Improving the way organizations run through participative planning and management.
Six Sigma: GE’s Tool for Process Management

Overview

General Electric is a large company. I recently moved from GE Capital Card Services to GE Aircraft Engines and will present that perspective on process management and process improvement.

Business process management at GE

GE Capital thinks of process management somewhat differently than other companies. They deployed a Business Process Management System that was really a mix of Six Sigma, ISO 9000, and process management. Its overall focus was on documentation: using a balanced scorecard approach, documenting core and enabling processes, and going through the four levels of documentation from the highest level to the lowest level for the creation of metrics. It will take time to import this Business Process Management System to GE Aircraft Engines. The challenge is to show what Business Process Management can bring to the bottom line.

GE’s focus in Six Sigma

GE, of course, is well known for using Six Sigma as a tool for business improvement. One of the things that helps Six Sigma work for GE is that we are very focused on the basic formula of $Y = f(\chi)$, a key concept within Six Sigma (output, $Y$, is a function of input, $\chi$). We talk about the difference between latent or output measures ($Y$), and the internal measures or the things that can be more readily controlled before it is too late ($\chi$). Our focus has evolved, from eliminating defects, to focusing on the end deliverable/product, to our present focus on the process and variation. We determined early on that we can move the mean of a distribution, but moving that mean does not attack what was most painful to the customer, which was the variation. Customers don’t measure us on our mean. They measure us on our variation because variation is what annoys our customers.

Six Sigma employee training

The Six Sigma methodology depends on people for successful implementation. We train individuals as Champions, Master Black Belts, Black Belts, and Green Belts. Black Belts are the driving force behind implementing the Six Sigma strategies. Black Belts must possess the Six Sigma knowledge and skills necessary to implement, lead, and sustain the Six Sigma initiatives in each area of the business. Master Black Belts lead, mentor, and coach many Black Belts and 100% of their...
Six Sigma employee training, continued

time is focused on Six Sigma process improvement. Master Black Belts receive approximately six weeks of Six Sigma-related training. Black Belts are also 100% dedicated to Six Sigma process improvement and receive approximately five weeks of Six Sigma-related training. Black Belts drive project results, through projects of their own and clusters of Green Belt projects. All other employees in the company are Green Belts. They have regular full-time jobs and responsibilities; however, now built into their job is the responsibility of continuous process improvement through Six Sigma tools and techniques. Green Belts receive approximately three weeks of Six Sigma-related training.

We're evolving now to recognize the importance of Six Sigma and process management at the individual, everyday level. Our training program for Green Belts is a mandatory condition of employment. A training database tracks every employee, and their training is not considered complete until the close of their first project. This project includes five formal presentations to senior management, at each of the stages of Define, Measure, Analyze, Improve, and Control (DMAIC). GE’s goal requires that each Green Belt complete at least two projects in each upcoming year, as a way to keep momentum moving forward.

Training Black Belts

The Master Black Belt and Black Belt organization is viewed as an opportunity to develop leadership. Top players from throughout the organization are selected for placement as Black Belts and Master Black Belts. Master Black Belts have key roles in the organization, working with the CEO and all of the vice presidents to create clusters, or subgroups of Green Belt and Black Belt projects that span the company.

Black Belts and Master Black Belts are seen as the driving forces, a SWAT team to be sent in wherever there's a big issue to be tackled, so they will often move between various functions. There are Black Belts that come from sourcing organizations (which is what GE calls its purchasing/procurement department) that may be trained in sourcing and may remain in the sourcing organization. But there might also be a Black Belt from an engineering background serving in an Information Technology (IT) environment or in a manufacturing environment.

Work Out

In 1988, GE became very focused on a process called Work Out, a five-step methodology that's still in use today. Basically, it is about eliminating bureaucracy and non-value-added steps. It fits well with GE’s overall culture because GE is very focused on numbers, the bottom line, and no nonsense in the business place. Step 1 links weak performance to unproductive work practices. Step 2 engages coworkers in the Work Out process. Step 3 reviews inefficient procedures and practices. Step 4 is where functional groups reach consensus on suggested changes. Step 5 presents recommendations to the boss and gets the boss to agree, reject, or assign responsibility for further study.

The mechanism within all GE businesses to know that what is coming from top management is actually being done is to count things. So if Work Out is our
How do we choose a project for Work Out?

There is a lot of discussion at the start of a process to determine if it would be a valid choice for a Work Out or if Work Out is the best methodology to use; there could be serious ramifications if Work Out is misused. The discussion must be very cross-functional in nature. All the stakeholders must be included so that there’s a voice from everyone who could be both negatively or positively impacted by that process change. There is an extra level of management that comes in to initiate Work Out and to provide another set of eyes to see the possible ramifications to workers and their areas.

One of the recommendations of the process is to reconvene the group at a later date to determine if the change is working, if we have seen the impact, and if it is working the way we had expected. If it is, then the lessons learned are captured. If not, then the process needs to be reworked again.

Learning the tools, building critical mass, and creating significant returns

Around 1996, we very quickly established a goal to become a Six Sigma company. One requirement toward accomplishing that goal was to put every employee through Green Belt training, i.e., three weeks of training on all the tools and statistics. This training mode—get the word out and put everyone through 100% training across the board—is a huge effort that requires a lot of investment. By 1997 we were starting to “Build Critical Mass” by training Black Belts and Master Black Belts. In 1998 it was time to see a return on all of this investment. All of the Six Sigma projects within GE businesses get unique identifiers, and these projects are loaded into databases. Since the 1996 rollout, Aircraft Engines has completed 25,000 Green Belt, Black Belt, and Master Black Belt projects that have delivered approximately $600 million to the bottom line of the company.

In their book Six Sigma: The Breakthrough Management Strategy Revolutionizing the World’s Top Corporations, Dr. Mikel Harry and Richard Schroeder stated:

General Electric’s Jack Welch, a self-proclaimed cynic when it comes to quality programs, describes Six Sigma as “the most important initiative GE has ever under-
Six Sigma: GE's Tool for Process Management

Learning the tools... continued

‘Taken.‘ GE’s operating income, a critical measure of business efficiency and profitability, hovered around the 10 percent level for decades. In 1995, Welch mandated that each GE operation, from credit card services to aircraft engine plants to NBC-TV, work toward achieving Six Sigma. GE averaged about 3.5 Sigma when it introduced the program. With Six Sigma embedding itself deeper into the organization’s processes, GE achieved the previously “impossible” operating margin of 16.7 percent in 1998, up from 13.6 percent in 1995 when GE implemented Six Sigma.¹

Making the customer feel it

In 1999, our customers said, “We see that your stock price is growing significantly, and we see that you’re doing really well with Six Sigma. Where’s our benefit?” So we really focused on “Make the Customer Feel It.” We started with the implementation of feedback mechanisms, with the customer helping us understand their measures, the ways that they view quality, and how variation affects them. By focusing on these types of things, we are better able to pass some of the benefit on to our customers.

Intensifying customer focus

In the year 2000, we will continue to “Intensify the Focus on the Customer.” We are sending our Black Belts to focus on customers: training customers in Six Sigma methodology, and having our customers talk to us about their measures. We’re doing more in the partnership piece to make sure that we’re really focused from the outside in.

Example: Wing To Wing

In response to customer feedback, we’ve developed a concept called “Wing To Wing.” While we were more focused on specific turnaround and cycle times, the customer focuses on the time the engine comes off wing to the time the engine is back on the wing, and the plane is flying again. “Wing To Wing” allows us to see firsthand how our processes impact their bottom line.

The business Y

Our mechanism of policy deployment, specifically within Aircraft Engines, are the business Y’s. Business Y’s are 9 or 10 critical key initiatives or goals for a given year. They allow us to knit together Six Sigma, all of the projects coming out, and the business directive. These critical areas might be short term, and center on time, inventory, inflation, or focus on customer satisfaction. Y’s are owned by Master Black Belts at a very senior level, who then talk with all the business leaders to show how current projects and activities relate to the strategic plan. The assignment of the Y to a Master Black Belt facilitates assembling a large group of Green Belts underneath to start the flurry of working those projects and activities. It appears chaotic from the outside, but it is working and delivering direct impact to the bottom line.

Keeping track of the business Y

A database helps to record which Y any of the 25,000 Green Belt projects is impacting. You can sort projects by the Y that they’re aligned to. Questions appear electronically if the data entered is not aligned to one of the business Y’s, if data is entered that does not have some kind of financial benefit, or to ask if the project is...
Keeping track of the business Y, continued
directly linked to a customer feedback mechanism. All of these questions provide continual reinforcement in the database to help control Green Belt project activity.

A Y is established for deflation
One of the goals that was handed down from Jack Welch for 1999 was adjusting or preparing for a deflationary period. We were facing a deflationary period, which means that if we're going to get less for our product, then suppliers were going to get less for their product. A Y was therefore established for deflation and assigned to a Master Black Belt. We scoured the company to improve processes and reduce supplier cost. We also aligned heavily on the Black Belt numbers associated with this key initiative. When deflation was established as an initiative, 50 new Black Belts were moved into the sourcing organization.

What are Stable Operations?
A concern we have is stability and creating focus on variation. One of the big pushes that we have now is called Stable Operations. This is GE proprietary and I cannot give any more detail in this area, but it's really focused on Q1 and Q3 from a box plot perspective, and looks at a stability factor for a process. Basically, Stable Operations states that if you have variation, don't get too focused on moving the mean. More focus should be placed on the span of the variation and those critical events causing that variation. It focuses on the outliers on the tail of a normal probability distribution to determine if there are other processes operating there, and what is driving that variation. It's a little counter-intuitive to GE's standard Six Sigma approach, which was too focused on moving the mean. Moving the mean is good, but customers don't feel the mean; they feel the variation.

New Product Introduction
To demonstrate Design For Six Sigma (DFSS), Aircraft Engines specifically has a process called New Product Introduction (NPI). It's a 10-tollgated methodology (Figure 1 on the following page) that is now used throughout the business, not just on engines and engineering but also in software development. This cycle has a set of deliverables within each of the tollgates. There are standard reviews in each tollgate with various levels of leadership, from a leadership team at the immediate level to a senior leadership team or a general management leadership team, depending on applicability.

Making Six Sigma the standard process
Operationalizing Six Sigma is a big focus right now. Black Belts may be mentoring anywhere from 100-200 Green Belts, to ensure we hit the numbers. Black Belts also focus on certain organizations and a set of Six Sigma goals. Those goals are assigned to the Black Belts who motivate the Green Belts and make sure projects get closed. All of this information is incorporated into an accounting system that then rolls up. The Black Belts meet their goals, the Black Belts' goals roll up to a Master Black Belt goal, and those goals roll up to a section leader's goal. Forty to sixty percent of a Vice President's incentive compensation is based on meeting those Six Sigma targets, so there is a very strong focus on it.
Every organization has anywhere from five to seven core processes. From within our IT organization, we know that Plan, Budget, Execute, and Support are our four core processes. Those processes then can be given owners at the very highest level, and metrics can be established. Our Process Councils can focus on these critical processes and allow the IT organization to focus Green Belt activities and continuous improvements around those core process areas.
CASE STUDY

**Six Sigma: GE’s Tool for Process Management**

**Auditing Six Sigma**

GE has a Six Sigma audit organization that reports information to the stockholders and to Jack Welch on a regular basis. There is an awful lot of communication that goes directly into our financial analysis, including the number of Black Belts and Master Black Belts trained, what they are focusing on, and the expected and actual project savings. We have to make sure that we go through a very rigorous process, because, on a routine basis, any Black Belt or Green Belt could be tapped on the shoulder and asked to report on a particular project and how the savings were achieved.

**Six Sigma is process management**

What’s interesting about the GE model is that Six Sigma is process management. It has a very heavy slant on leadership development and is very focused on the numbers. There are some drawbacks to that, of course, specifically in the areas of documentation and control plans. There are an awful lot of very excited, energetic people who run around continuing to fix things. Whether or not that’s really documented or can be stated over the long run is a concern, because those people are on to the next project or the next gain, and the projects that don’t show a direct bottom-line benefit don’t get any focus. Every business has some projects that really need to be done that just don’t show a dollar benefit in the short term. Unfortunately, these projects get pushed aside.

**Customer Focus**

The Six Sigma methodology is very focused on who the customer is, both internally and externally, and identifying what we call Critical-To-Quality (CTQ). GE is determined to find those CTQs that are most important to the customer and then to base process management and process modeling activities on those CTQs. We’re looking to focus on the processes that have the greatest impact on the customer.

In GE’s 1997 Annual Meeting, Jack Welch stated:

The best Six Sigma projects begin not inside the business but outside it, focused on answering the question - how can we make the customer more competitive? What is critical to the customer's success? Learning the answer to that question and then learning how to provide the solution is the only focus we need.²

We focus on customer CTQs as the Voice of the Customer, and we use the Quality Functional Deployment (QFD) methodology to gather customer CTQs. Sensing sessions, which partner well with our Work Out mentality, and focus groups, are used to determine what’s going wrong and to brainstorm some of the key issues in a particular process. This helps us to focus.

**Customer involvement and Work Out**

The Work Out mentality often has direct customer involvement. Direct customer involvement can be very good because the customer is in the room providing feedback and asking questions.

Work Out really is a blitz process improvement that can go as short as half a day or as long as three days. When you take a group of people offsite, they're com-
Customer involvement and Work Out, continued

 completamente empowered to look at the problems and issues, and make changes online in the process. Management enters at the beginning of the Work Out and empowers the group to determine how to make the process better. They return for a final presentation to hear the group’s conclusions, and can agree, disagree, or require more information. By and large, you get agreement to go forward and make the change immediately without going through a complete DMAIC cycle.

