Personal Six Sigma: Adapting Six Sigma to Professional Practice

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Author Biography

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Abstract

This paper adapts the tools and thought processes of Six Sigma to the personal practice of software engineering and software quality. Many information technology organizations are adopting Six Sigma practices as part of larger organizational quality initiatives. Software engineers and software quality professionals in these organizations can find it difficult to adapt Six Sigma techniques to their own professional practice because the emphasis of the organizational initiative is on organization-wide and project-level implementation. Individuals working in organizations that are not adopting Six Sigma can feel completely overlooked by the Six Sigma movement. This paper focuses on learning and adapting Six Sigma techniques at a personal level, incorporating these techniques and tools into one's professional practice regardless of whether or not Six Sigma is being implemented at the organizational level.

(This presentation does not presume any particular Six Sigma knowledge or expertise on the part of attendees.)

Introduction

As a quality movement, Six Sigma is about process capability. It emphasizes reducing the variation in a process, and increasing our control over a process, such that we can predict with considerable accuracy exactly how the process will behave. This level of capability can be used to implement improvements in the process where we set targets for future behaviors, and achieve those targets within the levels of quality control that we choose to design into the improvements. This perspective on Six Sigma applies equally well in both individual and organizational settings, and yet the history of the Six Sigma movement is almost exclusively a history of organizational adoption and change. That history, as it applies to individuals, includes obtaining certification as a Green Belt or a Black Belt, always within the context of an organizational Six Sigma program.

This paper discusses how Six Sigma can be adopted and adapted by individuals to personal settings. In particular, it highlights the adaptation of the tools and thought processes of Six Sigma to the personal practice of software engineering and software quality. Many information technology organizations are adopting Six Sigma practices as part of larger organizational quality initiatives. Software engineers and software quality professionals in these organizations can find it difficult to adapt Six Sigma techniques to their own professional practice because the emphasis of the organizational initiative is on organization-wide and project-level implementation. Individuals working in organizations that are not adopting Six Sigma can feel completely overlooked by the Six Sigma movement. You can adopt the Six Sigma thought process to enhance or improve an operational process that you are involved with, regardless of whether or not the organization in which you work has adopted Six Sigma as an improvement model.

This paper focuses on learning and adapting Six Sigma techniques at a personal level, incorporating these techniques and tools into your professional even if you work in an organization that is not adopting Six Sigma. It is beyond the scope of this paper to provide a full coverage of Six Sigma concepts. A brief primer of key Six Sigma concepts is provided in the Appendix, and recommended readings are listed in the Bibliography.

Six Sigma DMAIC

Large organizational initiatives and projects tend to get the most attention in the Six Sigma literature. The intent of most organizations adopting Six Sigma is that the tools and thought processes of Six Sigma will eventually become so embedded throughout the organization that Six Sigma simply becomes the normal way of conducting business for everyone in the organization. Using this perspective, the idea of defining and conducting Six Sigma projects targeted at improving certain processes or products – the current dominant model in the Six Sigma world – can be viewed as an immature application of Six Sigma. As Six Sigma programs mature, the specific improvement project will increasingly give way to continuous improvement of processes and products while they are being used.

Figure 1 – The Six Sigma DMAIC Lifecycle

Whether as a distinct project or an embedded activity, the Define-Measure-Analyze-Improve-Control (DMAIC) lifecycle of Six Sigma (Figure 1) is applicable to a large variety of situations. Its application as an implicit embedded tool is not without precedent. For example, when a project manager or systems engineer tailors a standard organizational lifecycle into a project lifecycle, the tailoring act is an improvement activity preceded by a definition of the project, measurement of risks and opportunities, and an analysis of options for mitigating and managing scope and risk. The resulting tailored project lifecycle is then used to control the effort. The tailoring process is an implicit DMAIC cycle.

The DMAIC thought process can, and should, be used to improve and control virtually any process, whether or not the organization in which that process occurs is aware of its use. When added to existing practices such as project tailoring, additional benefits and improvements will quickly materialize. The benefits are immediate and substantial when introduced into processes that do not already contain any implicit improvement capability. This is the basis for Personal Six Sigma.

Competency Improvement

When personally adopting Six Sigma to a professional practice, an obvious starting point is in the application of Six Sigma thinking, and the DMAIC lifecycle model, to the management of your professional career. The DMAIC lifecycle can be used to understand the elements of a human resource management system that affect your personal career choices and opportunities. (Figure 2)

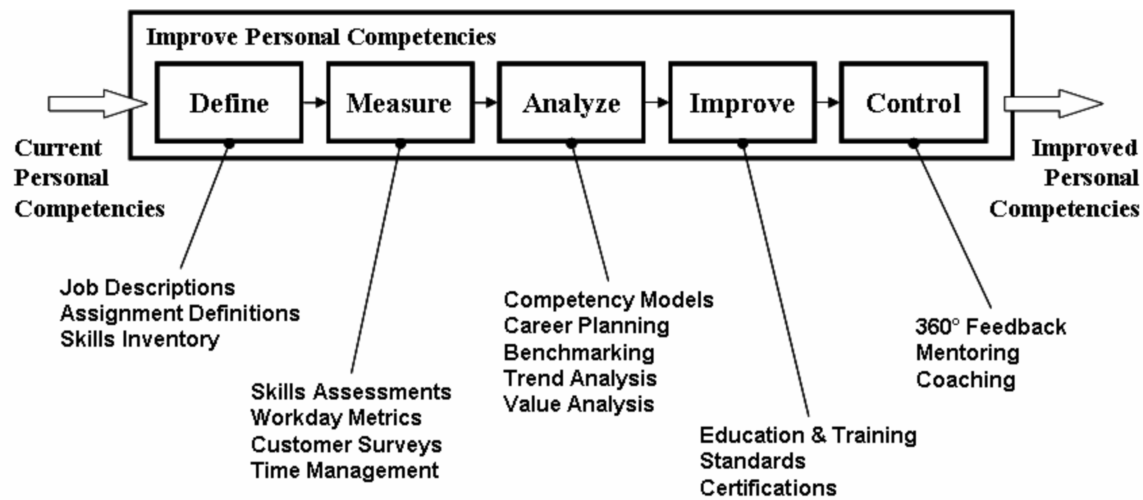

Figure 2 - Personal Six Sigma Process Map

The resulting model involves the process of improving personal competencies, where the key inputs are your current personal competencies, and the key outputs are your improved personal competencies. As a lifecycle, this process can be carried out as often as seems necessary. Initially, an arbitrary plan of conducting such an analysis annually might make sense. As the process matures, the aspects of the DMAIC Control Phase will determine how frequently you need to repeat the lifecycle.

