PART I

# Introduction to Organizational Leadership, Financial Performance, and Value Management Using Design For Six Sigma



These three topical areas are the basis on which DFSS, at the executive and managerial level, achieves success. Corporate support is not good enough. DFSS initially requires a driving impulse from the highest levels in a company, well beyond verbal support. It then requires an active, frequent, and sustaining push from the top down. Clear and measurable expectations, required deliverables, and strong consequences for high and low performance must be in place for DFSS to work. If you want to read how this was handled at GE, just read the chapter on Six Sigma from Jack Welch's autobiography *Jack: Straight from the Gut.*

The reason to do DFSS is ultimately financial. It generates shareholder value based on delivering customer value in the marketplace. Products developed under the discipline and rigor of a DFSS-enabled product development process will generate measurable value against quantitative business goals and customer requirements. DFSS helps fulfill the *voice of the business* by fulfilling the *voice of the customer:*

- DFSS satisfies the voice of the business by generating profits through new products.
- It satisfies the voice of the customer by generating value through new products.
- It helps organizations to meet these goals by generating a passion and discipline for product development excellence through active, dynamic leadership.

***Let's find out how. . . .***

CHAPTER 1

# The Role of Executive and Management Leadership in Design For Six Sigma

## Leadership Focus on Product Development as a Key Business Process

Let's begin with a great example of an executive who successfully led a company into organic growth using Design For Six Sigma (DFSS), Jack Welch of General Electric (GE). Jack Welch took advantage of the cost reduction approach of operational Six Sigma pioneered by Motorola and Allied Signal, which guided GE to over $1.5 billion in savings during its third full year of deployment. However, Jack saw the incredible power of Six Sigma in terms of growth and realized that limiting it to a cost-reduction focus was short-sighted. He saw the numbers and their impact inside of GE and noticed that GE's customers were not yet feeling the results of their Six Sigma initiatives. Never complacent, Jack set a new goal where the customer would feel the impact of Six Sigma as GE developed new products and services. In the end, GE became the most successful company to date to deploy the DFSS methodology, as you'll soon see.

In 1996, GE Power Systems launched an innovation in their gas turbine design that was so reliable that 210 units were produced without a single unplanned reliability-based power outage. This put them into the enviable position of market leader at exactly the time power demand surged in the late 1990s. Even in 2002, Power Systems is one of the most significant contributors to GE's corporate profits, all due to a deliberate focus on product reliability and customer satisfaction. GE Medical Systems launched a CT Scanner called LightSpeed in 1998. The time for a chest scan was reduced from 3 minutes to a mere 17 seconds. GE Medical Systems launched 22 new designs between 1998 and 2001 using Design For Six Sigma. Jack drove the transition from operational Six Sigma to Design for Six Sigma as a matter of strategic intent. GE management did the most effective thing a company can do to move the benefits of Six Sigma upstream into their company's strategic business processes—they aligned the tools and best practices of DFSS with their product development process, and they did it with rigor and discipline.

Welch was relentless about getting the results of Six Sigma out to the customer. This behavior made him open enough to listen to a suggestion from GE Plastics and set the mark for a new vision for his Six Sigma investment. GE launched metrics of performance into their scorecard system which were measured as the customers saw them. Armed with the customers' view, GE has not only applied Six Sigma to their products but also to the way their business processes deliver services to their customers. This brings us to our next major insight about properly leading a company using DFSS: Creation of management scorecards that measure new product development performance data in comparison to things customers directly state they care about.

GE's current CEO, Jeffrey Immelt, has taken this one step further, withholding a portion of executive bonuses unless the executives can prove that they have added value to their customers. At GE, the Six Sigma story is still evolving. Our third major insight for managing in a DFSS context is that executive management will continue to drive Six Sigma into the upstream organizations that do advanced platform and product planning, as well as applied research and technology development. A new form of DFSS called Technology Development For Six Sigma (TDFSS) has emerged in the last year. This book contains the first disciplined approach to its deployment within a structured Phase/Gate process context.

In contrast, consider a different company who launched Six Sigma in 1997. In the late 1980s, Polaroid Corporation was considered one of most enviable companies in America. They had over $600 million in cash and an excellent balance sheet. Their market share was secure and growth seemed to be guaranteed into the next century. Polaroid took on some debt to avoid a hostile takeover by Shamrock Holdings before the end of 1988. They then conducted two very expensive product launches into carbon-based films for medical imaging and small-format SLR instant cameras. Both of these initiatives failed miserably, which resulted in a change to their top leadership. With a new CEO focused exclusively on cost reduction, Polaroid initiated a Six Sigma program in their operations.