Work Out can provide quick solutions

The Work Out session can also provide a laundry list of quick fixes, as well as a list of more extensive Green Belt or Black Belt projects for problems that cannot be corrected by quick hits. Those quick fixes need to be very simple and very rapid to show everybody that we are very focused on making a difference.

For example, recently within IT we said: “Our projects are not on time, they’re over budget, and they’re not delivering the right level of quality. Let’s fix it.” This produced requests from many different directions for many different metrics. Project leaders began complaining that reporting data was taking up too much of their time, yet they hadn’t seen any results generated from all of their reports. A Work Out was initiated that included the project leaders and each person requesting project metrics. The Work Out team agreed there would be one scorecard, one central process owner, and one group that determined what metrics to collect and metrics would be collected only one day each month. There would also be no overlapping metrics. The results were 10-12 quick-hit decisions and a couple of projects that needed to be further defined. It was very well received and we made a big impact.

Dashboards as feedback mechanisms

Our “dashboards” provide us with customer feedback (Figure 2). They have dials and instrument panels that actually look like instrument panels from inside the cockpit of an airplane. The dials contain red, yellow, and green symbols that indicate how well we’re doing with our customers.

Figure 2. Customer Dashboard

Over a period of time we discovered there were problems associated with dashboards. They provided a good measure but it was too late. The dial may be
green, but the customer could be very unhappy with us because of a very recent problem. In the beginning, the customers did not define the dashboards. Consequently, companies such as Delta Airlines complained that the metrics created were not useful to them. We have since asked Delta executives to help refine those dashboards and they have been very happy to define what the metrics should be.

There are some very distinct differences within different GE businesses as to how they approach customer focus. For instance, given their industry, NBC and GE Capital have to be more customer focused. The Business Process Management System with all the mapping and linkages were much more important there, and were rolled out with a lot of emphasis. In contrast, the way that Six Sigma impacts the work that’s going on in Aircraft Engines is different, due to the slant of a manufacturing environment and strict dollar control and the culture of that particular business. Aircraft Engines has been resistant to customer focus in the past, activities that they haven’t had to do because of superior technical products.

Right now the Information Technology Services Department is focusing on metrics for customer satisfaction. We currently have seven measurements focused on service excellence. We have a list of seven questions we ask, to collect at least 50 data points per month for evaluation. This same type of thing is already happening with our Aircraft Engine customers. We now have a Master Black Belt who is focused on customer relations, and multiple Black Belts whose sole job is to determine how they can assist customers. They give presentations, help mentor Green Belts, and work on projects at the customer’s location. The information they gather is brought back into GE.

GE is really trying to increase the emphasis on customer focus. We are aligning more with customers, and bringing them in to tell us what their problems and expectations are. It is an area that is somewhat foreign to us and it’s something that’s going to increase in the future. It’s interesting, because given that the pendulum has swung so far on the cost side, there is a huge internal struggle between those working in customer focus and those who think it doesn’t matter because it’s not directly now impacting the bottom line or that you can’t show the benefit.

Process Mapping

Process mapping is an expected output of every Six Sigma project. In DMAIC, part of the Define and part of the Measure requires at least one-page process map to define the start, end, and boundaries of the project. There is also “as-is” process mapping and “to-be” process mapping that are used during the Improve phase.

Process mapping is essential for providing focus and clarity for process improvement, and you don’t truly understand a process until you process-map it. We use it at the project level to define the project boundaries. I don’t know how you do
Process simulation helps define a project, continued

Process simulation is an extremely powerful tool. It allows you to see the layout of processes, model the behavior and the characteristics of the elements, and then run a flow to determine results. You can do all kinds of “what-if” analyses that are amazingly powerful. It’s a great tool that’s not difficult to learn and not difficult to use. But process simulation is not for everyone, and the model is only as good as the assumptions that you plug into it. A bad assumption will result in a bad model.

Within IT, we were actually able to link process simulation to dollar savings. Remote diagnostic tools implanted in an aircraft engine send signals to report what’s happening within the engine. The process includes satellite technology, is very highly technical, and requires a lot of processing power. A one-page process map was created, filling in some process simulation characteristics of the way that this information behaved, to simulate how many servers of what power would be needed and where the bottlenecks were as information flowed through the system. We were able to actually show that two processors with a different database structure would perform better than one processor with a database structure and processing methodology that handled things in a different way. We could compare the options in a simulation environment and it turned out to be exactly what happened in the real environment.

Deployment charts allow you to see “who’s playing in the game” and to distribute the process steps accordingly. You can see from a process perspective when to get the CIO involved and when the customers are involved. It’s easy to analyze and circle the customer touchpoints. It provides great cross-functional alignment and understanding, because these processes contain different players across an organization who regularly see only their single input and their single output. Deployment charts really create a better understanding of the whole process.

The SIPOC model

The Supplier, Input, Process, Output, Customer (SIPOC) model is a standard tool in all of our Green Belt training (Figure 3). All Green Belts, Black Belts, and Master Black Belts have a basic understanding of this high-level process mapping tool. The tool allows users to draw the first process mapping box by beginning at the highest level. We use it a lot as a 10-minute exercise to define customers, outputs, processes, start and stop points, and critical measures. It’s the basic way we introduce all levels of people to process management and it seems to work well. It’s more conversational in manner than boxes, arrows, diagrams, or decision matrices. It’s an easy way to get people engaged in process analysis.
The SIPOC model, continued

GE Capital has a corporate license for All Clear and Optima software. The Black Belt organization is split down the middle; some decided to use All Clear and some decided on Optima. By and large, people found that Optima was very easy to use because the ramp-up time was almost zero. They could open it, start process mapping, and print something out 10 minutes later. We also use an Excel extension called Crystal Ball to do simulation.

Process mapping software

DPMO and Sigma

Comparing Sigma values can be misleading

Process Measurement

Sigma can be explained in a simplified way. The basic formula is the number of defects ÷ (the number of opportunities x the number of units). That result is then multiplied by one million to determine defects per million opportunities (DPMO). DPMO is then checked against a conversion table to get a Sigma value.

Sigma is useful in that it provides comparative numbers for communication by people from separate processes. However, the fundamental issue with Six Sigma is that the individual determines each value on a project-by-project, analysis-by-analysis basis. The first thing to be determined is the number of dimensions of quality, or how many CTQs will be measured on an element. But, given that you define what you measure on each element, you're completely in control of how Sigma ends up turning out. Whatever you decide to measure is what the Sigma value is predicated on. To increase Sigma, you could simply change the way you measure.
Comparing Sigma values can be misleading, continued

So it may be better to look at DPMO and how that value was calculated, rather than simply comparing Sigma values.

Within GE Aircraft Engines, we do not roll up the Sigma values. We use DPMO and DPMO reduction. One requirement of each Green Belt project is to determine the percent reduction of DPMO for each individual CTQ. Based on this reduction, dollar values saved are then determined by multiplying the cost per defect by the number of defects eliminated.

Six Sigma measurement

Process measurement can be difficult. Use of attribute vs. continuous data, noise factors, the Hawthorne effect, and sample size can all cause errors in the measurement process. A critical point, as stated by Dr. Mikel Harry, the founder of the Six Sigma Academy, is where the measurement occurs. Most companies are set up so that by the time the customer sees the product, it’s of high quality. A measurement of the Sigma value at the end of the process may therefore show a Five Sigma process. But an internal process evaluation of defectiveness, efficiency measures, and rework may show something quite different.

To avoid this miscalculation, we often used three separate Sigma values at GE Capital (Input, Process, Output Sigma). We took input metrics and determined the Sigma value based on the CTQs of the inputs coming in. Then we looked at cost to produce the product, and the inefficiency in the process. Our goal is to continually work improvement projects further back in the stream to get more preventative in nature with our measures.

Our Six Sigma process also requires discussion about the reliability and repeatability of that measure. We call it gauge R & R. If the measure is repeated, does it result in the same number? The operational definition becomes a factor, and is critical in determining what’s “good” in a level of “goodness vs. badness.”

The departmental Y

The business Y’s can be further refined or drilled down. For example, if there’s a Y centered on turnaround time, we can create a departmental Y that determines what that Y means to us and how our projects link to that Y.

Measuring service excellence

Within the IT Department we have a departmental Y that is centered on service excellence. We have many operational measures but now we’re thinking if we should have some service measurements as well. Operational metrics measure our ability to meet service level agreements. Service excellence measures how, the way in which we deliver.

We ask several questions to measure service excellence. (1) Do we communicate with our customers in a language that we both understand? (2) Do we obtain a consensus or simply dictate the process? (3) Are customers treated with respect? (4) Are they kept up to date on the status of the problem at hand? (5) Did we set realistic expectations? We’re measuring a combination of these elements to gauge how well we perform for each and every one of our products and groups.
GE Capital Corporate office requested Sigma values for all of the core processes in its businesses. A Sigma value that is determined for each core process is then used to determine how we can close the gap between projected and actual values. Conversations during reviews with corporate executives center on capability vs. production, and are used to rate processes at the highest level. The ratings are published and then compared with other business units. The businesses with the best Sigma values are the ones established as the benchmark and we are highly encouraged to leverage and learn from other GE businesses, no matter the industry.

**Problem Solving/Process Improvement**

Everything to do with problem solving at GE is under the umbrella of Six Sigma. It includes QFD, process measurement, and change acceleration tools. Internally, there's a Six Sigma University mentality and that step-by-step flow is our problem-solving process. At GE, Six Sigma methodologies and the problem-solving tool set are one and the same. There are no other methodologies talked about. We do differentiate between improving an existing process or using a different tool set to design a new process or reengineer a process, to be clear about where you should start. We cover every quality tool imaginable in Green Belt training.

We also have Work Out, which was really in vogue long before Six Sigma. It was very well received, to the point that some people want to bring it back as a way to get some quick hits and avoid an unnecessary, long-term, highly structured project. A Work Out project works best for a fairly small, well-bounded problem that focuses on a very specific piece of a process. It involves a cross-functional group of all the stakeholders. As the pre-work, you go through a list that clearly states the problem, the possible causes, what has been done thus far, and the measurement systems in place. This process provides answers that create a pseudo-charter that is then distributed.

Work Outs are very strongly facilitated. I would call it a blitz Green Belt project. It’s a systems approach with multiple processes banging at each other from different perspectives. We’ve used it to encourage cooperation between application groups and architecture groups. Application groups listen to a particular customer to determine customer needs. Architecture groups translate the Voice of the Customer into architecture. A conflict of customer needs vs. the cost of the architecture can arise. An interaction-based Work Out would allow the groups to brainstorm certain areas and list them out. Although the process map may not have been worked out at that point, the Work Out has fostered communication and started a process of adjustment or correction.

Sensing session are small group discussions that identify where to focus our Work Outs. For example, we can’t have an effective Work Out on a topic of deliver-
Using sensing sessions to focus, continued

ing software systems faster. The scope is too large and we would never reach an actionable quick-hit result. However, if we first held a few 1-2-hour sensing (investigation) sessions to identify the critical X’s or major roadblocks for why software systems are not delivered faster, we might find that “Scope Creep” and continuously changing requirements are specifically what is keeping us from achieving our goals. With that as our focus, we can hold a Work Out that will yield some quick-hit changes that will make a difference. Sensing sessions help determine what the problems really are. The tendency for a Work Out is to reengineer a whole development process. Sensing allows you to hone in on the major component of a process, and start to whittle away at what the issues are. Sensing sessions might give you a whole list of things that you might be able to do Work Outs on throughout the year.

DMADV

DMAIC is a continuous cycle that is used for improving a process that already exists. DMADV (Define, Measure, Analyze, Design, Verify) is better suited for a massive reengineering or brand new process. The QFD tool and Voice of the Customer come in much more heavily in DMADV than in DMAIC. The thought is that DMAIC should go faster because you’re starting with solid measures. Measures in DMADV are not necessarily the output of an existing process, but could be a decision to do more benchmarking, or a search for something brand new.

Every person is a process owner

Operationalization within our own department is currently focused on keeping Six Sigma going. Step 1 was to keep it simple for the average person. Every single person is a process owner so they need to identify customer CTQs and define the internal processes that drive those CTQs. A departmental manager with multiple practices needs to establish and monitor metrics and target levels for customer CTQs. They need to identify issues, analyze data, and implement sustainable controls.

This internal version of the Plan-Do-Check-Act (PDCA) cycle is done in an interviewing style. We’re taking less of a confrontational approach with operationalization than we did with the completion of Green Belt projects. We act as facilitators for section leaders, helping them to document the process or documenting it for them. We have a check list that shows the Six Sigma operationalization steps in detail, with bullets to show how to accomplish each step (Figure 4). We use this check list to do an assessment one-by-one to gauge whether or not we’re getting to operationalization.

Which approach works best to operationalize Six Sigma?

Initially, we said: “Six Sigma hits the bottom line and makes money. Let’s go. Launch projects!” We went in on a strategic mission to pull money out of this thing, and then we saw that this was really process management. Now we’re backing up to determine how to keep from doing Green Belt projects on the same thing repeatedly.