Define Phase

The Define Phase of Personal Six Sigma requires that your job competencies that are to be addressed be clearly and accurately defined so that they can later be measured and improved. The inputs that drive this definition process are job descriptions, assignment descriptions, and a skills inventory. Define Phase activities are the most difficult to complete the first time Personal Six Sigma is put into practice. Subsequent passes through the lifecycle need only update materials created on previous iterations.

Job Descriptions

The first definitional activity requires establishing a detailed definition and model for your job and career path. This involves collecting or creating a job description for your current job, as well as detailing descriptions of any anticipated or desired jobs for the future. If you work in an organization that is good at creating and maintaining accurate and descriptive job descriptions, this activity is much easier than if you work in an organization that only offers vague or superficial job descriptions.

It is critically important that a clear and detailed description of your current and future jobs be defined as the baseline model for the DMAIC improvement cycle. Future job descriptions can be especially challenging because there may be multiple career paths that you consider possibilities, including the potential for future jobs that do not yet exist in the current job market. Your definition need not be clairvoyant to be useful; a best estimate of the future is all that is needed since this DMAIC cycle will be repeated over and over throughout the course of the unfolding of those jobs. Your current view of the competency requirements that will materialize in the future need only be accurate enough to guide effective plans or decisions in the current cycle.

Assignment Descriptions

Job descriptions tend to provide a relatively static definition of your professional responsibilities. An additional layer of definition is provided by systematically defining your actual job assignments. The assignments you carry out in your job provide a more dynamic view of your professional practice. For many, assignments will be dominated by project work. However, even when project work constitutes the bulk of your assignments, there are typically still many aspects of your job that would be omitted if only project work were included. For some professionals, project work may even constitute only a small percentage of their responsibilities.

Where feasible, assignment descriptions should be projected into the future. Being able to forecast the assignments that you plan to undertake in the future can be a key element in career and competency planning. The level of difficulty of these descriptions will depend upon the level of detail and breadth of the job descriptions captured initially. Some job descriptions also describe assignments in a fair amount of detail. However, many do not. Even with detailed job descriptions it can be difficult to get an accurate picture of how a working professional will actually spend her or his days. A complete combination of job and assignment descriptions provides that picture, and to the extent that it projects into the future, will enable more effective measurement activities in the next phase.

Skills Inventory

The third definition activity in the Define Phase involves cataloging an inventory of all of the skills that are implied by the current and future jobs and assignments defined previously. Depending on how they were written, the job and assignment descriptions might already explicitly lay out the skills required. Even so, there are likely to be additional skills that should be included in the skills inventory beyond those explicitly identified. This inventory should be as complete as possible. It is important to capture all of the skills associated with your job, not just those that might be listed in an official job description or assignment.

Measure Phase

The Measure Phase of Personal Six Sigma requires that an accurate and quantified picture of actual job, assignment, and skills performance be collected so that improvement opportunities that are well-grounded in the data can be identified. The inputs that drive this quantification process are skills assessments, workday metrics, customer surveys, and time management data.

Skills Assessment

A critical input to an understanding of professional competencies is an honest and thorough skills assessment. A skills assessment involves reviewing each skill in the skills inventory created in the Define Phase, and assessing whether or not you possess the required levels of skill. This measurement activity depends on establishing a scale for measuring competency levels, and for determining the likelihood that you will need the skills in the future.

For example, you might use a five-point scale, where “0” indicates that you have no knowledge of the skill, “1” indicates a general familiarity with the skills but no current real capability, “2” indicates some knowledge or capability usually as the result of some training, “3” indicates sufficient competency to practice the skill, “4” indicates experienced competency to the point of being able to help others with the skill, and “5” indicates that you have mastered the skill to the point where you can teach, adapt, or extend the skill.

If an item in the skills inventory requires a “4” but your current capability is a “3,” then action might be needed to improve the competency. However, if future job assignments might only require the skill at level “3,” then the need for immediate capability enhancement might be mitigated. The use of current and future job and assignment descriptions, coupled with the ever-changing profile of job skills across the industry, makes a skills model rather complex. Here in the Measure Phase, the emphasis is on building an accurate skills assessment, not making decisions about improvements. Improvement decisions need to be made based on an entire picture of your capabilities and plans, and will be the subject of the later Analysis Phase.

Workday Metrics

Each combination of job and assignment descriptions will have a unique profile of actual work activities that are conducted on a typical workday. Within this variation, however, it is important to be able to measure the actual activities performed. If you work in an organization that already collects time reporting data, these metrics will be easier to identify and collect. However, since the objective here is competency development, it will be important to collect data beyond traditional time-recording mechanisms. In particular, while job and assignment activities and time should be tracked, so should actual utilization of your competencies in the skills inventory.

Depending upon the specifics of your professional practice, you will count different things. Typical metrics might include timings and quality of requirements, system components, design artifacts, verification or validation items, or any other configuration items touched in the everyday execution of your job. Metrics should include the relative size of each artifact, time or effort expended, defect and issue data, rework time and scale, and skills actually used. Particular note should be made of any skills that you need to immediately improve in order to complete some activity.

Customer Surveys

A critical set of data needed for Personal Six Sigma is customer feedback. A challenge the first time through the cycle is to accurately identify all of the customers of your professional practice. We are often more accustomed to identifying our company’s customers, or even the customers of our projects; but the customers of our professional practice are sometimes less visible to us. The customers of interest are the individuals or work groups that directly receive our work products. The list will vary depending on job assignments. For example, as a logical data modeler, your customers might include the requirements analyst for whom a data model is being developed and the data base designer who will eventually use that data model to define a physical data structure. Note that the customer of interest here is the direct and immediate customer.

Once your customers are identified, seek methods or occasions where direct customer feedback can be obtained. While this can be as formal as a feedback survey given to these individuals periodically, it need not be. Effective feedback can be obtained using less formal methods, including simple feedback discussions or a shared coffee break. Many such opportunities might already be available if an effective peer review program is in place in your organization.

Time Management

The fourth category of data to be collected during the Measurement Phase is time data. How do you spend your time? Useful categorizations include value-added versus non-value-added time, as well as time on or off task. Time spent off task might include a variety of meeting types, training, or other administrative activities.

