp. – the well-known "dependability company" – which started out making farm equipment in Iowa in 1893. The mega merger also made Jenn-Air and Amana part of the Whirlpool brands.

The two appliance companies had much in common, besides the obvious. "When we acquired Maytag, one of the key features of their LeanSigma program that we really liked was the combination of the Lean and Six Sigma competencies under one development program, for both their engineering and transactional sides of the business," said Blaine Rycenga, a Master Black Belt and senior manager with Whirlpool's OpEx program. "We had used this same combined approach when we developed the curriculum for our [customer-centered] OpEx program [for transactional processes], with very effective results."

Whirlpool had deliberately kept its OpEx and Customer-Centered Manufacturing (Lean) programs separate, choosing to focus on design in OpEx. Now one of the company's goals is to integrate Lean and OpEx.

"The current challenge," Rycenga said, "is to effectively combine these two competencies into one development program for the engineering folks, without losing the integrity and effectiveness of each separately.

"Essentially we are all after the same thing – eliminating waste. Combining these forces," he continued, "would allow us to share resources, take advantage of the efficiencies, and at the same time, send a consistent message throughout the corporation regarding the importance of both Lean and Six Sigma in everything we do."

Whirlpool engineers are implementing performance modeling right from concept selection and making use of virtual prototyping wherever possible, Ohme said. About 70 percent of the engineers are Black Belts.

Eckroth seconded that interpretation, emphasizing that the "underlying premise" of their model was to develop engineers with critical thinking skills. "We need…people who can attack problems that are big, ugly and murky, as well as problems that fit within a confined scope.

"Had we just given [the engineers] a roadmap that told them what tool to use when, that wouldn't have worked for us," she said. "We didn't want to give them too much of a cookbook. We wanted to give them the capability to make decisions based on the questions that needed to be answered, the knowledge that needed to be discovered, and what they uncovered through exploration."

More often than not there are several questions that need to be answered, added Blaine Rycenga, a Master Black Belt and senior manager with the OpEx program; many parallel paths need to be explored, each with its own discovery work to be done. "Regardless of whether the type of work was in product development, manufacturing or a business process that cuts across all these areas, Whirlpool needed an approach that was a natural fit with our objective of creating critical thinkers," he said.

The right approach, leaders concluded, was the PDSA cycle. (See "A Primer on the PDSA Cycle.")

"Using PDSA, we can tackle issues that are a lot less firmly defined than traditionally required for DMAIC projects," Eckroth explained. "What we teach people to do in the Plan phase is to think critically about what they want to accomplish, what questions need to be answered, and what methods are most appropriate for them. Then they're taught to go through a series of sequential PDSA cycles, to study and reflect on what they've learned versus what knowledge is still needed. If more knowledge is needed, they are taught to continue the PDSA cycles until the appropriate level of knowledge is gained."

Once adequate knowledge is obtained, the project can follow a typical execution-type project management path for implementation.

Eckroth thinks that having a flexible foundation has allowed Whirlpool to be more adaptable than other companies. "We've been able to embrace a lot of new techniques, such as Lean and robust design, and our innovation tools," she said.

Six Sigma in Design Processes

Whirlpool's first applications of Six Sigma were in design processes.

"Our thinking back in '96 was that we already had good management practices around product development processes like ideation and concept selection," recalled Clark, who speaks from first-hand experience. The company used Six Sigma to enable those tasks and get better answers to issues such as what design options to pick, he said.

Now, Six Sigma tools are a part of every phase of every design project at Whirlpool. The company looks to its customers to understand how they use a product in their homes and how it performs in different conditions, said Kerr. Then the engineers seek to understand the internal sources of variation in the manufacturing process. "When you fit those two pieces together…you have a product that meets customer needs and is robust to variation."

The choice of tool depends on the need. "If we need to have a new burner design or want to optimize flow in a system or determine which factors most affect glass breakage, we run designed experiments," Clark said. "If we need to better understand customer requirements, we'll use DOE [design of experiments]-based conjoint analysis." The latter helps engineers identify the critical

"We need…people who can attack problems that are big, ugly and murky, as well as problems that fit within a confined scope."

–Jennifer Eckroth

requirements up front, which lets them do more intense analyses on those factors throughout the design process.

Todd Ohme, a senior engineer in the global mechanical structures group, said Whirlpool is using Six Sigma tools as part of the systems design process. "These tools and methods help us understand and manage the complexity inherent in our engineering processes," he explained. "Systems engineering is a key enabler to our strategy. The implementation of DFSS methods is critical for us to understand the expected variation in our systems and support systems engineering." Engineers are focusing on capturing and managing requirements early in the development cycle and designing from the top down. "Along with performance requirements, we are also tracking business and stakeholder requirements, and using the entire set to evaluate our different design concepts," Ohme said.