In hindsight I don’t know which approach I would take to start over again. A top-down approach requires more investment in people’s time and they can become
Every person is a process owner, continued

Which approach works best to operationalize Six Sigma?, continued

Linking lessons learned to dollars

bored with it before they get to a point that shows any return on their investment. However, the opposite approach starts in massive chaos, and forces you to take a backward approach to institutionalize the process. There are pros and cons with each approach.

I’ve been setting up the Process Councils to link the processes and define the process owners, but I am encountering resistance. People want to see this...
CASE STUDY

Six Sigma: GE’s Tool for Process Management

Linking lessons learned to dollars, continued

Information connects to dollar values. You have to show the link. People say that they don’t have time for their Green Belt project because it’s work on top of the work they already have. The reply is “Six Sigma is the way you work, and if you aren’t using that as part of your job, then you’re not doing your job.”

The idea now is to apply the lessons learned on previous Six Sigma projects to your job as a process manager and incorporate it into your work. We’re creating cluster managers and turning Green Belts into Black Belts by their understanding of how their work fits into Six Sigma. We’re having them create, and we’re doing this again based on dollars.

Benchmarking

GE is trying to evolve from the mentality that we are the benchmark. The belief is that if it’s not invented here, the product or procedure has little value. That’s hard to overcome. When you’ve worked at a company for a very long time, you can get very complacent.

One reason that I think benchmarking is not as big of an issue at GE involves market share. You can do a lot of things to gain market share, but that doesn’t necessarily mean that you’re the best process in that area. GE looks at the acquiring model as a huge growth potential, and if they find someone who’s doing a process well and they need it, they buy it. But the push to be “number one” is clearly a huge driver and it’s something that is communicated on an ongoing basis within every GE business.

One thing that drives continuous improvement is that you know there are no sacred cows in GE. You could be sold tomorrow. When GE exits a business, it’s not a matter of a communication that it’s gone wrong. Jack likes to ask, “Is your business number 1 or number 2? If you’re not today, do you have any short-term plans to get there? And if you don’t see a way to get there, would you enter that business again today if you weren’t already in it?” You have to face up to the obvious. It’s simply “are you providing the operating margin and how is this fitting in within our total portfolio of businesses?”

GE’s strategic planning rhythm is centrally controlled

From the corporate office down through each business, GE has the best strategic planning process I have seen. They have a rhythm. From the time you start in January to the end of the year, that rhythm repeats. Session One is a strategic planning session that projects the next three years out. It’s a grueling presentation that includes what your competitors are doing, where they are going, what you have done to them lately and what they have done to you lately, where you are likely to go, and what your operating margins are going to be. Session Two repeats that process in the fall, with 12 top businesses within GE hitting each other and sharing ideas. I think Jack believes that by running the business that way he’s got a handle on
GE's strategic planning rhythm is centrally controlled, continued

the environment, where we are going, and what we are doing.

GE, even though it's many separate businesses, is run very centrally from the corporate office. Process-to-process, it is run from the top down. The key elements are provided, the presentations come down, and everything else aligns with that. At GE, you will dot every “i” and cross every “t” as many times as you are asked and send it to corporate. That's ingrained in the culture.

Benchmarking within GE businesses

Leveraging from GE business to GE business is a base of Jack Welch's business philosophy. He has quarterly meetings with executives from each of the GE businesses. They showcase what they're doing and Jack puts out a directive, based on the best of the best. He also sets the direction every January by stating the priorities of GE as a business, showing who is doing it best, and aligning all businesses on these priorities. This theme is then followed up relentlessly.

Last year he started the concept of saying “the priorities of GE as a business are eCommerce, eCommerce, eCommerce.” In January 2000, he looked for what we’ve done and whom we have benchmarked. As one GE business begins to shine, it will become the standard that all other GE businesses will try to emulate.

The importance of external benchmarking

Once GE started to get more involved in Six Sigma and analyzing internal processes, we began to see the value of accepting that we couldn't know everything or be the experts in all of those processes. We began to hear talk from the top down about the importance of benchmarking. Benchmarking is a checklist item in the Six Sigma methodology. It's taught as part of the Six Sigma training. Black Belts and Green Belts are asked what they have leveraged from and what they will leverage to. There is a dual responsibility to show what you have learned and where that would be applicable.

eCommerce is changing competition and modes of thinking

Jack and his leadership team have brought people in to talk about supply chain management and eCommerce. They've done extensive studies with Dell and others about where we're at, where we should be, and where the whole industry is moving.

We're way behind where we should be with eCommerce. Granted, we'll say, “we should have been,” and we'll catch up and be fine. But, in my opinion, if we were focused a little bit more externally, we could have and would have seen these signals earlier on, and been much further than where we are today.

We're spending a lot of time on eCommerce. It's going to change the way we do business and it's going to make competition very different. It's a form of benchmarking that's getting us to think more outwardly than we ever have before.

How could competition change to affect our business?

With eCommerce changing business so drastically, we've discussed a concept we call "destroy-your-business.com." It is not a website, but it is more of a strategy or mentality. We've done a lot of brainstorming around who our current competitors
How could competition change to affect our business?, continued

are and what could change that would bring us down tomorrow.

    Presently, there are websites, such as “http://www.planeparts.com,” that gather up parts and compare GE parts to other parts. In this type of environment, we have to be real sharp about how our parts are superior to others and say that in terms that are directly meaningful and understood by the customer.

    I wouldn’t call it benchmarking per se, but if I look across the business units within GE, there’s always a position for business development. Business development is primarily a process of due diligence looking at companies, analyzing and visiting them, and following a very rigorous process to determine buy-out, partnering, or joint venture opportunities. From that perspective, I would have to say that provides a lot of very good information.

    We don’t have a market research organization, which is very different from what you see at other companies, but our Business Development Division is focused in that particular way. GE Capital also has a Risk Department. The Risk Department analyzed a lot of very highly technical information from diverse financial models and compared it to what’s going on in the industry. The Business Development and Risk Departments really make up a benchmarking component that is very strategic in nature, that is focused at the top level, not down at the individual process level. While we may not have Master Black Belts, Black Belts, and Green Belts benchmarking in the traditional manner, it is being done strategically from the top down. It’s then being rolled out as an initiative that provides goals and the impetus to go get them.

References

2. Ibid., p. 39.

Author information

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    Editorial assistance for this article was provided by Daniel Picard.
**Medtronic: Creating Customer-Focused Quality**

Gary Floss, Vice President, Corporate Quality, Medtronic, Inc., Minneapolis, Minnesota

Medtronic is a medical products company founded in 1949 by Earl Bakken. At fifty, Medtronic employs about 23,000 people and has approximately $5 billion in revenue. In 1999 the US Patent Office ranked it first in the world for the number of patents (960) issued for medical devices during the years 1969 through 1998. Medtronic was named to Fortune’s list of “Most Admired Companies” and Industry Week’s “World’s 100 Best Managed Companies” in 1998 and again in 1999. The world’s first wearable pacemaker, invented in 1957 by Earl Bakken, was designated an Electrical Engineering Milestone in 1999 by the Institute of Electrical and Electronic Engineers (IEEE). In 1999, the People’s Republic of China presented Medtronic its Marco Polo Award, their highest business award, for the company’s role in China’s economic and social development—Editor.

**Overview**

Medtronic’s mission is simple: restore people to full life and full health. Earl Bakken wrote the company’s mission statement in 1960 at the time of our first public stock offering. We have used this as our mission statement ever since. It has provided us a wonderful foundation upon which to build our quality processes.

**Customer-Focused Quality**

We call our overall quality process, or system, Customer-Focused Quality (CFQ). The CFQ system has three simple—but not easy—tenets:

1. Listen to the Voice of the Customer. This customer/market focus gives us a true direction. It tells us what to do.

2. Listen to the Voice of the Process. This process focus helps us continuously improve our business. It tells us how to do what we do.

3. Listen to the Voice of the Employee. This focus on our people enables and empowers the workforce to improve what we do and how we do it. In practice this requires a wide range of powerful listening posts.
Customer-Focused Quality, continued

We think of our company as built upon a three-legged stool: one leg is the customer, the second is operational excellence, the third our people. If we over-concentrate on one, and not on the others simultaneously, we'll lose our balance, and our future growth and survival are at risk.

CFQ delivers superior business results

The CFQ tenets are part of the glue that holds our company together. They have worked as a management model at the corporate and business unit level. Medtronic is extraordinarily decentralized and its business units are highly autonomous. And having grown both internally and through major acquisitions, the maturity of our quality processes varies. For example, we have business units ranging from Medtronic Physio-Control of Redmond, Washington, a Baldrige-based company that won the 1998 Washington State Quality Award, to a few divisions that have not yet implemented Customer-Focused Quality—and everything in between.

Renewal strategy centered on Baldrige model

In 2000, ten years after CFQ was inaugurated, our chairman asked us to review our CFQ strategy. Though CFQ has produced good results, there is variation across business units and we feel that we have reached a plateau in our deployment. The CFQ-Renewal strategy will be rolled out with Vision 2010, positioning us for the year 2010. The renewal strategy will be built upon the Baldrige Criteria for Performance Excellence.

The three tenets of our existing Customer-Focused Quality process align perfectly with three of the seven Baldrige Categories (Figure 2). The renewal strategy will incorporate the rest of the Baldrige criteria to augment those three tenets.

One of the first tasks of the renewal strategy is to build a deeper level of understanding about the key drivers in the Baldrige Performance Excellence model.

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Figure 2. CFQ—A Systems Perspective
Medtronic Performance Excellence Criteria, Based on Baldrige Model

[Diagram showing the three tenets of CFQ: Leadership, Strategic Planning, Customer & Market Focus, Process Focus, People Focus, Expanded Business Results, Information & Analysis.]
Renewal strategy centered on Baldrige model, continued

in all of our 23,000 people. The drivers are Leadership, Strategic Planning, and Customer and Market Focus. How we get things done is described by Category Five (Human Resource Focus) and Six (Process Management). Category Seven illustrates the expanded set of business results to measure the effectiveness and comprehensiveness of our performance management systems.

Duality of work principle

Everyone in the organization—from senior management to the shop floor—needs to understand that they must work both in the process and on the process. Most people say that they are overwhelmed by the number of things they have to do. We advise that in the prioritization of opportunities they have to find a way to work both in and on the process. Everyone must deliver results and figure out how to make the process better. It is management’s responsibility to create a work climate that makes it in people’s best interest to work on both.

To encourage people when they say they’re too busy, we try two approaches: (1) we teach them to recognize the difference between working in the process and on the process. And (2) we improve the “soft side” of the system—reward, recognition, compensation, promotion, job and position descriptions—to recognize the value of working on the process. It’s hard work, and there is no magic solution. We have to build a dialogue and use the language that persuades and influences management. [If you, our readers, have any good experiences on this, send your ideas and comments to the editor, and then we can run a dialogue.]

User-friendly Baldrige assessment

One tool to help people work on the process is what I call a user-friendly Baldrige assessment, which allows people to use the criteria without having to write a full-blown application. We’ve written a review form that contains 100 plus assertion statements that describe a 900 or 1000-point company. In general, we walk manage-
User-friendly Baldrige assessment, continued

At this point we explain, “Working on these prioritized themes is working on the process. Now you have to decide if you are going to redeploy or otherwise commit resources to improve.” When we coach teams, we point out that this is when they start to work on the process.

Understanding process vs. procedure

I believe that all work is a process, including the work of creative idea conception performed by knowledge workers, by artists, and by software or hardware developers. I’ve bit my lip many times when someone tells me, “My work is not a process.” I counter this belief by starting a line of questioning: “How do you do your work? Where do you get bottlenecked? What are your problems? What are your woes?” Once we begin discussing things that interrupt their ability to deliver, then we can help them understand that there are some repeating aspects to the work. If we can then remove the obstacles, performance improves.

When some people hear the word “process” they think “procedure.” People who hear process incorrectly think I’m putting their wrists in handcuffs, throwing them into a lake, and telling them to swim. What they are really thinking of is a procedure.

Part of the coaching we do is to explain the difference. Oversimplified, a process has a feedback loop. The process can be measured, and that information directed back into the process to improve the results. An auditor can come in and tell whether or not a procedure is being followed; that’s binary. But processes are on a continuum and are to be improved, not simply complied with in an all-or-none fashion like a procedure.

There is no one formula for building understanding of process. Medtronic is a very diverse company built from a number of core competencies and acquired firms, so we use many different approaches. Sometimes the concepts are quickly adopted, sometimes the change proceeds slowly.

Waterfall Model

We use our Waterfall Model, taken from the US Food and Drug Administration’s (FDA) Design Control Guidance, to look at product development and process design. When we design processes, the team has a set of user needs to address. The team needs to design it, verify it, validate it, and put it into continuous operation. There is a step to verify that we got it right when we translated customer
**Waterfall Model, continued**

Patient visits reinforce customer focus

Patient visits reinforce customer focus. During the presentations, the patients and their physicians, who accompany them, tell us their story and sometimes show videos of their circumstances before treatment. Last year, for example, we watched the story of a 51-year-old woman from Georgia who had severe tremors from Parkinson's disease. Her physician showed a video of the patient confined to her wheelchair before she was treated using one of our therapies, deep brain stimulation, to control the tremors. At the end of the video she trotted up on stage in person and did a pirouette. It was a very moving experience to see such a dramatic improvement in her health— and a powerful way to reinforce customer focus throughout the company.

Listening post process

Listening post process

Listening post process. Over the last several years we've worked on staying close to customers and improving how our businesses listen to the Voice of the Customer and to the Voice of the Marketplace. We define a listening post as any place were in touch with the customer, and where there is a stream of information coming in— from complaint management, to key opinion leaders, to advisory groups. We've found that our business units may have anywhere from 15 to 30 different listening posts.