This type of data most closely aligns with data that might already be collected for time reporting in your organization. Depending upon the level of project management maturity in the organization, much of the data required might already be available. However, such data is less likely to be available for non-project work. If sufficiently detailed, this data will identify the aspects of your job assignments that are being complete on-time and on-budget, or late and over-budget.

Don't limit your time data to on-the-job time. Pay particular attention to how you spend time outside of work hours. How much personal time are you spending for learning? How many professional journal articles are you reading per week? How much time are you devoting to professional society memberships? These time investments are strong enablers of career and competency growth that remain hidden if your measurement effort is limited to at-work activities.

Analyze Phase

The Analyze Phase of Personal Six Sigma requires that the metrics collected be reviewed objectively in order to identify trends and opportunities that can be addressed for improvement or growth. The inputs that drive this analysis process are competency models, career planning, benchmarking, trend analysis, and value analysis.

Competency Models

A comparison of your actual job description and assignments (from the Define Phase) to how often you actually use your competencies (from the Measure Phase) can serve as an indication of whether or not your competencies are being developed and used in ways that are consistent with your career plans and goals. If not, then analyzing the gaps between your plan and actual competency use can help identify places where your skills might need to be realigned with real job opportunities, or job opportunities might need to be rethought in light of how your competency development is actually unfolding.

Career Planning

While your organization often has a career planning model available, it is typically limited to career options within the organization. Depending upon your personal goals, you might need to develop a career plan that extents beyond your current organization. If the workday metrics, customer data, and time management data point toward career change opportunities or needs, then potential career improvement might entail a rethinking of the job and assignment descriptions that currently form the basis of this DMAIC cycle. Be particularly alert to new career opportunities that might be emerging that were not available or considered during the Define Phase.

Benchmarking

Envisioning a change is always easier when the target change can be visualized or observed. You should continually look for opportunities to measure or observe other professionals as they progress through similar career paths. Professional publications and conferences are excellent sources of benchmark data; many trade publications provide periodic salary surveys, and many professional societies provide detailed body of knowledge materials to members. All of these sources provide a clear picture of what a "might be" career target can include. This view can be used to help define a working path from your current "as is" model to some future "to be" model.

Trend Analysis

Pay particular attention to trends in the data, even if they are small. Picturing your job five years ago can highlight how much can change over the course of time, and yet those changes rarely stand out during very short-term discussions or observations. The influence of technologies, organizational changes, and skill models are constantly changing the way your organization functions, and the ways you experience being a part of your organization. By noting trends in the data you can spot areas that need improvement long before your supervisors or peers do. Such trends might include the frequency with which your skills are used, or shifts in performance data related to certain types of artifacts meeting specifications. By planning for improvements in these areas, it is possible to prevent anyone else from ever observing slippages in your skills sets or performance.

Value Analysis

A particular form of analysis, perhaps viewable as a subset of trend analysis, is value analysis. What value are you providing to your customers over time? Ideally, there should be significant trends in the conducting of value-added activities that directly impact customers. On-time performance and skills utilization should continuously improve over time. As a Personal Six Sigma goal, these value measures should be improving notably faster than corresponding value measures for your entire organization. If not, you should work to identify reasons why not, and think about ways to improve such situations.

Improve Phase

The Improve Phase of Personal Six Sigma takes the information gleaned from analysis to directly implement improvements. The inputs that drive this improvement process are education and training, standards, and certification.

Education & Training

The most obvious improvement opportunities will involve forms of education and training. These might vary from very focused training opportunities to improve specific skills, to full academic degree programs. Long-term planning will often involve both extremes. Professional conferences or professional society involvement can also provide for skills enablement or expansion. Simply reading publications from the many professional societies that cover aspects of your job can be an excellent improvement strategy.

Many other educational opportunities are likely to be available all around you in your current position. The many committees, task forces, or special assignments available in your workplace offer excellent opportunities to develop skills that might otherwise not be needed or practiced in the day-to-day activities of your job. The question shifts from whether or not you have the skills to participate, to whether or not participating will help you develop needed or desired skills. Very often these activities present opportunities to develop specific skills or relationships that would rarely be developed through your normal work assignments.

Standards

Standards are an important part of planning improvements. The information technology and systems engineering fields are rich in standards that cover every aspect of IT products, services, and processes. Identifying and adopting standards is the easiest way to improve the direction of your skills and career without needing to reinvent the wheel. Adopting a standard can help even if the organization in which you work is not moving in the direction of that standard. (This paper is an example of such an adoption of Six Sigma if your organization isn't pursuing Six Sigma as an organizational strategy.) Many standards and guidelines are available through ISO, ACM, IEEE, SEI, PMI, and many other related organizations.

Certifications

As an extension of education and training, obtaining professional certification can be an important component of any competency improvement program. The body of knowledge for a certification program serves as a standard for the purposes of defining what needs to be learned. The examination process for the certification serves as an important benchmark for the level of competency that should be developed and how it should be measured. Because most certification programs also require some form of periodic recertification, they also serve as good initial components for the Control Phase.

Control Phase

The Control Phase of Personal Six Sigma works to institutionalize the improvements made, and assure that new cycles of DMAIC activity are driven by the data generated through the improved processes. The inputs that drive this improvement process are 360º feedback, mentoring, and coaching.

360º Feedback

Just as the Measure Phase includes soliciting customer input, the Control Phase also ties actual performance to stakeholder feedback. Data should be continuously collected from customers, suppliers, peers, and managers. Shifts in this feedback over time might represent signals that something has changed in the work environment, or your performance has shifted. In either event, such feedback can serve as an early warning that problems might be occurring that can be addressed through another iteration of this DMAIC lifecycle.

Mentoring

To obtain more future-oriented feedback, it is important to identify one or more mentors, and to enter into mentoring relationships with those individuals. A mentor can often help you identify trends or opportunities that affect your future plans long before the details behind those trends become self-evident. In the most extreme case, such information might trigger a replanning of your job or career options that would necessitate a complete redefinition of future job, assignment, or skill opportunities.

Coaching

Try to identify individuals in your organization who can serve as coaches on a day-to-day basis. Coaching provides an additional control over whether or not things occurring in the environment are being properly interpreted and used to influence plans over time. Again, the emphasis is on using the coaching relationship to identify data or thought shifts that would necessitate a recycling through this DMAIC lifecycle.