Although official savings were never made public, it is believed that Polaroid Corporation (a $2 billion company at the time) saw savings in relative proportion to those posted by Motorola, Honeywell, and GE. In April of 2000, Polaroid's former Executive Vice President of Global Operations told a Six Sigma team of a major appliance manufacturer that their Six Sigma cost reduction initiative had kept them out of bankruptcy for the past 4 years. Unfortunately, in the fall of 2001, Polaroid, with over $900 million in debt, filed for Chapter 11 protection. How could a company that embraced Six Sigma get into such a position? Primarily, they failed to take it upstream into the most important business processes for organic growth—their technology development and product commercialization processes.

Real estate agents, insurance adjusters, and other businesses that used instant photography for the past 50 years had all switched to digital cameras. Polaroid saw this trend coming too late. They finally tried to enter this emerging market but failed to stand up to the marketing and design competition of Sony, HP, and Kodak. There is no doubt that Polaroid would have stayed alive longer and maybe even survived with a focus on linking together key up-front Design For Six Sigma elements such as market forecasting and segmentation, voice of technology evaluations

and benchmarking, gathering and processing the voice of the customer, product platform architecting, and focused technology building based on all the previously mentioned activities. Things would have likely been different if they had deployed these as key tools within the earliest phases of their product development process.

One key lesson to be learned from Polaroid is the risk that accrues from focusing on internal metrics and executive opinions rather than external data and customer needs. An internal focus can bring short-term gains if you are lucky, but customers and technology change rapidly, as Polaroid learned too late. Just like the shift away from slide rules and typewriters, we have witnessed the passing of another era in technology and the company which brought it to fruition.

We are reminded of the efforts taken at Motorola to achieve the goal of Six Sigma in their new product introductions. In 1988 and 1989, they achieved remarkable results and saw manufacturing labor costs reduce to almost half. Scrap was reduced by 65 percent per year, and Motorola immediately became more competitive in their market segment. As they moved into the 1990s and attempted to achieve 5 and 6 sigma designs, they often heard the following argument, "*Due to the exponential relationship of sigma scores to defects, there is not nearly as much savings when improving from 5 to 6 sigma as there is when improving from 3 to 4 sigma.*" They were convinced that they could no longer achieve the remarkable profit margin improvements of before. What made this scenario worse was that their teams actually believed it.

Internal metrics, such as sigma improvement levels based upon cleaning up designs in defects and waste, are only half correct. Consider a company which produces paper products. Through some manufacturing and production process focused improvements, the company can reduce the scrap and the amount of paper wasted through paper breaks and reel changes. However, as long as the focus is on reducing the amount of trim, the return per Six Sigma project will only get smaller. This is because the paradigm of trim and waste reduction has been established as the primary goal for this product. Contrast this with a focus on product platform application in alignment with market characteristics which cause their customers to choose their products over the competition across differentiated segments. New, breakthrough designs using different substrates, densities, materials, and processing technologies will largely be ignored if the cost of poor quality (COPQ) focus becomes the overriding goal for their business processes. Business processes must account for both cost control as well as investment of capital to increase growth. Six Sigma has evolved to the point where its new frontiers are on the growth side. This means Six Sigma has to be coupled with the business processes that govern technology development and product commercialization.

As consultants, we have been able to work with over 35 different companies in the deployment of Six Sigma. Many of these went on to deploy DFSS as a natural follow on to operational Six Sigma. We have been privileged to see some companies achieve results that match or rival GE. We have seen others fail despite their best efforts. For us, one thing is very clear in the deployment of DFSS: You must focus on acquiring true customer needs and then apply the discipline of Design For Six Sigma within the phases and gates of your product development process to efficiently transform those needs into new products and services.

A company which we have been able to work with since 2000 is Samsung SDI. Samsung SDI produces various displays including ones for color televisions and computer monitors, STN LCD, VFD, and rechargeable batteries. Samsung SDI kicked off their Six Sigma program with a vengeance in January of 2000. Within 24 months, they saw their profits more than triple to $530 million USD and their sales grow from $4 billion USD to $4.4 billion USD. In December of 2000 Samsung SDI was the first recipient of the annual South Korean Six Sigma Award.

SDI has deployed Six Sigma across all areas of management, one of which was their product development organization, with numerous DFSS projects focused on improving design as well as completely new innovations. SDI led Samsung Electronics to become the largest producers of televisions and flat panel display monitors in the world (*Newsweek,* 2002). Their flat panel displays for TVs and computer monitors were rated the number one value independently by two large electronic chains in the United States. Samsung SDI and Samsung Electronics, both as world leading companies, have maintained a mutually supportive relationship. The two launched an amazing string of technologies and products that are setting them up to become a powerhouse multinational company in their own right.