We look at the people who own listening posts as process owners. Their process is part of what drives the development of products, the delivery of services, and the management of relationships. We are working to create feedback loops that feed customer information back into the business at the appropriate places (Figure 5 on the following page).

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**Figure 4. Waterfall Model, FDA Design Control Guidance**

![Figure 4. Waterfall Model, FDA Design Control Guidance](image)

**Customer Focus**

Customer Focus

Customer Focus. Every December, just before the holidays, and also on Quality Days within business units, Medtronic brings in several patients who have been treated during the past year with our products. During the presentations, the patients and their physicians, who accompany them, tell us their story and sometimes show videos of their circumstances before treatment.

Last year, for example, we watched the story of a 51-year-old woman from Georgia who had severe tremors from Parkinson's disease. Her physician showed a video of the patient confined to her wheelchair before she was treated using one of our therapies, deep brain stimulation, to control the tremors. At the end of the video she trotted up on stage in person and did a pirouette. It was a very moving experience to see such a dramatic improvement in her health— and a powerful way to reinforce customer focus throughout the company.

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**Spring 2000**

Listening post process, continued

We try to manage the Voice of the Customer as a macro process, using what we call a TV Screen to conduct interviews with listening post owners. [An example of this worksheet is shown as Figure 10]. It helps Medtronic appreciate the input, the value-added processes, and clearly identify whom they serve.

Most listening post owners have metrics around one or two items. Usually there is a metric on productivity (how much volume goes through at any point in time). Second, there is often a metric on cost (how well the budget is being managed). When we ask the next logical question, “How well are our processes serving our customers?”, we may find some listening posts coming up short.

Improving the Voice of the Customer process

We are interested in improving the listening post processes because without it, the right hand does not know what the left hand is doing in our business units. Such information streams have often been looked at in isolation. We want to aggregate the information, trend it, and review it at a higher level.

While there is some cross-fertilization in some of the business units, we have found some units where decisions made on the basis of one information stream were out of sync with input from another stream. We are trying to move the company away from the old practice where market research was done by one functional area and has not been effectively transferred to others.

In the past, when reviewing market research or customer satisfaction surveys, we typically saw one of two reactions. (1) If people agreed with the results, they’d pat themselves on the back and say we told you so. (2) If they didn’t agree, they’d rationalize it away. Today, we are trying to encourage people to be receptive to all of the information coming in. We’ve found that because we are a technically driven company, if we can bring in solid market research data, people will accept the input and change their assumptions or past understandings if those differ from the data.
**Exciting quality**

Changing unverified attitudes or assumptions is part of the next step in our renewal strategy, moving from a mode of satisfying “stated expectations” to a mode of creating exciting quality—valued but unstated expectations—and doing so systematically and routinely.

One of the tenets of CFQ is to have Medtronic’s processes and products not only routinely meet what the customers expect and rest of the market delivers, but also routinely exceed the customer expectations with performance that the rest of the market cannot routinely deliver. We use the Kano Model (Figure 6) to help people understand the relationship between the customer focus, the quality process, and exceeding customer requirements. The model shows how the innovative and exciting quality of today becomes the stated quality of next week, and becomes unstated—but expected—thereafter.

**Managing the customer relationship**

To make “exciting quality” routine, business units have to understand the breakpoints in customer behavior. What creates customers who are loyal for life? The
Managing the customer relationship, continued

Challenge is uncovering the quality aspects that are exciting and that delight the customer. There are crucial differences between a customer who is satisfied and a customer who is delighted:

Satisfied customers:
- Are vulnerable to prices or competitive offerings
- Have no organizational allegiances
- Have no tolerance for mistakes/problems or associated corrective action

Delighted customers:
- Resist switching
- Create partnerships—doing business together
- Tolerate corrective action

It is critical to understand what drives satisfaction at each step of the loyalty ladder (Figure 7).

Figure 7. Customer Loyalty Drivers

<table>
<thead>
<tr>
<th>Loyalty</th>
<th>Product Performance</th>
<th>Problem Resolution</th>
<th>Relationship Management</th>
<th>Each stage of satisfaction has different drivers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Highly Dissatisfied</td>
<td>2 Somewhat Dissatisfied</td>
<td>3 Neither Satisfied nor Dissatisfied</td>
<td>4 Somewhat Satisfied</td>
<td>5 Highly Satisfied</td>
</tr>
</tbody>
</table>

Tools for selecting improvement opportunities

Process Improvement: Developing the Context

While it is crucial for people to work on the process as well as in it, there is always competition for resources. Organizations need to create a systematic selection process to choose which of many processes ought to be worked on first.

Medtronic has identified a generic set of core processes (Figure 8 on the following page) and a set of tools for the selection of improvement opportunities. In general, projects that aim at the core processes assume higher priority than projects aimed at other processes. The actual improvement effort uses a systems map, shown in Figure 9 also on the following page. The systems map describes the social support side and the technical support side. Facilitators will lead the group through the map, asking where gaps exist. A number of issues usually emerge in the ensuing conversa-
Tools for selecting improvement opportunities, continued

This comment is a fairly high-level description of a process that is far more detailed, as Figure 8 so well illustrates.

If the group isn't yet ready for the system mapping approach, we'll start with a

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Figure 8. Core Process Model, Selection of Projects

![Figure 8](image-url)

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Figure 9. Systems Map Example

![Figure 9](image-url)
Tools for selecting improvement opportunities, continued

Process Characteristic worksheet (Figure 10). This approach points out where we have inadequate knowledge about the “as is” condition of the process. In forty-five minutes to an hour, we can complete the worksheet, and with some follow-up questions, create better understanding about the group’s opportunities for improvement. We also coach teams to decide for themselves on the screening process to select individual projects.

Figure 10. Example of Process Worksheets

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Customers:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Commerce clearing house</td>
<td>• Physicians</td>
</tr>
<tr>
<td>• TAG resource library</td>
<td>• Nurses</td>
</tr>
<tr>
<td>• Medical directors</td>
<td>• Office managers</td>
</tr>
<tr>
<td>• HCFA</td>
<td>(billing staff)</td>
</tr>
<tr>
<td>• Outside consultants</td>
<td>• Technical Assessment Committees</td>
</tr>
<tr>
<td>• Neuro</td>
<td></td>
</tr>
<tr>
<td>• Tech services</td>
<td></td>
</tr>
<tr>
<td>• Clinical &amp; reg.</td>
<td></td>
</tr>
<tr>
<td>TAG</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Name: Therapy Access Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>t(start) = issue identification</td>
</tr>
<tr>
<td>t(done) = Solution developed and implemented</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Owner: Therapy Access Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Performer—</td>
</tr>
<tr>
<td>• Therapy Access Coordinators</td>
</tr>
<tr>
<td>• Therapy Access Analysts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance Measures for System</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Securing coverage &amp; payment</td>
</tr>
<tr>
<td>- Increase number of prior authorizations</td>
</tr>
<tr>
<td>- Increase level of payment</td>
</tr>
<tr>
<td>- Sales growth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Consulting services</td>
</tr>
<tr>
<td>• Reimbursement strategy</td>
</tr>
<tr>
<td>• Billing &amp; Coding</td>
</tr>
<tr>
<td>• Provider business dev.</td>
</tr>
<tr>
<td>• Written materials</td>
</tr>
<tr>
<td>• Presentations</td>
</tr>
<tr>
<td>• Telephone info line</td>
</tr>
<tr>
<td>• Prior authorization service</td>
</tr>
<tr>
<td>• Solutions</td>
</tr>
<tr>
<td>• Coverage policies</td>
</tr>
<tr>
<td>• Influencing payers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Frequency (Volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 staff, 8 hours, 100% customer dedication</td>
</tr>
</tbody>
</table>

Team dynamics

The saying, “A gathering of people is not necessarily a team” is true. It is as important to spend time on team dynamics as it is the analytical tools. We added a step in our problem-solving process that celebrates completion. It brings the “soft” reward system in line with the organization’s goals.

Creating good team dynamics begins with clarifying the various roles of the team leader, coach, and sponsor. The team leader’s role is to set the pace of the project, take ownership for moving the team to victory, and to act as the interface with the champion.

The coach or facilitator is the person who provides expertise on the tools, team skills, and will guide the team through the PDCA cycle. It usually takes two to three passes through the problem-solving methodology before everyone starts to understand the process. This is true, I think, because people have become accustomed to treating problems at the symptom level.

The sponsor identifies project goals and gives the team its mission. The champion relates the importance of the project to the most important goals of the organization. The champion selects/approves of the team leader, and removes any barriers the team may encounter, follows progress, and ensures that the problem is solved for good. Solving it for good means that procedures and systems are formally changed, along with necessary control mechanisms, to ensure that extra attention is not necessary to have the revised system perform at the improved level and that real
CASE STUDY

Team dynamics, continued

Institutional learning has occurred.

The sponsor makes sure the team refines their mission statement before they start spending resources and making changes. We want to make sure everyone has a clear understanding of the team’s purpose.

After doing so, then success is a matter of good project management—carving up the project into bite-size chunks and executing them. We advise that improvement efforts should last no more than four to six weeks at most. Beyond that, it is a project, not a team effort.

Teams also need to have a victory statement that ensures:
- the team agrees to do it,
- it is doable, and
- there is a date set for completion.

Why teams succeed or fail

The ingredients for a successful team are simple—
- Top management championship/sponsor
- Clear mission selected for focus/alignment on expectation
- Five to eight-member team representing all needed functions
- Management provides right resources
- Plan-Do-Check-Act—a closed loop, problem-solving methodology
- Results-oriented team technologies
- Management implementation of team recommendations
- Customer-centered culture that rewards teamwork.

I encourage management—especially senior staff—to publicly show their interest in what teams are doing. This is often difficult because calendars fill so quickly. But experience has shown that when management shows a personal interest, teams rally—and this rubs off on the entire organization.

Figure 11 shows some of the reasons why teams fail.

Baldrige model guides design of process measures

Measurement unites the critical parts together into the Baldrige model of Performance Excellence.
There is a saying, “There are only three types of leaders: Those who know the score and know they are winning. Those who know the score and why they are not winning. And those that don’t know the score at all.” We take guidance on our measurements from the Baldrige model (Category 4, Information and Analysis) to identify key measures and the reason for them. We have endorsed the use of a balanced scorecard, but our deployment throughout the company is not yet mature.

The Baldrige model (4.1) requires us to address:

- What operational measures should be used,
- Integration of measures to track performance,
- Use of key, comparative data and benchmarks,
- Reliability of data and information,
- Cost/benefit of improvement options,
- Data correlations/projections to support planning,
- How to keep the performance measurement system current.

We use case studies from our Star of Excellence Award system to address the Analysis of Organizational Performance (4.2) criteria, which ask:

- How do you ensure analyses cover the health of your organization?
- How do you ensure that organizational analyses and results are linked?
- How does analysis support daily operations and align with action plans?

We are trying to improve understanding of the difference between measures at the end of the process, and in-process measures, which really measure the “goodness” of other steps earlier in the process.

Too often, we have focused on lagging indicators. Now, we are trying to focus on leading indicators, for a more balanced look at the cause-and-effect reasons for our performance. This gives our senior leaders a different set of questions to ask. Figure 12 represents an example of how we chart lagging and leading indicators, and internal and external indicators.

Business units should position their key measures in the quadrants that form the pie. If the measures are all lined up in the lagging side of the circle, that shows that units are not balanced. This approach can be used at any level of the organization.

Ultimately, what you measure is what you get. When senior management asks the right questions, such as “With-
CASE STUDY

Leading and lagging indicators, continued

out counting defects at the end of the line, how do you know the process is performing well?” and allows operational time to improve those measures, the good results will follow.

Benchmarking

Benchmarking is a good shock treatment for organizational complacency. We like to remind people that if they don’t think externally and look at other organizations’ best practices, they’ll develop myopia. This is especially true of business units that are the leader in market share.

We do not have a common approach or formal structure for benchmarking at Medtronic. We invite our people to think of benchmarking as a continuum, from informal networking and real-time conversations to formal benchmarking, where there is a systematic analysis of company practices during a long-term, multi-site partnership.

Comparison vs. benchmarking

While there is value in each approach, we’re also trying to help our people understand the difference between a comparison and real benchmarking. A comparison looks at the numeric differences—the what. Benchmarking looks at the process and results—the how. Knowing HOW will explain why one organization is achieving better results than the other. Organizations need to understand their own process, as it is, and understand their competitors, before they begin to compare or benchmark.

Why? Because site visits without that beforehand knowledge are just expensive industrial tourism. So, one of our ground rules requires that teams really understand how the work is being done before looking elsewhere.

Forum groups and the Global Benchmarking Council

We have a long history—since 1978—of developing forum groups in a number of technical areas around the company. These forum groups invite outside speakers to share their knowledge and answer many questions from our own personnel. These groups shine a powerful light on our gaps and areas for improvement. We are trying to build a broader appreciation in our organization for organizational learning. We talk about it conceptually, but in practice we would like to develop a more systematic approach to learning, including benchmarking and process improvement.

In 1998 Medtronic joined an organization called the Global Benchmarking Council, which meets quarterly. The council invites member companies to share their best practices, and also invites guest speakers to present at these meetings.