Technical Performance

Beyond the improvement of personal competencies associated with job and career planning, Personal Six Sigma also involves the continuous improvement of your technical performance within your job. Six Sigma, as a quality improvement paradigm, can be adapted to any disciplinary setting to make it more domain-specific. The use of Six Sigma within Information Technology presents specific opportunities to tailor Six Sigma thinking to the information technology domain. Within such specialization, IT professionals will put their Personal Six Sigma practices in place. (Figure 3)

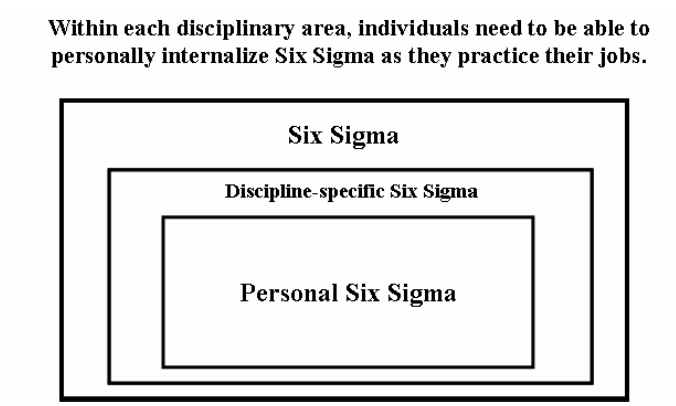

Figure 3 - Personal Six Sigma occurs within discipline-specific contexts

In the context of Personal Six Sigma, there's no presumption that your organization has adopted Six Sigma. The focus here is on personal adoption of these tools and practices in order to become a stronger and more valuable professional. Although the discussion below might make it sound like your organization needs to adopt these tools, that isn't the intention of this discussion. This discussion focuses on you, as an individual, learning and using Six Sigma tools and techniques as part of your job even though your organization hasn't asked you to. The results you achieve might leave those around you wondering how you've become so productive, and why your deliverables seem to so easily address problems and concerns typically seen in the workplace.

As a professional, you can map your own job into the Personal Six Sigma framework in order to decide how and where to incorporate Six Sigma tools and thinking into your everyday practice. You might decide to incorporate Six Sigma into every aspect of your job, or else into only limited areas where the opportunities seem to be greatest, such as system or software development. (Figure 4)

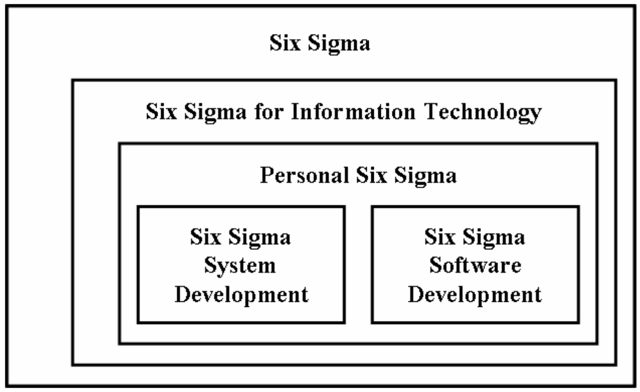

Figure 4 - Personal Six Sigma frameworks for software professionals

Choosing where to apply Six Sigma in your job will be determined by how much time and effort you can put into reading Six Sigma books, browsing the web for useful materials, and practicing your new skills on your projects. Because you are approaching this as a personal goal, you'll also be able to adapt and apply your new skills in setting beyond the workplace, include using these tools in your home and community activities. For this discussion, we're focusing on applying these skills in the workplace.

Within each disciplinary framework, you can adapt Six Sigma to your professional practice in ways that seem most beneficial, blending the specifics of each technical discipline with the available Six Sigma tools and techniques to find a combination that works most effectively for you. Please keep in mind that Six Sigma adds value to any discipline, but can never replace or supersede the specifics of the discipline itself.

Many Six Sigma organizations get themselves into trouble because they overemphasize Six Sigma tools, expecting them to take on a life of their own as replacements for previously used tools. Such organizations are often observed to say that "every project should be a Six Sigma project," implying that every project would begin to use Six Sigma tools as their primary deliverables instead of the traditional domain-specific tools used previously. Instead of advocating such an approach, Personal Six Sigma simply involves gaining an understanding of how each traditional deliverable maps into Six Sigma thinking so that the appropriate heuristics of Six Sigma can be applied to improving any deliverable. (see Figure 5)

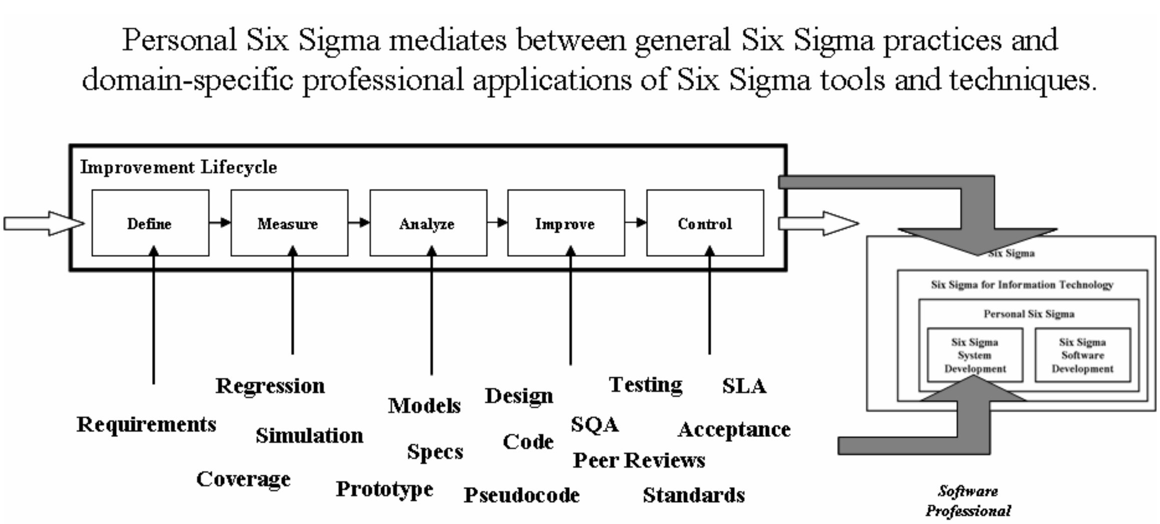

Figure 5 - Relationship between Six Sigma and domain-specific tools in software field

By mapping traditional deliverables against the DMAIC lifecycle, each deliverable can become the focus of a Six Sigma improvement thought process. By understanding where each deliverable fits into the DMAIC thought process, deliverables can be evaluated against a broader array of criteria than available previously. Also, in a full review of the deliverables based on the DMAIC process, it becomes possible to spot weaknesses in the overall IT lifecycle approach.