Engineers are implementing performance modeling right from concept selection and making use of virtual prototyping wherever possible. For example, to optimize the performance of a clothes dryer, they can run a complex computational fluid dynamics analysis to identify the influential factors, and then use those factors in an analytical or physical DOE. "We are enhancing our existing engineering knowledge with advanced computer simulations in order to understand the physics of the system," Ohme explained. "You can use the best components, the best motor, etc., to pursue meeting select system-level requirements, but without a systematic process, the interactions between those components can cause challenges when trying to optimize an entire product."

Ohme pointed out that with more advanced analysis capabilities comes the need to process and manage more data. "By implementing [information-management] systems to handle this data, we are able to effectively verify that our designs meet the system-level requirements," he said. "Once in production, we can compare our process data with the original design intent to maintain the high level of quality our customers expect."

As a global company, Whirlpool has subject matter experts throughout the world who perform simulations and other analyses. The data-management systems are designed to promote a connected community, which can result in shortened development time and allow for better quality across the products.

Kerr added, "Without Six Sigma to understand the relationships and validate the simulation, our systems-based design work would all be theoretical." He expects this "virtual" use of Six Sigma tools in the design space to continue. "When we run any major new product development, platform update or system design project, we want to do as much as we can in the virtual world because it cuts design time and holds down costs," he said.

A Primer on the PDSA Cycle

It may seem hard to believe today, but there was a time when DMAIC was not the standard improvement methodology. Back in the early 1980s when the quality movement first began to take root in the United States, most practitioners were taught a simple four-step cycle called variously Plan, Do, Check, Act (PDCA) or Plan, Do, Study, Act (PDSA).

W. Edwards Deming, the quality pioneer whose work gave rise to much of what is practiced today, called PDSA "the Shewhart cycle," after Walter Shewhart, the father of statistical process control. Deming said Shewhart had been using the basic cycle for decades, and described it this way:

- **Plan** a change or a test, aimed at improvement.
- **Carry it out**, preferably on a small scale (now called "Do" the change).
- **Study** the results. What did we learn? What went wrong?
- **Act** to adopt the change, abandon it or run through the cycle again, possibly under different environmental conditions.

Deming was also fond of saying that the key in the Plan step was to have a *theory*, an explicit prediction about what was going to happen. Without a theory, there could be no learning in the Study phase because there would be nothing to compare the results against.

Practitioners who began working in quality in those early years view DMAIC as an elaborate version of PDSA. On a broad scale, Define and Measure describe work done to help develop a theory about a root cause of variation or other problem; in Analyze-Improve-Control, team members Do the change, Study the results and Act on what they learned.

PDSA can also be applied within each of the DMAIC phases – for example, Plan for data collection, Do the collection, Study the results and then Act to either gather more data or refine the team's knowledge.

The beauty of PDSA is said to be its simplicity and wide applicability – the very characteristics that Whirlpool found so advantageous for its Operational Excellence program.

"Oddly enough, creating virtual products helps our people understand what the machines will look and feel like," Kerr said. "They can see how the product's going to look, which gives our marketing people a head start."

Growth and Expansion

The focus on design in the early years of OpEx is not surprising given the ongoing demand in the competitive appliance market for new products and new features. All of the first Black Belts and Master Black Belts were engineers in the company's North American operations, and within just a few years, Whirlpool expanded the program to engineers in Europe, Latin America and then Asia.

The initial goal was to get 60 percent of the engineers through a four-week training program (one week per month). Black Belts who applied Six Sigma tools in their job for a year were then eligible to be considered for Master Black Belt candidacy.

"Our Master Black Belts go through two years of additional training under Glenn," Kerr said. "They continue to do projects, learn how to teach these methodologies and mentor others. As a result, their level of skills and knowledge are second to none." He noted that while Whirlpool used an outside consulting firm to deliver the first 14 training classes, since then, all training has been done internally by Master Black Belts.

The initial goal of training 60 percent of its engineers has long since been surpassed. "Today, about 70 percent of our engineers are Black Belts, which appears to be a stable percentage," Kerr said. "It's hard to go higher than that because we constantly have new hires and people moving into other jobs."

"We tracked every project...and we never had a problem generating more than 10 times the savings that we invested."

–John Kerr

At the end of 2003, Whirlpool expanded the application of Six Sigma – and thus Black Belt opportunities – by developing a counterpart on the transactional side of the business called ccOpEx (customer-centered Operational

Optimizing Refrigerator Door Design

One recent project that illustrates how Six Sigma tools are integrated into Whirlpool's design processes is the redesign of a double-door refrigerator. Material costs were too high for the three-year-old model, and in order to cut production costs, the company wanted to take a new look at the materials used.