Conclusion

We have a lot to learn, and a strong commitment to our customers that we will always be searching for a better way to bring them new and better products that can restore their full life.
Author information

Gary Floss joined Medtronic, Inc. in 1998 as Director, Customer-Focused Quality; he became Vice President of Corporate Quality in 1999. He was with Ceridian, formerly Control Data Corporation, for 30 years in diverse positions, including Vice President of Quality for Computing Devices International, and three years as Vice President of Corporate Quality. He served as a senior examiner for the Malcolm Baldrige National Quality Award for six years, and as a judge for three years, two years of which he was the chairperson for the nine-person panel of judges. Gary is also a member of the Board of Directors for the Minnesota State Quality Award, which is patterned after the Baldrige Award.

Editorial assistance was provided by Carolyn Field
AlliedSignal: Six Sigma Transformation

In December 1999, AlliedSignal and Honeywell merged to become Honeywell International Inc. Honeywell, with its 120,000 employees, is a $24 billion diversified technology and manufacturing leader, serving customers worldwide with aerospace products and services; control technologies for buildings, homes, and industries; automotive products; power generation systems; specialty chemicals; fibers; plastics; and electronic and advanced materials. Prior to the merger, AlliedSignal was led by Larry Bossidy who transformed the company into one of the world's most admired companies by implementing Total Quality Management practices, improving customer focus, and applying Six Sigma tools.

With the merger of Honeywell and AlliedSignal, the new Honeywell has created a powerful quality system called Six Sigma Plus, a fusion of Allied Signal’s Six Sigma strategic toolkit and Honeywell’s Malcolm Baldrige-based Quality Value assessment process.

This article describes the merged company’s approach to process management, and how it is continuing to utilize the Six Sigma toolkit to continue its growth path—Editor.

Overview

AlliedSignal referred to its improvement efforts as Six Sigma: it was our methodology for process improvement and our measurement of quality. AlliedSignal began the journey to Six Sigma in 1992 when Larry Bossidy created a vision: “We will be a premier company, distinctive and successful in everything we do.” The seven values—Customers, Integrity, People, Teamwork, Speed, Innovation, and Performance—were made visible in conference rooms and offices, and were heard in leadership meetings and training sessions. The vision and values became the foundation for the Total Quality program.

To kick off the program, every employee at every location spent five days in training, learning basic problem-solving tools and a common problem-solving model, methods of cycle-time reduction and defect elimination, teamwork skills, and empowerment. This new knowledge was transferred into the workplace by having existing teams come to the workshop with a work-related project to reinforce the use of the tools. Over the years more sophisticated methods were introduced, including the Six Sigma tools and techniques developed at Motorola, to focus on improving profitability. More programs were launched to build on the success of Total Quality: Total Quality Speed focused on cycle-time reduction, T QII on...
customer focus, Operational Excellence on manufacturing improvement, the Technical Excellence program on product design, and Customer Excellence on customers. We came to refer to all of our improvement efforts as Six Sigma. Figure 1 illustrates our journey to Six Sigma—it shows how each successive program moved us closer to our corporate goal.

Figure 1. AlliedSignal’s Journey to Six Sigma

Six Sigma has been defined as both a measure of quality and a problem-solving process. To deploy the process throughout the organization, Master Black Belts, Black Belts, and Green Belts have been trained to reduce variation in processes (administrative as well as engineering and manufacturing), reduce cycle times, lower inventories, increase output, and reduce scrap. These “Belts” also have the responsibility to complete projects critical to business results, as well as train and mentor others. Goal deployment (Figure 2) generates Six Sigma projects to align with

Figure 2. Business Objectives Determine Goal Deployment

Top-down deployment generates Six Sigma projects

Bottom-up review
Black Belts deploy program, continued
corporate, business unit, and site goals. 1998 results related to Six Sigma implementation were in excess of $2 billion.

Goals determine project selection
A goal deployment, or Hoshin Planning process, is used throughout many AlliedSignal Strategic Business Units (SBU), which results in the development of problem statements. These problem statements then become the basis for chartering Black Belt and Green Belt projects throughout the organization. The charter includes the financial impact of the project, customers and suppliers of the process, suggested team members, inputs and outputs of the process, a business champion, and a Six Sigma mentor. The selection of projects is important because the purpose of Six Sigma is to attack critical customer and process-related problems in the workplace. It is also important because the training received by Master Black Belts, Black Belts, and Green Belts is project-based. Six Sigma Councils or Leadership teams approve charters prior to scheduling training. Master Black Belts carefully review Black Belt projects to be sure they are linked back to business goals and are clearly defined. Black Belts review Green Belt projects the same way.

Learning and Six Sigma
Six Sigma and learning have become synonymous at AlliedSignal—one of our corporate goals is for all employees to complete 40 hours of learning per year. (Learning hours may be accrued by reading books, attending college classes, attending internal or external training, or working on a new project.) Another corporate goal is to have the entire salaried workforce Green-Belt certified by the end of 2000. To earn certification they must: (1) complete a chartered project demonstrating the use of Six Sigma tools learned in a training course and/or through on-the-job, just-in-time learning provided by the Black Belts, and (2) show quantifiable business results.

Taking Six Sigma to the next level
Now that AlliedSignal has merged with Honeywell, we will employ the Six Sigma Plus process strategy, which takes Six Sigma and adds Honeywell Quality Value with the aim to accelerate improvements in all our processes, products, and services.

Customer Focus
AlliedSignal works to develop customer focus in every employee at every level of the organization. The AlliedSignal Vision (We will be a premier company, distinctive and successful in everything we do) and Values (Customers, Integrity, People, Teamwork, Speed, Innovation, and Performance) state our commitment to customers and we reinforce it in many ways.

Our new employee orientation program includes a business simulation that helps employees learn to interact with their customers. The “Aggie Boat” simulation gets new employees involved in a boat-building exercise on the first day of training. In the beginning of the exercise total chaos occurs. No one knows what to do, work instructions are vague, the customer is the only one who knows what he wants—and
Developing customer focus at the employee level, continued

no one can talk to the customer but the supervisor. Throughout the simulation, a problem-solving process and process improvement tools (using The Memory Jogger™ as a reference) are used to emphasize the need to involve the customer in problem-solving activities.

Voice of the Customer processes

Customer focus is the major element of our Six Sigma Plus initiative. Black Belt and Green Belt training includes Quality Function Deployment and the Cause and Effect matrix, both of which rely on customer input.

At the business unit level, AlliedSignal relies on a variety of processes to glean the information we need to serve our customers. The sophistication of these processes varies from SBU to SBU. For example, at one of the aerospace sites all customer activity is entered into a customer database that is monitored on a daily basis. This database is used primarily for problem solving; customer concerns are recorded, along with the names of the action item owners, who are responsible for entering updates on all activities. The “Voice of the Customer” is used by sales and marketing to record customer input. Every quarter, sales and marketing gathers customer performance ratings. Independent research consultants also provide important input from customers as well as competitive market information.

Hearing the Voice of the Customer clearly

It is not always easy to discern the Voice of the Customer. Because many of our enterprises within business units are organized by product, they may all deal with the same customers. With each enterprise reporting on the same customers, it has been difficult to determine how satisfied any one customer is with our overall performance. There also exists a disparity in the customer satisfaction data that we collect, our research company collects, and our own hard data about customer problems. Because our company has grown so rapidly and acquisitions have brought many new systems, we have created systems that can’t communicate. Implementation of a common Enterprise Resource Planning (ERP) system is in process and will enhance our customer focus and supply chain efforts.

Process Mapping

Process maps provide insight into the problems of the process and can take many different forms—top-down maps, flowcharts, wall maps, thought process maps, or mind maps. When AlliedSignal began defining its core processes in 1993, teams created process maps of all the core processes. Teams created huge wall maps that extended all over office and conference walls. It proved very useful to walk people through the process to discover where there were overlaps and disconnects. This wall mapping was the foundation for cycle-time reduction efforts. Wall maps are based on the time needed to complete each process step. This made bottlenecks and delays in queues very visible.

Calculating throughput

At one time one of our sites was having a serious problem with customer
deliveries. Our metrics were horrible, the customers were unhappy, so improving customer satisfaction was our goal. We gathered a team consisting of members from the critical process areas. Our goal was to increase our on-time delivery performance to 95%. The team process-mapped their own internal process and established their internal delivery goals. When the team met again, each of the six internal departments came back with a process map and a goal of 95% on-time delivery from their process area. If you calculate the rolled throughput yield for 95% for six processes $(0.95 \times 0.95 \times 0.95 \times 0.95 \times 0.95 \times 0.95)$ to determine the yield of the overall process, the result would be 73.5%.

The calculation was a revelation to the team. Of course, we had to set more aggressive goals within each department to yield a 95% overall goal. The team saw the value of using process mapping to really understand linkages, overlaps, queues, and bottlenecks within internal processes, and the rolled throughput yield calculation highlighted the interdependence of all internal processes. This is the power of process mapping: it makes the workings of the whole process visible to everyone working in the process.

### Process Measures

Sigma is a metric we use to define the defect levels achieved in making products. Sigma levels can be customer, internal product, supplier, or design. A sigma level of six indicates that a product or new design has only 3.4 defects per million opportunities. Compare this to a sigma level of four, which means that for every million opportunities to “get it right,” there are 6,210 defects or opportunities “to get it wrong.”

To calculate sigma levels, you must consider three measures related to product quality: defects, number of units produced, and opportunities for making the product correctly. The calculation of sigma levels should not be confused with the calculation of a sample or population standard deviation. A formula is used to calculate the DPMO (defects per million opportunities). A standard table provides the conversion from DPMO to sigma level. [See Pamela Dunham's article, “Six Sigma: GE’s Tool for Process Management,” this issue for more information—Editor.]

### Process Improvement/Problem Solving

A step-by-step approach has become a part of the problem-solving activities at AlliedSignal. The Nine-Step Process Improvement/Problem-Solving Model was introduced in Total Quality training and continues to be utilized as an approach. The model is shown in Figure 3 on the following page.

The Black Belt and Green Belt training program simplified the number of steps of the process to five. Figure 4, also on the following page, shows the five steps of the model: define, measure, analyze, improve, and control. It provides us a road map to problem solving.
Rewarding teams and recognizing their contributions is so important that we made it part of our problem-solving model. Teams receive rewards and recognition as part of completion of their projects, and an annual Quest for Excellence is held to celebrate successes of teams and projects. Each SBU holds a series of celebrations and competitions throughout their sites and enterprises to select the team to represent them in the Quest for Excellence. Teams travel to various locations to hold an
Reward and recognition, continued

New employee orientation introduces benchmarking concepts

exposition and make a presentation about their results. A panel of judges selects a Premier Achievement Award winner, the team that most exemplifies our corporate values, and the attendees at the Quest select a People's Choice Award winner. The Premier Achievement Award winners from the Americas, Asia, and Europe attend a recognition dinner hosted by the company's chairman to recognize their contributions. The event is a special one for all involved—the team spirit and camaraderie is infectious and many teams vow to return the next year!

Benchmarking

Benchmarking is a formal way for organizations to compare their processes with the best processes of other organizations. It allows teams to learn from others and implement improvements. AlliedSignal introduces benchmarking during the new employee orientation program through a cycle-time reduction exercise using rubber balls to demonstrate concepts of baselining, entitlement, and benchmarking. The goal of the exercise is to demonstrate that while you can improve cycle time by simplifying an existing process, it sometimes takes benchmarking to redo the process to make dramatic improvements. It is recommended that employees who are considering benchmarking another company take a benchmarking class. They learn the following guidelines:

1. To identify targets of opportunity,
2. To do a cost/benefit analysis of the benchmark study,
3. To use a designed process to evaluate the benchmark to make sure that the team really understands what it is looking for (AlliedSignal does not have its own defined process; we leave that for the teams to develop.),
4. To understand the current process before they perform the study.

Internal benchmarking

The Internet is changing benchmarking dramatically by making it so much easier to learn about competitors and the marketplace by visiting their website instead of visiting their plants! By embracing benchmarking we challenge our employee's internal paradigms of process performance. We can then better understand opportunities and methods for improvement. Benchmarking helps us identify our own strengths so we can better use them. It helps us learn from the experience of others.

Bibliography


Author information

Linda Phillips is a Learning Leader at AlliedSignal, now Honeywell.

Editorial assistance was provided by Carolyn Field
Agilent Technologies, a company of 43,000 employees and nearly $8 billion in revenue, was recently spun off as a subsidiary of the Hewlett-Packard Company. The new company was formed from HP's existing instrument, measurement, components, and medical products groups. This article describes Agilent's quality system: how it evolved, how it co-exists with government regulatory oversight, and how it has become customer centered. This article was developed from a presentation made at a GOAL/QPC Learning Event—Editor.

Douglas Daetz, Project Leader for Customer-Centered Process Ownership, Hewlett-Packard Company, Palo Alto, California
John Hamilton, Quality & Regulatory Manager, Healthcare Solutions Group, Agilent Technologies, Andover, Massachusetts
Gary Hupf, Quality & Regulatory Manager, CSD, Agilent Technologies
Frank Smith, Total Quality Management Program Manager, Agilent Technologies
Fred Van Duesen, Quality System Manager, Agilent Technologies

The names and titles may be changing in Hewlett-Packard and Agilent Technologies, but commitment to quality remains fundamental to both companies. In HP's formative period, the years from 1939 through the early 1970's, quality was achieved by a "test-fix-test" approach. Products were designed for the engineer on the "next bench." Our customers were engineers and we understood their needs intuitively because we were a company of engineers. By the late 70's HP had deepened its understanding of quality and process management. And we began to learn how to market to a broader range of customers because the new opportunities for growth existed outside HP's traditional markets.