As Samsung SDI launched their DFSS program, they went through a rigorous process of matching the broad set of DFSS tools with their existing Product Development Process (PDP). As we will discuss in Chapters 5 and 6, generic product development TDFSS and DFSS roadmaps have been proven to help align companies' technology development and product design processes with the right mix of DFSS tools and best practices. Samsung SDI fully embraced the Critical Parameter Management (CPM) methodology we discuss in Chapters 8–13 to manage and balance the voice of customer and the voice of physical law throughout their development process. Within 6 months of launching DFSS, SDI had a well designed system of scorecards and tool application checklists to manage risk and cycle-time from the voice of the customer through to the launch of products that meet customer and business process demands. The culture of SDI embraced this disciplined approach and they have realized tangible benefits in a very short period of time. Just visit your local computer and electronics stores and look for Samsung products—they are the direct result of their recent DFSS initiatives. SDI is literally putting DFSS developed products on store shelves today and using product development methods they initiated just 2 years ago. One of them is OLED, which is recently emerging as a new type of display. As a result of a successful DFSS project, Samsung SDI became the first company in the world to produce the 15.1" XGA AMOLED display.

The product development process should be one of the top three strategic business process issues for any executive leadership team. Even if you have excellent technological platforms and world class sales and marketing capabilities, you must always make the management of the PDP (sometimes referred to as the product pipeline) a key part of the way you manage your business. The DFSS roadmap and tool sets presented in this text can, if followed with sincere and active leadership discipline, help your teams design cycle-times and manage risks that consistently deliver products and services that truly delight your customers.

You can launch a DMAIC (Define, Measure, Analyze, Improve, and Control) Six Sigma program with significant initial success without much regard for your business processes.

Chances are good that each function and operation has enough internal waste to yield numerous financial breakthrough projects during the first few years of a traditional Six Sigma initiative. However, achieving your top-line growth goals will be strongly improved by integrating Six Sigma tool applications within the core business processes which align key customer metrics with your flow of product offerings.

The best performance of launching products under the influence of DFSS comes from using the right tools at the right time from start to finish during your Phase/Gate product development cycle. Just like Samsung SDI, you must map the generic DFSS roadmap into your specific Phase/Gate process, develop scorecards for quick and easy measurable go/no-go decisions, and rigorously manage your PDP with data from properly selected and applied tools. This brings us to our next major recommendation: Executive management cannot take a hands-off approach to the design and structure of the product development process and the tools that are required to develop the data they need to manage risk and cycle-time.

We have seen some of the best-designed product development processes in the world. Many of these processes were making almost no impact on the company's cycle-time or commercial success. The usual reason is passive indifference to actually using the Phase/Gate discipline the process was supposed to embody. Few teams or individuals were ever held accountable for using specific tools and delivering specific results. We have also seen well-designed DFSS tools integrated into these Phase/Gate processes with little effect on success. Again, management indifference to the process, its deliverables, and its metrics lay at the root of the anemic performance. While we can't expect senior leadership to know all the intricacies of the DFSS tools and roadmaps, we must expect regular and disciplined gate reviews with real go/kill decisions based on business, customer, and capability metrics. The key issue for senior management is to establish a disciplined product development process, require and personally participate in its use, and structure a system of performance metrics that are routinely summarized and used to manage risk and drive growth at their operational level.

The first three parts of this book will provide an outline for a systematic approach of DFSS integration to product development process management in your company.

Again, we admonish you to take an active role in developing and using your PDP. Hold executives, managers, and teams accountable for the deliverables that come from proper tool utilization. Attend the regular gate reviews—ask yourself "When was the last time I sat in on a gate review and got involved with the teams and shared in the positive and negative implication of their results ?" Demand data, reject unfounded suppositions and guessing, and require statistical validation to back up the recommendations proposed at gate reviews. Make the hard decisions to kill the low probability of success projects early and manage short falls in project performance as proactively as you can. If you get involved with your PDP correctly, you will achieve PDP cycle-time reductions that are predictable and reproducible.

How is it possible to attain meaningful cycle-time reductions in your PDP if we add more customer needs and requirements definition tasks up front such as DFSS requires? Most commercialization cycle-time problems are attributed to correcting errors in judgment and problems created by undisciplined use of a limited set of tools that underdeveloped critical data. Few programs

are late because teams focused on preventing technical and inbound marketing problems. DFSS is about preventing problems and providing breakthrough solutions to well-defined requirements—not about fixing problems your people created in the earlier phases. In fact, as much as two-thirds of the cycle-time in new product development is spent correcting such problems.