The redesign was constrained by two key existing specifications for cabinet deflection and door drop; both are related to what happens when a fully loaded door is opened. The team also could not increase cabinet stiffness, which could potentially harm insulating capability.

To identify the most significant variables that affected door drop and material costs, the team used design of experiments (DOE) to structure computer simulations of the components. The analysis showed that by reducing the thickness of certain components – the compressor plate, deck reinforcement, bottom deck and front rail – material costs could be reduced without exceeding the door drop specification.

The DOE tests also revealed that the thickness of the outer paneling had the biggest impact on mass (and therefore material costs), but that reducing the thickness of the current design increased door drop beyond acceptable limits.

The most significant factor driving door drop was a screw that connected two components. The design team discovered they could offset the increased door drop associated with using thinner paneling by using two screws instead of one. That design change had two added benefits: It increased cabinet robustness and compensated for the loss of foam thickness that sometimes occurred because of manufacturing variability.

At the end of this process, the team had a refrigerator that was 26 percent lighter than before, which reduced the cost of material by 15 percent per product. The redesign saves the company $1.2 million per year.

Excellence). In developing the curriculum for ccOpEx, Whirlpool decided to blend the Six Sigma competencies of OpEx and the Lean competencies of its Customer-Centered Manufacturing program. Today, Six Sigma is being used in such areas as logistics, finance, marketing and sales.

"The continued demand for OpEx training is the best validation that we are on the right track," Kerr said. Whirlpool usually conducts more than 20 Black Belt classes worldwide every year. "We've been working hard on deploying Six Sigma around the globe and getting to a point where the whole company speaks the same language," Kerr said. "I think we've finally hit a critical mass worldwide."

All told, Whirlpool has trained more than 60 Master Black Belts and almost 2,500 Black Belts to date. "Our retention rate for [Master Black Belts] is about 95 percent, which I suspect is an unprecedented figure," Kerr said.

"OpEx is pervasive throughout the company," he summed up. "After 10-plus years, it is part of our DNA."

In addition, Whirlpool is carrying Six Sigma beyond the company, "doing more to work with our whole value chain," Kerr said. "We've trained 200 engineers at our suppliers' because it's critical that we be able to use those skill sets up and down the supply chain."

Delivering on the Promise

Metrics tell how well OpEx is working. The guarantee of a 10-to-1 return on Six Sigma that J.C. Anderson made to the company chairman back in 1995 has been fulfilled and then some. According to Kerr, Whirlpool has regularly exceeded that goal on all its projects. "We tracked every project by product type, engineers, business unit and so on," said Kerr, "and we never had a problem generating more than 10 times the savings that we invested in a project." The company's 1999 annual report cited $175 million in global manufacturing savings during the first three years of the OpEx program.

In addition, soon after the company implemented OpEx, its key business metrics began to improve significantly. "We've been able to drive net cost improvements in most cases year after year, despite increases in material costs," Kerr said.

Other improvements are harder to quantify. "What I can tell you is that in the past 11 years, our cycle times have really improved," Kerr said. "We have dramatically increased our rate of introducing new products and new features in all our product lines – front-loading washers, refrigeration, convection cooking."

Equally important, the company has maintained this higher speed of introducing new technology while maintaining or improving customer satisfaction. "Just look at any kind of consumer reports," said Kerr. "Our quality is still best in the industry. That's the best endorsement I can think of that our approach is working."

All this performance explains why OpEx gets such strong support from Whirlpool's executive committee and chairman. "Even through the ups and downs that every company goes through, we [have] never canceled a single OpEx training course since we began," Kerr noted.

A final indicator of success comes from Austin, the Master Black Belt who a decade ago was unhappy working as an engineer at the company. "Now, with OpEx, Whirlpool has become a fun place to do your job every day," Austin said. "I'm asked to use my talents to discover, innovate and continuously improve." ◆

"What we teach people to do in the Plan phase [of the PDSA cycle] is to think critically about what they need to accomplish, what questions need to be answered," Eckroth said.

Six Sigma Snapshot

Deployed: 1996

Number of Belts:
Black Belts: Approximately 2,400
Master Black Belts: 68

Projects: OpEx projects are no longer tracked separately

Sue Reynard is a freelance writer and a frequent contributor to iSixSigma Magazine.

For more information contact:

Bill Ross
Six Sigma Associates
303.494.8521
billross@sigma-science.com

Blaine Rycenga
Whirlpool Corporation
Blaine_J_Rycenga@whirlpool.com

Glenn Cark
Whirlpool Corporation
719.282.4077
glenn_a_clark@email.whirlpool.com

Ken Austin
Whirlpool Corporation
269.923.5055
Kenneth_B_Austin@whirlpool.com