In the early 1980's we adopted what we called Total Quality Control (TQC), and implemented activities such as Quality Circles and the Plan-Do-Check-Act (PDCA) cycle in order to achieve continuous improvement. We also began to explore ways to better understand our processes and how to manage them, using process mapping and the techniques of process control. We tried to better understand our customers and their needs, and developed new ways to measure our customer satisfaction levels, both internal and external.

In the late 1980's HP developed its Quality Maturity System (QMS), which assessed the level of quality in a business unit around five dimensions: (1) the customer, (2) the planning process, (3) process management, (4) process improvement, and (5) leadership. By the mid 1990's our Quality Maturity System had
evolved into something very similar to a Baldrige Assessment Criteria. Then we sharpened the focus of our quality effort to become fully customer centered. The Quality Maturity System has now been renamed the Business Leadership System, shown in Figure 1 (Management System model). Previously we strove to build customer involvement, process management, and breakthrough planning. Now we look to build customer enthusiasm and loyalty. We now ask ourselves, “How are our actions influencing customer choices?”

The Elements of Competitive Success

Douglas Daetz—To help convince management teams to use QMS as their management system for improving the quality of their management (so as to improve the customer’s whole experience vis-à-vis H P as well as improve their organization’s growth and profitability), we have used various conceptual models and messages. One such model is called “Elements Needed for Competitive Success.”

The first version of QMS was very much like a TQC Audit, and informally we began to hear some negative comments. After we had begun implementing QMS throughout the company for a bit over a year, we surveyed the general managers who had had a TQC (QMS) Review to see what they thought of QMS and find out what they really valued in their organization. Five words frequently appeared in many of the answers: Adaptability, Initiative, Flexibility, Teamwork, and Accountability.

One of the reasons for H P’s success over the past 60 years has been our ability to attract people of high intelligence who have a lot of passion and will (that leads to commitment). These traits help generate initiative. To have accountability and
Adaptability, initiative, flexibility, teamwork, and accountability, continued

flexibility, you need processes that are defined, well understood, and managed. Processes are necessary for real teamwork, but so are interaction skills because now virtually every team, organization, and value delivery system is cross-cultural. And with good interaction skills added to intelligence, individuals and organizations gain adaptability. These four elements—intelligence, passion/will, process, interaction skills—are important because they interact, and enable the organization to be both dynamic and disciplined. Intelligence enables people to adapt to different circumstances, and to act with initiative. It enables a good understanding of processes—to understand what you can do—in order to be flexible. You really can't have accountability without process, nor can there be teamwork without process. Organizations need people with interaction skills in order to work harmoniously with one another.

Figure 2. Elements Needed for Competitive Success

<table>
<thead>
<tr>
<th>Intelligence (Genius)</th>
<th>Adaptability</th>
<th>Interaction Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiative</td>
<td>Flexibility</td>
<td>Teamwork</td>
</tr>
<tr>
<td>Commitment (Passion/Will)</td>
<td>Accountability</td>
<td>Process (Order)</td>
</tr>
</tbody>
</table>

Customer Focus

John Hamilton, Frank Smith—When we moved in the early to mid 90’s from a Total Quality Control approach to a customer-centered, value-delivery-system approach, we changed the questions we asked. Our TQC teams used to work from the following set of questions:

- Who are my customers?
- What are their needs?
- What are my products and services?
- How do I know I’m meeting their needs?

Now the questions asked are centered on value, such as:

- Who are the key customers across the value delivery system?
- What is the compelling value proposition for each key customer?
- What is the whole customer experience that fulfills the compelling value?
- How do we know we've provided value and gained customer loyalty?

Asking these new questions has helped us see the relationship between our partners, suppliers, customers, and ourselves.
Voice of the Customer informs the product generation process

The Voice of the Customer flows into the Healthcare Solutions Group process at two key points: first into business planning, our strategic planning process, and at product generation (Figure 3).

At the Business Planning point, we have relationships with people who are very influential in the industry. Panels of senior doctors at prestigious institutes advise us on a strategic level about the changes that are occurring in the industry such as medical treatment protocols. We are also able to bounce technical ideas off of them. Research companies such as Arthur Andersen and McKinsey help us understand what is happening in the marketplace. Business Planning then creates a portfolio of projects that are strategically positioned, which kicks off the product generation process.

At the Product Generation point, we receive input from primary and secondary market research and information on customer satisfaction. If partnerships are needed to generate products, these relationships are developed here. At one point in HP's existence, customer satisfaction metrics were our main focus; now it is one of several sets of customer input we use.

Understanding the whole customer experience

We did some work with the patient monitoring group several years ago in which we looked at what it was like for customers to work with HP. We looked at the whole experience, from selecting a supplier, through the ordering process, installation and set up, training for the actual application, product support, to the product's eventual disposal. Understanding the whole customer experience forced a shift in our thinking. It requires us to be really clear about what the experience is like for the customer, and to understand what is important to them.

A colleague in HP's Corporate Quality group put together what we refer to as...
Understanding the whole customer experience, continued

an “eyeball” chart to visually represent the connection between the whole customer experience and our processes. This chart (Figure 4) shows that we have a system of partners and suppliers, and that together we deliver value to the customer in all the different parts of the customer’s “life cycle” (e.g., choosing, ordering, using, supporting, disposing).

Implementing this approach is a big challenge for us, because we are built from many small sub-businesses. Even within the Agilent Healthcare Solutions Group, the ultrasound business is different from patient monitoring, and yet we often serve the same market. And within that market, there are low-end and high-end hospitals, each with its own priorities. High-end hospitals purchase more leading-edge technology, and drive where the market is going, but we still have to be sure that technology is viable across the whole customer base. (One approach we use to make this work is to offer a range of products with upward compatibility.)

Customer value delivery

For many management teams, there is a point in the planning process after they sit down and begin to map out the stakeholders and the key processes that they start to see the business in a different way. Before, they saw the hierarchical structure that supports it; now they see it as a system of collaboration that feeds into the whole customer experience. They really understand what it means to drive the process horizontally across the functional areas. This triggers a new way of thinking about how to improve our processes and the whole customer experience (Figure 5).
**Process Mapping**

Gary Hupf—Process mapping is one of the basic tools used for process improvement because it presents as visual information things that are not normally visualized. Placing all the elements of a process on a map (the sequence of steps and metrics) allows easy visual comparison and speeds analysis. Once a process has been mapped, teams can quickly identify ways to eliminate bottlenecks, queues, and non-value-added steps.

Recently I worked with a software product group, HP EEsof, to help them improve the renewal rate for their service agreements. HP EEsof creates electronic design automation software products used by engineers to design and simulate circuitry on semiconductor devices. The product was sold to chip manufacturers and design houses in the communications industry, along with a support agreement to make sure they received the latest updates of the software. The problem was that the renewal of these support agreements wasn’t happening. It wasn’t that the customers didn’t want to renew; they needed the updates to stay technically competitive. The problem was in our internal processes.

I brought together the people who worked on the process: division, sales, administrative, and IT people. They all did some small piece of the process, and they all did it very well. But although their metrics looked very good, less than 10% of the contracts were renewed on time.

We used the Rummler-Brache approach, a process improvement methodology designed for cross-functional organizational improvement. We began by creating a...
HP EEs of renewal process, continued

relationship map to describe who is involved in the renewal process. This determines how big the process is and what is involved. This helps us decide who is going to be on the team.

Mapping the way it really is

From there the team developed an IS map, which describes what is right now. The information needed to create the IS map is gathered by interviewing all the people involved, asking questions such as:

- What do you do?
- How do you do it?
- Where does it go?
- Where do you get it from?

When the IS map was completed, the team actually saw for the first time what was really going on. Oddly enough, the sales representatives thought that there was a process and so did the telemarketing group. When we walked through the process on the IS map, everyone realized that the process was broken in many different ways. Although HP EEs of was not a big business, there were ten pages of disconnects in the renewal process. The challenge in leading a process-improvement team like this one is that people want to talk about the way they think it works, rather than the way it really is. The value of process mapping is that by getting it down on paper, it brings people down to reality. From there, we worked to get the team to visualize the process as it should be.

Process mapping metrics

A key part of the Rummler-Brache method is that it addresses the metrics. Metrics are taken wherever there is a hand-off between different functions. At that point, there is an output and input, a customer and a supplier. (This methodology uses different terms to describe measures: process end-point measures are M1; step measures, M2; and substep measures, M3.) I don’t usually train teams to this level of detail. Our approach has been to have them show us what they do, and then we’ll create the maps to help them visualize the process. We use it as a tool to help teams change their awareness.

Root cause analysis

We then performed a root cause analysis to determine why the original process was in place at HP EEs of. It turned out that the IT system required it; the system wouldn’t let them do anything else. The sponsors had hoped that there would be a simpler solution, but when the team’s work was presented to them, they realized they would have to make an investment in the IT. Once they made that decision, we were able to implement the changes, and they eventually got the renewal rates they wanted.

Using process mapping

Although process mapping can be done quickly, it is exhausting because it requires deconstructing and reconstructing the process. Process mapping also works in other, less structured areas. Sales people, for example, may not think that they
Using process mapping, continued

Quality systems in a decentralized organization

Unifying diverse quality systems

The HSG quality system

Functional titles aligned with processes

Management’s role in developing process measures

Process Measurement

Fred Van Duesen—Agilent Technologies is built from many different smaller businesses and uses many different approaches. Within the Healthcare Solutions Group, however, we have a very structured way of operating. We are, of course, regulated by the FDA, and are required to follow their quality systems rules. FDA regulation is somewhat similar to ISO, but tougher in that they inspect us and can close us down if we are not in compliance. This results in a number of cultural issues because Agilent and HP, in general, are built on persuasion and employee empowerment, rather than top-down control.

At one point in the Healthcare Solutions Group’s history, we had about a dozen different quality systems. A few years ago the FDA came in and found some issues with some of the elements of one quality system. As we looked into it, we realized that in order to fix it, we would have to fix many of our other quality systems significantly. We realized that this was our opportunity to create a single quality system across the entire group. There are now about 5000 people working in many sites around the world under one set of process documents—HSG’s quality system.

The HSG quality system is hierarchically structured. Tier 1 contains high level documents, such as our Quality Manual, which would be in force across all of the HSG entities. Tier 2, also in force across the HSG, includes things such as requirements documents, policies, and process documents. The requirements documents can range from very high-level requirements to very specific procedures for how things will be accomplished in the HSG. The Tier 3 documents are basically entity-specific. Different divisions within HSG can have their own specific ways of doing some things, but they have to be in line with Tier 1 and 2 requirements. The Device Master Record (DMR) documents are product-specific and highly regulated. DMR is a FDA term and it is derived from good manufacturing practices. The result is that how we do things here at HSG is highly controlled: we even have documents that tell us how we are to perform management reviews and monitor our metrics.

HSG organization is structured to align the key quality processes with the functional manager’s titles. For example, we used to have an R&D manager; now we have a process manager for Product Generation. The Order Generation Process is headed by the Sales and Marketing manager, and the Supply Chain Process is headed by the Supply Chain manager.

From the top down, these managers define the process measures for the high-
Management's role in developing process measures, continued

level processes, review process performance, take corrective actions, and use our management review process. At lower levels, we perform similar processes. We collect data on the lower-level process performance and defect measures. The process owners determine the set of measures that are then consistently used for all of the reviews (Figure 6).

Figure 6. Enabler’s Value-Add, Key Metrics, Critical Business Issue, Critical Process Issue

There are some types of data that we are required by the FDA to collect; for example, customer complaints, non-conforming products, returned products, on-time delivery, quality audit reports, and corrective and preventive Action Performance. The divisions have some latitude in determining how they are going to track the data.

Standardizing metrics

We use a standard form to define the metrics for each of our key processes, called a definition form. Metrics are categorized as either a Quality or a Business Metric (any area that is affected by a regulation is categorized as a Quality Metric). For example, Product Shipping Holds is a quality metric, while all financial measures are business metrics. The definition form lists why the business metric was selected, where the data is obtained, the formula for calculating the data, how often it is collected, and how we will use it.

Standardizing reviews of process metrics

We use the same form for our reviews that we’ve used for years. The review form started out as a business fundamentals review form. The form tells the name of the metric being tracked, the status of the actions from the last review, actions completed, actual performance against measure (indicated as a red, yellow, or green dot), and why it is in the red or yellow range, how serious it is, and planned countermeasures.
This data is used in our three levels of review. For example, the Supply Chain manager may track five measures during the year. At a process review meeting, he would have all of the Supply Chain managers submit their metrics for review, then they would develop the roll-up metrics for the group. They look for all of the systematic problems that need to be fixed across all of the divisions. Division reviews are a little different: they review each of the division’s processes, the Supply Chain, Product Generation, H R, etc. M anagement looks for areas that may require additional resources. At the group review, all of this information is rolled up, and the group is reviewed as a whole.

Douglas Daetz—Process owners need to work in an environment that supports good process management; without it, they will encounter many obstacles on the road to success. Therefore, process management really begins at what I call the cultural/organization level. W hen I train teams in process management, I have them identify the cultural and organizational elements needed for them to get serious about developing customer-centered processes. O ne of the first elements usually identified is evidence of top management’s commitment to customer-centered process management. M anagement shows its commitment by the goals it sets. If you don’t set any goals for improving customer satisfaction and loyalty retention, for example, then there is no evidence of commitment to being customer centered.