The synergy of the domain-specific lifecycle and tools with the general DMAIC lifecycle of Six Sigma provides added-value for IT projects and professionals. While the value is maximized in organizations that have adopted Six Sigma, Personal Six Sigma supports the creation of some of that value at the level of each individual contributor. If you are new to Six Sigma, you will find three particular tools most useful:

1. Process Mapping – This toolset helps you understand the requirements for process components and flow, including a characterization of each input and output for each process step. It has several analogs in the traditional IT toolset that can be improved using process mapping analysis. As you advance, you'll also learn a specialized process map that defines top level stakeholders, the Supplier-Input-Process-Output-Customer (SIPOC) tool.
2. Failure Mode & Effect Analysis (FMEA) – This toolset, with its own rich history outside of Six Sigma, helps define and prioritize the aspects of the process maps that require further analysis and the introduction of controls. While an FMEA analysis can look for problems anywhere within the scope of a project, your initial emphasis should be on understanding how process map outputs can fail as a result of problems with the inputs. The correction of these problems is always within your project scope. You'll move on to failure modes in the inputs themselves, but the causes of these failure modes will always be outside of your project scope, and therefore, will be more difficult to address.
3. Process Capability – This toolset provides a mechanism for describing the performance of a process that is independent of what the process actually does or how it is defined. Its results can be understood by anyone who has learned the basic logic of Six Sigma. Although usually treated in the literature as a statistical subject (e.g. calculation of Cp and Cpk ratios from control and specification limits), process capability can be handled simply by sketching a "desired" and "actual" performance curve. A visual comparison of the two curves gives a good picture of the process performance. If the actual performance is wider than desired, the process is not capable. If the actual performance is off-center from the desired target, the process is not capable. Your learning will move on to the more complicated statistical calculations at a later date.

Of these three tools, Process Capability is the key to becoming a Six Sigma thinker. It forces you to define the metric that is being displayed in your performance curves. This critical-to-quality (CTQ) metric is what makes your analysis more quantitative. Your process maps and FMEA analysis then focus on the critical metric. Without the metric, process maps and FMEAs become useful analysis tools, but they aren't Six Sigma. Six Sigma is a quantified discipline that focuses project attention toward key requirement metrics.

Process maps, FMEA, and process capability constitute your Six Sigma starter kit. You will add others as you progress through the available literature, attend workshops or classes, and practice, practice, practice. Don't worry about using the tools incorrectly. Your emphasis should be on using the tools to improve your performance on your projects. Whether or not the tools are used "correctly" is an academic discussion for another time. Using the Six Sigma tools will help you recognize problems in your traditional IT deliverables. Fixing those problems will trigger additional Six Sigma analysis. You should continue to cycle between Six Sigma and traditional analysis until the cycle stops adding value.

Quality Function Deployment

As you advance in your Six Sigma studies and learning, you will continually add tools that can be used to deepen your understanding of business processes, and enhance your ability to use your traditional IT tools. While there are many ways to successfully add Six Sigma tools to your personal toolset, one highly integrated approach is through the use of a core tool in Design for Six Sigma methodologies: Quality Function Deployment (QFD). (Figure 6) [See (Cohen, 1995) for an effective overview of QFD.]

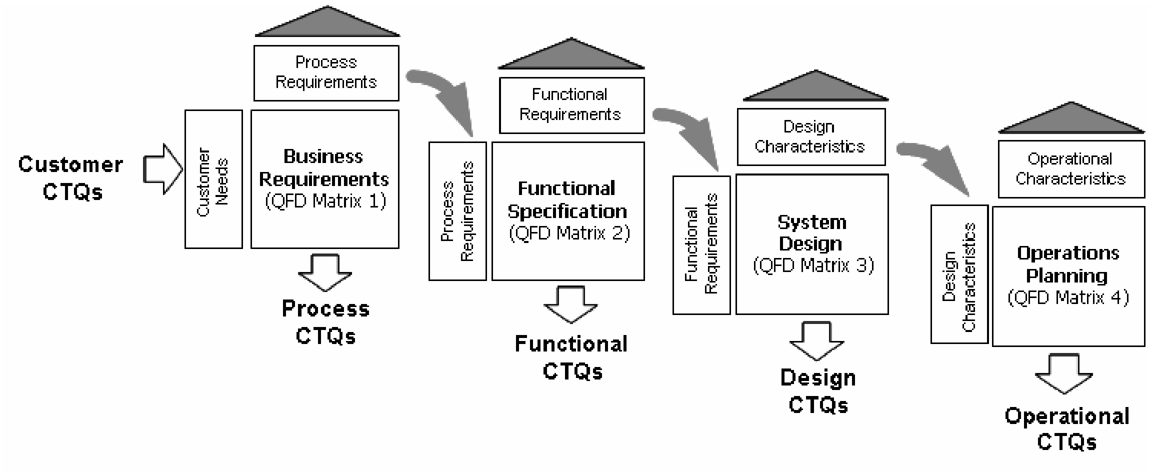

Figure 6 - Four common levels of QFD in IT

Again, note that Personal Six Sigma is not about having your organization adopt and use these tools. It focuses on you developing skills in the use of Six Sigma tools so that you can personally apply them in the workplace. As you read about QFD below, keep in mind that you'll be using it to help improve how you do your job while creating your standard deliverables that you already create on every project. Mapping your current deliverables into the Six Sigma QFD framework will simply help you do a better job in producing those deliverables in the shortest time, at the lowest cost, and with the highest quality levels. Nobody else needs to know that you are using Six Sigma (although you're likely to want to share that fact with anybody who will listen!).