O ther evidence of cultural support for customer-centered process management is allowing greater decision-making ability by employees. Empowering employees allows them to provide the customer with a more rapid, satisfying experience. We’ve tried giving employees a greater dollar amount over which they have discretion. O ne of our support divisions in G ermany authorized every employee in the division to spend up to $650 U S to fix any customer problem at the source.

H P is a very decentralized company, and it is the entity management team that sets the specific tone of the culture in their entity: they are responsible for the way the H P culture is implemented. T hey play a key role in fostering an environment that supports customer-centered processes. If the entity management team is not supporting and paying attention to the needs and requests of the process owner, the process owner feels like he/she is pushing on a rope.

At the process level, good management starts with educating, training, and coaching the process owners. T he process owners need a clear description of all the roles that they need to fill, and need to have or to develop the relationship skills to fill these roles. T hey must have or must learn the basic skills for defining, designing, and mapping processes. T hey need to learn to identify and select customer-centered metrics. W e need to teach them such things as the seven basic management tools, systems thinking, the seven creativity tools, and process modeling and simulation. S ince M arch 1999 we have offered a “W hat if” Process Planning class targeted at
Preparing process owners, continued

Process owners and those who coach process owners, in this class we teach participants how to use a PC software package called OptimaTM to do process mapping, process modeling, and process simulation. In a small way the class also helps develop process owners' systems thinking.

The whole customer experience

Process owners have to run their process by balancing internal and external needs. To do this they need to develop customer-centered attitudes and paradigms, as well as an understanding of the business's needs. We've also tried to get process owners to think about their customer's customer. I created the “Working Eyeball to Eyeball” chart (Figure 7) to show people how our processes and culture need to dovetail with our customer's processes and customers.

Figure 7. “Working Eyeball to Eyeball” with the Customer

Customer-centered thinking doesn't come automatically in a technology-driven company. HP first said that it was going to become a market-centered company 15 years ago. There are still areas that are making the transition. One area where this came true was in our Enterprise computing group. Customers who were building our hardware and software into their systems were just going crazy with the number of software patches being sent through. Once people began to see the impact they were causing, they learned to look at all of the places where our customer observes our processes and to understand the whole customer experience.

Author information

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Author information, continued

at Shugart Corporation. He was an assistant professor of Industrial Engineering at Stanford University and professor of Systems and Planning for two years at the Universidad Iberoamericana in Mexico City. Doug earned his BE degree in Electrical Engineering (EE) at Yale University and a PhD in EE & Computer Science from the University of California at Berkeley. He is a member of the IEEE and the American Society for Quality. In 1966 he originated the multivariate display technique now called the radar chart.

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Process Management and Process Ownership at Boeing Airlift & Tanker Programs

Authors
William C. Halczy, Performance Management Business Analyst, Boeing Airlift & Tanker Programs, Long Beach, California

Overview
As you may know, we were a recipient of the 1998 Malcolm Baldrige National Quality Award. You may also know that in 1992, The Airlift & Tanker Programs were in a crisis. We were under contract with the government for 120 C-17 planes when the Undersecretary of the Department of Defense (DOD) basically said, “We’re fed up.” We had quality problems, cost overruns, late deliveries, and a bad relationship with the customer. It was not a very good time to be around the C-17 Program. We knew that serious changes had to be made. The question was what did we need to do to turn things around?

Fortunately, we found the government willing to help, if we were willing to change. The Defense Contract Management Command (DCMC) formed a partnership with us, and the decision to formally pursue Process-Based Management (PBM) was made.

However, we had to deal with some preexisting views: “Process management is a culture change, and that’s going to take too long. It’s more work with all that we will have to learn, and we are already behind. Besides, we build a sophisticated product. Process management is for other people.”

The good news is that we found that we already had an element of process management—Quality Circles, where work groups got together to solve problems and improve work processes. The biggest perception that we have had to instill in our people is that Process-Based Management is the way you do what you do. It’s not more work; it’s the way you’re supposed to do work. Lastly, we found that we are just not that unique. We can apply process management just like everybody else.

What did we want PBM to do for us?
We knew we wanted five things from Process-Based Management: (1) gain control of what we were doing because most things were out of control; (2) establish joint expectations and metrics with customers, employees, and suppliers, and determine how our company was performing; (3) make decisions based on data at all levels of the enterprise; (4) focus disciplined continuous improvement across our entire organization, not just on the shop floor, but off the floor as well; and (5) link people, process, and goals. This was very important to the success of our program.

Our approach (Figure 1) was to (1) cover everything we do with our Enterprise
Process Model, (2) use one standard Process-Based Management tool to manage and improve processes as well as prevent confusion caused by different people using different tools, and (3) have Balanced Metrics from four categories: quality, timeliness, efficiency/cost, and cycle time. Quality and timeliness help us meet or exceed customer expectations. Customers want what they want when they want it. On the other side of the equation (the business perspective), we are interested in cycle time as well as the efficiency/cost, because they help us attain superior business results. The four Balanced Metrics are driven from the executive leadership team to individual teams on and off the production floor.

Figure 1. Process Management Approach

The benefits of a model that includes the entire operation

An Enterprise Process Model that encompasses our entire organization provides three benefits. First, process management is not just the mechanics of putting the plane together. It focuses off the floor as well, throughout the organization. Second, the model provides a perfect reference tool for strategic planning to determine which processes are affected and which areas need improvement in the future. Third, the model enables us to link different processes from different areas of the model and have a larger scale of improvement than any one particular process.

The Enterprise Process Model

The Enterprise Process Model has eight core areas (Figure 2). The top core area, Enterprise Management, is where our executives determine everything needed to lead our organization. Core areas 2.0–7.0 are the processes we use to develop and deliver any product. We intentionally kept this very generic so that we could use it for any product that we currently build or apply it to any future products. The eighth core area includes all of the support and services that weave themselves into and out of the standard development and creation of our product, including Human Resources, Accounting, Safety, Security & Fire, and Legal Services.
The Enterprise Process Model, continued

The three guiding principles of Process-Based Management

Process-Based Management is a seven-step tool that we use to define, measure, stabilize, and improve a process (See Figure 1). The seven steps illustrate three main points.

First, we want to know the process. In Step 1, we define the process, in real terms with real deliverables, using definition forms and flowcharts.

Second, in Steps 2, 3, and 4, we want to understand the capability of our process. In Step 2, we develop metrics that are needed to understand the capability of the process. In Step 3, we determine how a process is performing by establishing limits, including the minimum acceptable level, annual goals, and wherever possible, comparative thresholds. We then use these limits to score the health of our processes. In Step 4, we take steps to stabilize our process by reducing variability, fixing obvious problems, and eliminating or preventing special causes and variations.

Finally, in Steps 5, 6, and 7, we want to determine where the capability should be. Step 5 is where we set goals, based on (1) the business objectives flowing down through the organization, (2) the comparative data telling us how other people do...
The three guiding principles of Process-Based Management, continued

what we do, and (3) our own opportunities for improvement. In Step 6, we develop Process Improvement Plans that describe the processes that are being improved, who is doing it, and by when. In Step 7, we implement the improvements. We always return to Step 3 after our improvements to determine if our performance is stable and stable where we want it to be. Because we set goals every year, we are constantly in a continuous loop from Step 3 to Step 7, setting new goals, improving processes, and determining performance.

We created a process owner’s manual that describes the seven steps in great detail. Every manager is required to complete a training booklet, which basically is a synopsis of the owner’s manual, to ensure they understand Process-Based Management. We also have a 16-hour training course on the seven steps. Every function has a Process-Based Management focal point that tracks metrics, owners, and changes, and serves as a consultant role. Lastly, we have a Process-Based Management group in the Continuous Quality Improvement Department, that is aligned with our functions to help implement PBM. For example, I was the consultant to Supplier Management and to Production, where I would attend their meetings to answer questions and provide help. As the focal points and processes mature, the consultant’s roles decrease while the ownership roles increase.

I cannot really leave process management without also giving you a brief introduction into our Performance Management System (Figure 3) because the Balanced Metrics are integrated and linked. From the integrated planning process where we establish our strategic plans, we develop goals and targets. We ask what process from the model is impacted by that goal and what metric is being measured, wherever we can. This creates a clear link between goal, process, and metric, which flow down through the organization.

Our executives have established four high-level goals—Improve Operational Performance, Improve Supplier Performance, Institutionalize High Performance in the Organization, and Achieve Operating Plan Commitments. The Direct Reports to our executives determine how they can support each one of the high-level goals. In turn, each one of their Direct Reports determines how they can support the goal of the next level up. This goes on and on, until you have supporting teams all the way up, on a clear line of sight, to one of the high-level goals.

Once the goal flowdown process ends, the goal reporting process, or roll up, begins. We have quarterly reviews with all of our functions and programs. At the end of the year, that information feeds back into the planning process to determine where we were deficient, where we didn’t meet our goal, and where alterations need to be made.
Approximately 66 percent of the C-17 consists of parts and assemblies produced by suppliers. Our suppliers are integrated so we give them the same Process-Based Management classes that we give our own people. We do not require suppliers to subscribe to our Process-Based Management but we offer and they accept, because they are as motivated to reduce costs as we are to extend the program.

We are looking for the “Best Value Supplier,” and this includes how they manage their own processes, because we’re extending our process management focus to them. Like many companies, we rate our suppliers as gold, silver, or bronze. We factored in two areas: are they managing by process? And do they have statistical process control in place? Those aspects make a more rounded certification and rating process. Because process management is part of the rating system, there is a significant pull on their part in the way they manage their process.
The lessons that we have learned are: if you want quality, you have to manage your processes. If you want to reduce costs, you have to talk processes. If you want your work teams to understand and perform, they need to learn what process management is all about. And, if you want this improvement across the organization, then you need to link processes together.

We believe that we are more competitive now because of the quality problems, late deliveries, and cost overruns that we have solved through process management. These are the things that we believe most improved because of our programs of Process and Performance Management.

Customer Focus

By almost all accounts, we have reinvented our relationship with the customer. From an internal standpoint, we began using process management to convey to our workforce that one process follows another process; therefore, the first process is the customer for the second process. From an external standpoint, our primary customers are the pilots and crews of the C-17 and the Air Force personnel that maintain them. A second customer community is the Systems Program Office, an office in the DOD that oversees the production of our plane for the U.S. Government. And, onsite with us every day, the DCMC is an arm of the government that is responsible for making sure that the contractor fulfills each element of the contract.

Everything that we do for our program includes the customer. We created Joint Integrated Program Management with our external customers, to keep everyone fully aware and involved in the decision-making process. When we were formalizing our model for Process-Based Management, we solicited feedback from the DCMC (the local customer) about the validity of the model and their interpretation of which processes in the model needed improvement. This provided us with a customer-focused process list from the very start.

We regularly meet with our customer where we share which C-17s are not operating, what the problems are, who is responsible, and what do we have to do to fix it. We involve the customer in integrated master planning. We share our metrics with our customers; therefore, we give them access to our Intranet website. They can see all of the program data that our program manager sees, and they provide input. Our organization is aligned with the customer through direct interaction. We have a program manager and an Integrated Product Team (IPT), and they have a corresponding program manager and IPT to communicate at the same level. In short, they are on our teams, we share the data with them, and they help us manage our processes.

There are really two sides to measuring customer satisfaction, an operational side and a relationship management side. On the operational side, we have systems.
CASE STUDY

Measuring customer satisfaction, continued

in place that allow us to gather data on customer satisfaction. Customers have direct input into our service standards by agreeing to the minimum acceptable level on our Process Performance Charts. If they are not satisfied, the minimum level is adjusted. Customers also have direct input into our master plan, by agreeing when and how we deliver according to the contract.

On the other side, one way that we measure our relationship management is by a scorecard called a Contractor Performance Assessment Report (CPAR). It tells us how well we are interacting in all the various functions, including supplier management and contractor administration. We also use site surveys and annual customer surveys to gather customer requirement information.

All of the measurement teams for customer satisfaction have created listening outposts to help us manage customer requirements. There are many joint councils, panels, reviews, and teams that provide feedback. They involve everyone in project design. They provide ideas as to where the DOD or Air Force will be going in the future, and help determine what future support and spare part needs will be. We factor all of that feedback into our planning, and that flows into goals and flows down into processes.

Listening outposts

The customer helps define the process

Our processes are defined with both the internal and external customer. When we define or flowchart our processes, we solicit feedback from the customer. We also establish the minimum acceptable level and the annual goal as measurement thresholds.

The minimum acceptable level

The minimum acceptable level is the lowest level of performance that is acceptable to the customer. This can be determined by contractual obligations, an informal conversation with the customer, or as a business needs decision. A minimum acceptable level is set for each metric for all processes. In this way, customers agree to not only what we measure, but also to the thresholds for that measurement.

The annual goal

The annual goal is the desired performance by the end of the year, and the customer helps to define that as well. The goal can be determined by answering a few questions. What do the business needs say about where the goal should be by the end of the year? What is the comparative/competitive data telling us? What are our opportunities for improvement? What are the customer requirements? Similar to the minimum acceptable level, the customers agree to what is measured and the thresholds for that measurement.

Which two metrics are most beneficial to the customer?

Most of our discussions with the customer center on the two metrics that are most interesting to the customer, namely quality and timeliness. Quality we define as a measure of conformance to customer requirements or expectations. Timeliness is a...
Which two metrics are most beneficial to the customer?, continued

measure of success in meeting a commitment to the customer. Embedded in those two metrics is the word customer so you cannot come away from quality and timeliness without a sense of customer. We also define what we believe to be good metrics, because we try to focus on the right things to measure. The first question on any metric is always “is it meaningful to the customer?”

Why create a model?

I have been weighing on-the-spot process improvement vs. having a model. I really think that the only difference is that we have done an up-front definition first. It seems to me that when you start a project to improve a process without having a model, the first thing you have to do is define. To begin our process, we asked ourselves “what is a process?” and we defined it as “a set of tasks that uses resources to transform an input into an output according to certain requirements.” It is a rudimentary definition, but it became very important in determining how to improve processes and which processes should be improved. I do not think it matters whether you spend the time at the beginning or you spend the time later. We spent the time at the beginning to have at least some level of process mapping throughout our model.

Mapping the Enterprise Process Model

It took us about a year to put the Enterprise Process Model (See Figure 2) in place. We wanted to define all of the core areas and the level one processes directly below the core areas. We asked each function owner what their level one processes were, and then defined those level ones. The level one processes, listed as subheadings under the core area, also have owners. We also wanted to know what all the level two sub-processes were, but we did not define below level two unless business or customer needs require that we do so.

There are about 2500 processes within the eight core areas of the Enterprise Process Model. We do not deploy the full seven steps on all of those processes. We deploy to Step 1 because we want to define levels one and two. The business and customer needs really determine which ones we put metrics on, stabilize, and improve thereafter.

The forms we use to document the process

We use two forms to document a process after it is defined: the Process Definition Form (Figure 4) and the Process Flowchart (Figure 5). The Process Definition Form tells you the “what” but it does not tell you the subtle intricacies or steps in the decision process. The Process Flowchart has a place for everything from the definition form, in columns for suppliers, input, and output, with the tasks in between.

Tracking changes in the process

Steps 1–4 take you through the stabilized process (Figure 6). The Process Flowchart does not usually change much, because the procedure is being standard-
The forms we use to document the process, continued

Figure 4. The Process Definition Form

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<th>PROCESS:</th>
<th>Process No.:</th>
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<td>Creation Date:</td>
</tr>
<tr>
<td>Process Objective:</td>
<td>Revision Date:</td>
</tr>
</tbody>
</table>

### Inputs
- Process Tasks
  - Beginning Boundary Task:

### Outputs
- Process Requiremen Sources:
  - Information Systems:
  - Process Owner:

### Suppliers
- Process Customer:
- Process Specialist:

### Customers
- Process Owner:
- Process Customer:
- Process Specialist:

LEGEND
- Start or End
- Task
- Decision
- Connector
- Quality Record

Figure 5. The Process Flowchart

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<th>Major Process Tasks for: Process Owner:</th>
<th>Date:</th>
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Tracking changes in the process, continued

The real changes occur in Steps 5-7, where we set an annual goal. The owners are responsible for the process, so every year they set a new goal. As the processes change, owners simply revise the definition form, send in a new flowchart, and we change the processes in the database. We do not authorize improvements or hold them to extensive approval signatures. If an owner needs to change a process, they...
send in their new flowchart and definition form and we make the corresponding change. The signatures, on the definition form, of the owner, the customer, and, if necessary, the government specialist are our only check and balance. Signing the definition form means they agree to the way the process looks.

**Process Measurement**

Out of 2500 plus processes in the model, about 360 are doing PBM past the original definition point. Throughout the process model, performance agreements are being completed owner to customer, and in some cases where our external customer is involved, with them as well. Once those agreements are completed, we begin charting the data on metric charts. Metric charts are standard bar charts for each of the metrics agreed upon by customer and owner. A chart that contains a panel for each of four metrics is called a four-panel metric chart (Figure 7 on the following page). But, just because there are four categories does not mean there are only four metrics. We have some processes with nine panels, with three quality and two cycle-time metrics, while other processes may have as few as three. We try to keep a minimum of four panels, one for each of the metrics.

There is definitely interplay between metrics. For example, cycle time is the amount of time the process takes, and timeliness is the percentage of time that our agreement has been met. If I say I will get my product to you every second Tuesday and I only do it half the time, I am running at 50% timeliness. If the timeliness metric is not being met, you would expect to see the cycle time start extending. So we coach our process owners to make sure those four categories interplay.

In Step 3, we figure out what the performance on all the metric charts tells us. The first step in determining performance is the data values. We council our owners to look for patterns, sudden shifts, trends in the data that are going in the wrong direction, and cycles in the data bars themselves.

The next step is performance to threshold levels (Figure 8 on the following page). The thresholds give us our specification limits. We never want to drop below the minimum acceptable level, which is the lower specification limit. The annual...
Figure 7. A Four-Panel Metric Chart

Process: **Integrate TQM**  
Next-Higher-Level Process: **Enterprise Management**  
Process No: 1.07  
Date: 05-24-99

Process Performance Assessment

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What the metric charts tell us, continued

Each metric’s relative importance provides a weighting factor

One of the discussions that owners and customers have centers on the relative importance of the metrics when compared to each other. Does the customer value any one metric more than the other metrics? This discussion provides weighting factors for each of the metrics.

Every month, an assessment of the metric in relation to the thresholds is taken, and multiplied by the weighting factor to arrive at a weighted score for each metric. The sum of the weighted scores is divided by the sum of the weighting factors to provide an Overall Process Performance Assessment Score (Figure 9). A score of 3.0 means that we’re on plan.

As the month goes by, these overall scores change. The overall score is interesting but the value is really in how it changes from month to month. For instance, a decrease in the overall score from 1.3 to 1.0 could result from a decrease in one or more of the metrics from above the minimum to below the minimum. By contrast, if the score increases, something that was perhaps below the minimum is now better than the minimum, or something that was not quite at the goal or was behind plan is now on plan towards the goal. It’s really a scoring system based on those thresholds.

Rating factors and thresholds can be adjusted at any time, but typically happen once a year when new goals are set for that year. An exception would be if a customer has decided to focus on a different metric by adjusting the weighting factors.
Each metric’s relative importance provides a weighting factor, continued

We attach measurements to each of our four high-level goals. For example, one of the measurements for “Improve Operational Performance” is “Reduce Rework and Repair Hours.” As part of the goal flowdown process (See Figure 3), we determine which level one process measures rework and repair hours. That metric, rework and repair hours, is then measured by the level one process and becomes the quality metric of that four-panel metric chart.

When we break down the level one process into its sub-processes, we also break down each measure. The sum of those measures becomes the chart at “level one,” which is one of the charts we use in determining Operational Performance. It cascades all the way to teams like the wing team and then all of the pieces of Rework and Repair sum back up.

Improve Supplier Performance, another high-level goal, also has its measures, which typically include “Place Purchase Orders On Time,” “Percentage On Time,” “Place Purchase Orders With High Performance Suppliers,” and “Percentage with High Performance Suppliers.” Placement with High Performance Suppliers is one link between the process and a quality metric. The other measure, Place Purchase Orders on Time, is a good example of a timeliness metric.

Both the customer and owner of the process must agree on changes to the weighting factor.

The goal flowdown of the Performance Management System

We patterned our balanced scorecard (Figure 10) on the Texas Instruments T I M a trix. We populate this scorecard with our high-level goals and divide them among five categories: Customer Satisfaction, Quality, People, Backlog, and Operations Plan. For instance, we have a number of programs that report to us geographically, and we provide the people and the processes for them to use. We want to see if those programs are happy or unhappy with the service that they are getting from us, which

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<th>Metric Assessment</th>
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<th>Weighted Scores</th>
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<td>Cycle Time</td>
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Overall Process Performance Assessment Score

\[
\frac{\text{Sum of Weighted Scores}}{\text{Sum of Weighting Factors}} = \frac{10}{8} = 1.3
\]
The balanced scorecard, continued

Figure 10. The Balanced Scorecard

<table>
<thead>
<tr>
<th>CATEGORIES</th>
<th>Key Metrics</th>
<th>Description</th>
<th>Blue 10 Stretch</th>
<th>Blue 9</th>
<th>Blue 8</th>
<th>Green 7 Goal</th>
<th>Yellow 6</th>
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Some process improvement occurs before Step 6

Process improvement is embedded in Step 6

The tools we use for analysis

Problem Solving/Process Improvement

Although process improvement really occurs in Steps 6 and 7 of our methodology, definitely some improvement takes place before that. In Step 4, procedures are improved to ensure the process is standardized. At this point, we do our first Failure Modes & Effects Analysis (FMEA) to determine how preventative we can be. It guides our thinking on improving our methods of detection. In Step 5, we specify the goals and create Process Improvement Plans to close the gap between where we are and where we want to be. Those plans can be modified in Step 6, but process owners create a minimum of one Process Improvement Plan a year.

We really had to emphasize that process improvement is embedded in Step 6. In Step 6, we begin to delve into analysis to close the gap created by the annual goal.

Analysis for us begins with a simple model of Pareto Charts and simple tools.
The tools we use for analysis, continued

(Figure 11). If you're the process owner for a process on the wing and your rework and repair hours spike, the first thing you want to do is create a Pareto Chart for that data and then work on the highest bar. This work will lead to the use of other simple tools.

Analysis then includes a FMEA. The FMEA helps to determine the severity and frequency of potential problems, and the accuracy and speed of the detection methods in place. The numbers used to rate these measures then help to decide which problems need immediate attention and which are minor problems that occur infrequently. The FMEA also helps us find a medium between these two extremes.

Integrated planning

All of the analysis funnels into the standard Process Improvement Plan. In January and February, all of the process owners create improvement plans for the following year. It is all related to the goal flowdown. The goals come out of our integrated planning or strategic planning process and include an analysis of our strengths, weaknesses, and opportunities. If things take a turn for the worse in the middle of the year, then we pause, readjust the goals, flow the changes back down, and possibly begin tracking a process that we were not tracking before.

Our planning process integrates everything

Each core area owner decides which processes will be improved for the year, based on opportunities for improvement, ISO, or Baldrige criteria. Improvement plans will encompass all of the processes that are going to be affected, as well as all of the metrics they hope to improve. We want to make sure we're integrated.

Aligning the integrated process

We tried to move our process management in a strategic direction by aligning through our integrated planning process (Figure 12). Each of the functions has a representative on the planning team. They do an analysis of their strengths, weaknesses, and opportunities, based on certain assumptions. From resulting initiatives come process improvement plans.
**Case Study**

**Process Management and Process Ownership at Boeing A&T Programs**

**Aligning the integrated process, continued**

![Figure 12. Aligning the Focus](image)

**Benchmarking**

In Step 5, Set Goals, we determine where we are going and why, based on comparative and competitive data. Processes are scored based on the comparative thresholds, the minimum acceptable level, and annual goal (Figure 13). It’s scored a 1 if you’re below the minimum, a 2 if you’re above the minimum, a 3 if you reach the annual goal, or a 4 if you reach or surpass the comparative threshold.

![Figure 13. The Process Performance Agreement](image)

**Two types of benchmarking**

We have two benchmarking methods, formal and informal. Informal benchmarking is actually quite easy for many people. They just call former colleagues or previous employers to gather data. Formal benchmarking is a chartered and funded visit that is quite different from informal calls.
**Informal benchmarking**

We encourage all of our process owners to do informal benchmarking and set comparative thresholds (Figure 14). A lot of information is available quite readily on the Internet. We gather data and see how our similar metrics compare, but of course, that depends on everybody's maturity in process management.

We ask process owners to select similar processes and metrics, through websites, literature, or informal contact. The comparative metric analysis tells us how we are comparing in terms of data. If we are measuring defects as a quality metric on one process, how is someone else who does that process doing in the same metric? We also look at the comparative process analysis to figure out what they are actually doing if they are performing better than we are. We collect that data and then do a gap analysis to identify what the gap is now and what it is likely to be in the future. Comparative metric analysis then transitions to process analysis. If it looks like we are closing the gap, then we continue doing what we are doing. However, if the gap is getting bigger in future years, then we have to do some formal benchmarking to determine what they are doing.

![Figure 14. Informal Benchmarking](image_url)

**Formal benchmarking**

In formal benchmarking, we drive both the formal comparative metric and process analysis from a program standpoint. Formal benchmarking begins with our integrated planning process (Figure 15). The model helps us assess and understand the environment, identify our objectives and targets, and then develop our strategies. We then develop plans to meet those strategies, allocate resources, develop a financial plan, and begin the goal flowdown process. Implementing those plans and meeting those strategies often requires benchmarking specific areas in the process.

We use a list of criteria to help determine who we should benchmark. One trip in 1999 was to a shipbuilder, because they also create a large product, have similar government regulations, and, as we do, drill many holes to create their product.
It is an added benefit when a process owner has already done the informal benchmarking and comparative metric analysis. When we realized two years ago that we needed to improve in this area, we implemented two things: a Benchmarking Ambassador and a Benchmarking Website. The Benchmarking Ambassador is a person who keeps track of benchmarking, especially the formal benchmarking. The Benchmarking Website is inside our company firewall and keeps both the formal and informal information accessible for anybody within Boeing.

William C. Halcyn began his career with The Boeing Company in 1989 and began working for Airlift & Tanker Programs in 1991. Bill has spent the majority of his career leading process management and has guided process improvement throughout Airlift & Tanker Programs. Bill’s work has been instrumental in guiding the processes used in this Boeing business unit on its Quality Journey. Bill earned his Bachelor of Arts from Boston University.

Editorial assistance for this article was provided by Daniel Picard.