QFD is largely about trying to relate and prioritize different layers of your projects. A four-level QFD can be thought of as encapsulating Requirements, Functional Specifications, System Design, and Production Implementation. Different aspects of the tools your projects are already using will map into these layers. Even if not used as a requirements management tool on a project, QFD offers a structured framework for thinking about how different domain-specific IT tools and deliverables map into the Six Sigma thought process. (see Figure 7)

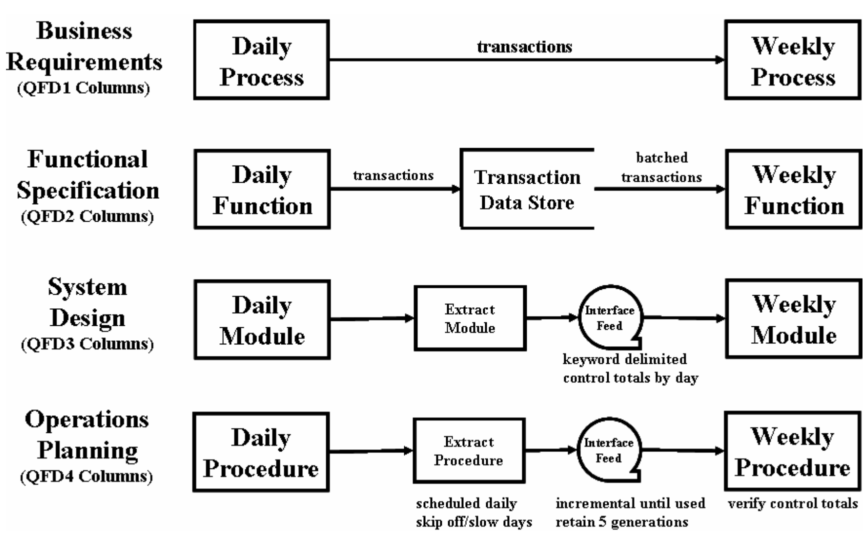

Figure 7 - Example of IT use of four QFD levels

For example, any IT artifact that captures business requirements regarding what processes, inputs, or outputs are needed, including timing and criticality of those inputs and outputs, would correspond to the business requirements in the columns of the first level of QFD matrices (QFD1). Since Six Sigma places the process map at this first QFD level, you'll know to use the verification and validation techniques associated with process maps on the specific requirements deliverables you create.

Many other IT analysis and design tools that you already use can also be mapped into the four-level QFD model. The location to which elements of each tool fit into a QFD matrix will determine which Six Sigma tool heuristics can be used to improve the content of your IT deliverables. Common examples include:

- Use Cases – The actors in your use cases will have customer needs recorded in your QFD1. The actors and use scenarios that you define become a combination of business process columns in QFD1 or functional specification columns in QFD2. Care should be taken to assure that the columns are defined as a hierarchy where standard and exceptional scenarios are included under the use cases that define them. Although actors aren't always thought of as functional components, their columns in QFD2 allow security and authorization rows to be better mapped.
- Logical Data Models (Entity-Relationship/Class Diagrams) – The entities, classes, relationships, attributes, and domains in your data models all become columns in QFD2. It is important to assure that the columns are defined as a hierarchy where attributes and domains are included under the entities or classes that define them. The QFD correlation matrix (e.g., the House of Quality "attic") should be used to record correlations between these data columns and any related functional steps or data structures that impact the data (often using the Create-Read-Update-Destroy designations to indicate the correlation).
- Data Flow Diagrams – The agents, processes, data stores, and junctions in your data flow diagrams also become columns in QFD2. The QFD correlation matrix should tie these functional steps to any associated data columns.
- State Transition Diagrams – The states and transitions in your state transition diagrams also become columns in QFD2. There should be correlation matrix entries to connect each state transition to the functional step responsible for the transition. There should also be correlations defined between the each data state and the associated entities, as well as between each process state and the associated functions.
- Customer Interviews - Customer input belongs in different levels of the QFD depending upon the type of input being collected. Many mistakes are made here, so it is important to pay particular attention to where such data generalizes into your QFD. Not all customer input is a need. If everything the customer says is interpreted as a need statement (row of QFD1), the resulting mess is completely unmanageable, and QFD fails. Customers talk about their needs (rows of QFD1), their processes (columns of QFD1), the functions they are hoping you will build to satisfy those needs (columns of QFD2), some specific design features they are looking for (columns of QFD3), or even what type of training or support they expect (columns of QFD4). The challenge is to put what the customer says into the correct QFD position, and then assure traceability back to the project charter via QFD1. Not everything the customer says will be a new QFD row or column; much of what is said will provide quantification of targets and specification limits for rows and columns that have already been identified in the QFD.

Likewise, deliverables associated with system design (including prototypes, data structures, screens and forms, and program code and scripts) correspond to the columns of QFD3. And finally, deliverables associated with production implementation (including operations plans, training materials, documentation, backup-recovery tools, support scripts and guides, and other operational details) belong in columns of QFD4. Since every row and column of a complete QFD will include measurement criteria for the content of the row or column, building test plans is a natural by-product of using a QFD to integrate the four levels of analysis and design.

Mapping these traditional IT tools that you probably use everyday into the Six Sigma framework defines the points at which Six Sigma will provide immediate value to your personal practice. Learning the basic Six Sigma tools and heuristics will help you improve the actual IT tools and deliverables that you are already using, even if no one ever sees your completed Six Sigma tools. This conceptual mapping provides a mechanism for you to take advantage of your own self-learning of Six Sigma tools and techniques to continuously improve your own technical performance. If eventually coupled with an organizational commitment to Six Sigma, the benefits achieved can be even greater.

SEI Personal Software Process^{SM}

Individuals who have had exposure to the SEI Personal Software Process^{SM} (PSP) [Humphrey, 1995] will recognize parallels between the PSP model (Figure 8) and the Personal Six Sigma model discussed here. PSP is a process improvement model to be used by an individual practitioner, just as Personal Six Sigma applies to an individual practitioner. The benefits obtained through PSP can be increased if the organization in which the practitioner works also adopts the SEI Team Software Process^{SM}. [Humphrey, 2000] While TSP is not a prerequisite to PSP, its use increasingly improves performance. Likewise, Personal Six Sigma improves the performance of the professional who adopts it, and those benefits can be compounded if used in an organization that fully adopts Six Sigma.

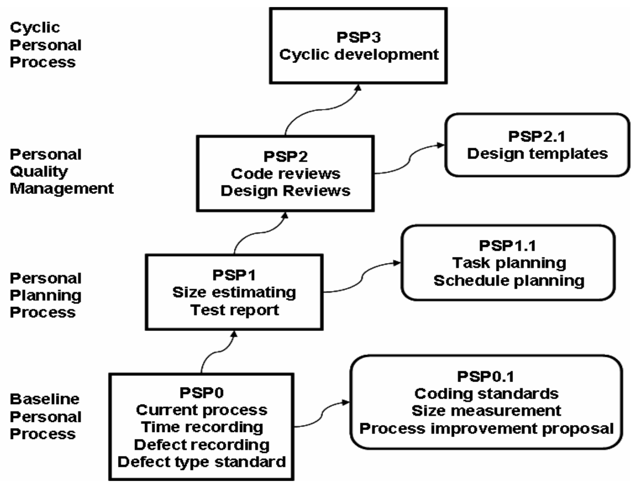

Figure 8 - Personal Software Process [adapted from Humphrey (1995)]

Beyond these parallels, the PSP model offers important insights for practitioners working to adopt Personal Six Sigma. The PSP model is incremental and layered. Beginning with core basic processes at PSP0, the PSP model grows in discrete stages toward cyclic development at PSP3, and encourages practitioners to adapt the model incrementally as confidence and skills develop. The same recommendation can be adapted to the deployment of Personal Six Sigma. You should begin with the basics of Six Sigma – most likely simple process maps, failure mode analysis, and basic process capability measures. In fact, practitioners of PSP will most likely begin their Personal Six Sigma adoption using the procedures and metrics that have been built during the initial implementation of PSP.

Conclusion

Personal Six Sigma offers a framework for you as an individual practitioner to adapt Six Sigma techniques and tools to your personal professional practice. Applications include using Six Sigma to model and improve your personal career path and opportunities, including an improvement cycle that can be repeated over time to help assure that your career is unfolding in the way you desire.

In addition to improving your personal career competencies, major opportunities exist for improving your technical performance in your job through understanding the mapping of Six Sigma processes and techniques against the processes and techniques of your work domain. Whether or not you ever actually create any of the common Six Sigma tools, you'll benefit from adapting Six Sigma thinking to the domain-specific tools you already use. As your knowledge of Six Sigma increases, you will increasingly use Six Sigma tools to supplement your domain-specific tools. The complementary nature of these tools will boost both your productivity and effectiveness. You will probably not spend as much time using Six Sigma tools as you typically spend using your domain-specific IT tools. That path is best reserved for individuals who choose the Six Sigma Black Belt career path. As an IT practitioner, your roots will remain in IT while you develop additional Six Sigma skills to assist you in continuous improvement.

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Appendix: Six Sigma Primer

This Primer provides a very simple introduction to some core concepts of Six Sigma. It is intended for novice readers that have not yet had any Six Sigma training or experience and want a basic background into the core concepts of Six Sigma centering on variation and control. Individuals with Six Sigma project experience will find this material too superficial, and may even spend more time noting the obvious omissions than concentrating on the materials.

Brute Force Quality

Historically, quality improvement was carried out as a management-dictated process of applying brute force effort to particular quality problems. For example, management might set a goal of reducing backorders in an order processing environment by 50%, from a current state of 24% to some target of 12% or less. This goal would drive an effort to attack the problem, making changes throughout the problem area and observing the impact of those changes on the targeted measures. After a time, the backorder rate would be seen to have been lowered to some value at or below the targeted 12%, and the improvement program would be declared a success based on that result. (Figure 9) However, the actual process behavior would still vary considerably.

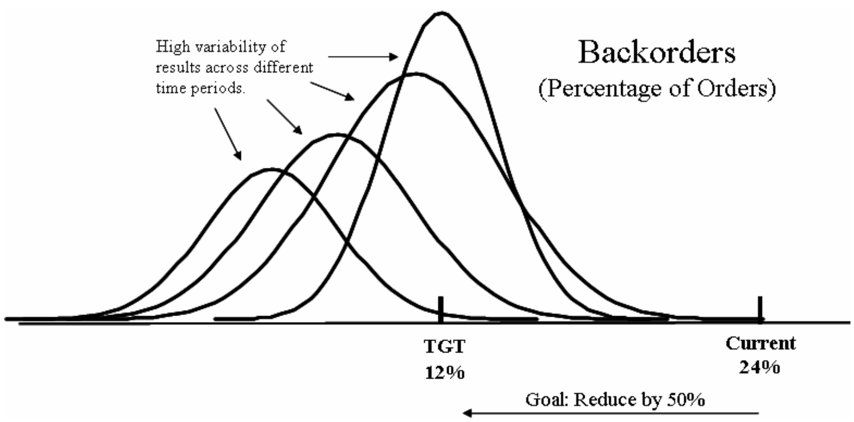

Figure 9 - Wide variability of brute-force outcomes

Problems with the brute force approach were numerous, but centered on the fact that such efforts often focused on incorrect or inappropriate solutions, and the solutions themselves were not usually sustainable. Recognition of these weaknesses caused a shift toward more systematic approaches to quality improvement. Collectively, these approaches came to be known as Total Quality Management (TQM).

Total Quality Management

TQM involved an expanded use of Statistical Process Control (SPC). The effects of SPC could be seen in two key areas: 1) processes were expected to exhibit variation around an average value, but the variation attributable to the process was expected to remain within certain expected ranges (the control limits), and 2) what a customer wanted from a process (the specification limits) wasn't necessarily the same thing as what a process would actually be observed to do. When a process was operating outside of its specification limits, it was said to be producing defectives. When a process was operating outside of its control limits, it was said to be out-of-control.

An out-of-control process is a signal that something is wrong with the underlying process, and that it should be addressed using the methods and tools of TQM. In this way, the SPC analysis tells us both where the problems are (producing defectives outside the specification limits) and whether or not we could cost-effectively fix them (out-of-control process behaviors indicating special causes that can be identified and corrected).

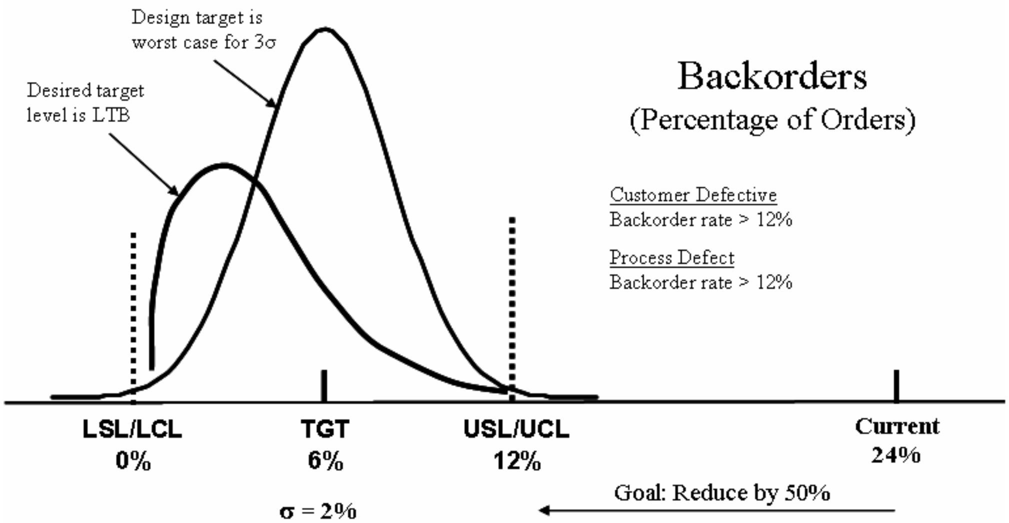

Figure 10 - TQM controlled processes to operate within specifications

Figure 10 illustrates the backorder problem using basic SPC thinking. The original target becomes the upper specification limit (USL) of the desired new process. The objective of the design will be to build a process that doesn't result in a backorder rate higher than this value, making the design target upper control limit (UCL) also 12%. Presumably the backorder rate should be reduced as much as possible (the lower-the-better, or LTB), and so the lower specification limit (LSL) and lower control limit (LCL) are both set to 0%. The target value for the process redesign is typically the mid-point between the two specification limits, or 6%. The new process is intended to deliver a backorder rate of 6%, with little enough fluctuation that any variation within three standard deviations (or 3σ) from the mean will still be within the 12% USL. The resulting process will exhibit a 3σ quality level.

Six Sigma

What makes the newer Six Sigma movement different from TQM is its emphasis on raising the bar on quality. The processes designed in TQM initiatives became very sensitive to 3σ control exceptions in SPC, with on-going improvement occurring incrementally at these margins. The Six Sigma movement uses all of the tools and techniques of these TQM initiatives, and adds an emphasis on long-term process variability and shift. Processes that were in-control in the short-term (typically operating within 3σ of their mean), would typically appear out-of-control in the long-term as greater variability was seen in human factors and error, equipment wear-and-tear, and gradual deterioration of process conditions.

With this increased variability included, TQM programs failed to deliver adequate quality, even at short-term 3σ levels. The short-term desired defect rate of less than 1% for 3σ processes could be seen to rise above 5% as a result of the long-term shifting of the process. With expectations expanded to 6σ quality, new processes could be defined that provided acceptable levels of quality while taking into account the implications of long-term process shift.

SPC is still used to monitor and evaluate process performance at 3σ levels. However, the identified exceptions beyond the 3σ control limits are now occurring well within the 6σ specification limits. In TQM, process defects and customer defectives were typically both defined at 3σ, and so process improvement to bring the process back into control was required while also dealing with customer defectives outside the specifications. Six Sigma separates the discussion of process defects (outside 3σ) from the recognition of customer defectives (outside 6σ) to allow processes and systems to self-correct and adjust to results in the 3σ to 6σ range.

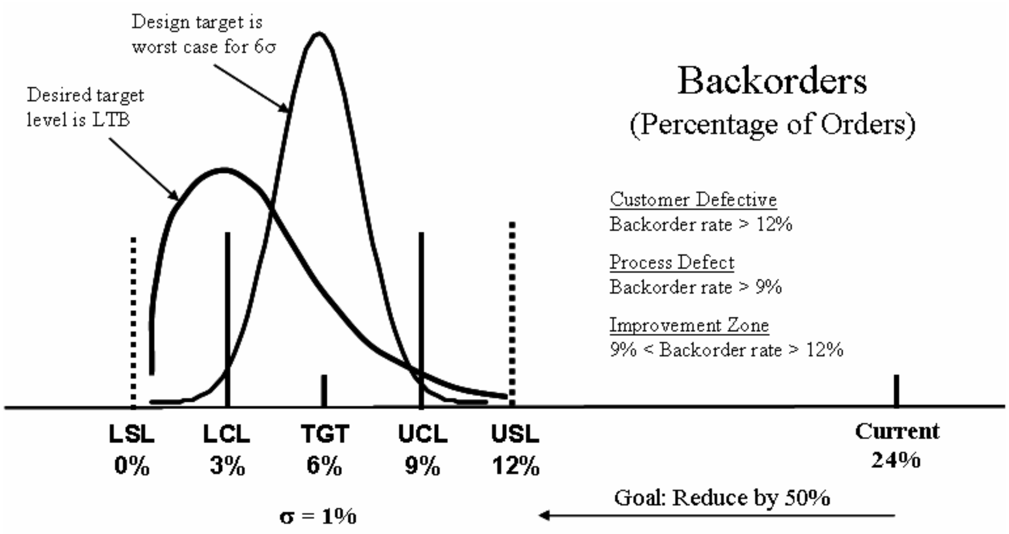

Figure 11 - Six Sigma brings even exceptions within specification

Figure 11 illustrates the 6σ viewpoint using the backorder rate example. The specification limits do not change because they represent what the customer wants, which doesn't change based on how quality is being measured; but, the control limits do change. Design target SPC control limits are still 3σ above and below the target, although the specification limits are now 12σ apart in this new Six Sigma view. This means that the revised UCL is now 9%, or the mid-point between the target value of 6% and the USL of 12%. There is now an improvement zone available between the UCL and the USL. Values above the control limit are process defects that SPC tells us can be economically corrected. If they can be corrected before they rise to the USL, the customer need never see a defective.

Implications for Practitioners

As processes are redesigned to align with Six Sigma thinking, process engineers have an opportunity to implement controls that take advantage of the improvement zone between 3σ and 6σ process performance. By building critical customer metrics directly into processes they can be made self-correcting by enabling specific actions to be taken when process defects are seen in the improvement zone. These actions need not always involve sophisticated technical solutions to be beneficial. Controls can be as simple as an e-mail notifying support personal of defects above the 3σ level, or a periodic report highlighting activity in the 3σ to 6σ zone. The point isn't to build processes without defects, but to build business solutions that can be kept from producing defectives in spite of their defects. That is the essence and opportunity of Six Sigma: making processes and systems increasingly self-aware and self-correcting.