There are two distinct areas that the DFSS roadmap will address, two "voices" which must be understood to minimize the redesign and design rework loop (build-test-fix engineering): The voice of the customer (VOC) and the voice of the product/process (VOP). Conducting Critical Parameter Management will remove the conditions that promote design rework.

Often a team will complete the design of an exciting new product only to hear the customer say, "That is not what I asked for." We will spend considerable time addressing this issue in Parts III and IV (Critical Parameter Management and Concept Development) and provide a roadmap to minimize this type of expensive commercialization error. We have seen countless new designs and concepts that no customer really wanted. The greatest opportunity to increase the efficient utilization of product development team resources is to reduce the number of projects that have no true "voice of the customer." In these cases, little or no data exists to back up the voice of the corporate specialists.

The other issue is that the product itself is incompatible with its manufacturing processes and the end use operating environment. How many times have we seen a product that is patentable but not manufacturable or fails to function as expected when the customer puts it to use? Parts V through VII cover the tools within the DFSS roadmap that are designed to prevent and minimize these kinds of problems. As an executive, you need to be in touch with these tools and how they provide the data you and your management teams need to manage risk.

## The Strategic View of Top-Line Growth

The following list of project types illustrates the transition a business must undertake to shift from bottom-line Six Sigma operations projects to top-line DFSS projects. Type A projects give you the most control over the market and your profit margins (assuming the customer values the new product), while Type D and E projects yield the lowest market control. Most DFSS programs start with Type C through E projects and evolve to Type A and B. If your DFSS program remains focused on Type D and E, you may still suffer the same fate as Polaroid and others. You can only cut costs so much—then you have to spend money to make money.

**Top-Line Growth Using Long-Term DFSS-Based Commercialization Projects**

**Type A Project:** Initiate market share by opening new markets with new designs
(*establish the price*)

**Type B Project:** Obtain market share in new markets with an existing design
(*at the current market price*)

**Type C Project:** Improve margins and revenue growth in existing markets with a new design
(*premium price*)

### Bottom-Line Growth Using Short-Term Hybrid DFSS/Operations Six Sigma Projects

**Type D Project:** Decrease cost of an existing design
(*hold the current price*)

**Type E Project:** Decrease product rework and warranty costs
(*reduce cost of poor quality*)

GE's former CEO, Jack Welch, stated, "You can't manage (grow) long term if you can't eat short term . . . any fool can do one or the other. The test of a leader is balancing the two" (Welch, 2001). While hundreds of companies will speak to their cost-reduction success using Six Sigma, only a fraction will state that it helped them achieve remarkable growth. Most of those actually attain growth through the additional capacity from production and transactional process improvement projects. Very few companies have been able to use Six Sigma to develop new products and services which "so delight the customer" that they impact the annual reports through increased growth and revenues. This book is about changing organizational behavior to grow the top line.

The model for strategic business growth can be illustrated as a matrix:

| Product \ Market | Existing | New |
|---|---|---|
| Existing | Type D/E (lower costs) | Type B (deliver value) |
| New | Type C (deliver value) | Type A (deliver value) |

A business can eat short term with cost-reducing Type D/E projects and then grow over the long term with value-driving Type A, B, and C DFSS-based projects and programs.

Operations (DMAIC) Six Sigma will help you solve your current problems and "eat short term." DFSS will prevent many of those same problems from ever occurring again and will leverage your resources to drive value into your future designs. If you do not develop new products that possess strong value in your customer's eyes, you will indeed starve. If much of your new product development resources are distracted from their mission because they are constantly fixing poor designs that have managed to get out into the plant and into your customer's hands, how can you ever find the time to fulfill your business strategy?

In some of the following chapters in this text, you will begin to see the strategic layout illustrated in the following list, defining the context in which a business deploys DFSS to generate new product development initiatives. It is a recipe for getting product development started right. These are the key elements that help drive value out to customers and return the required profits to the business and its shareholders.

***Define business strategy:*** *profit goals and requirements*
***Identify markets and market segments:*** *value generation and requirements*
***Gather long-term voice of customer and voice of technology trends***
***Develop product line strategy:*** *family plan requirements*
***Develop/deploy technology strategy:*** *technology and subsystem platform requirements*
***Gather product-specific VOC and VOT:*** *new, unique, and difficult needs*
***Conduct KJ analysis:*** *structure and rank the NUD* VOC needs*
***Build system House of Quality:*** *translate NUD VOC needs*
***Document system requirements:*** *create system requirements document*
***Define the system functions:*** *modeling performance*
***Generate candidate system architectures:*** *concept generation*
***Select the superior system concept:*** *Pugh concept selection process*

You can see that the strategy transitions quickly into tactical applications of specific tools and best practices. Financial performance will flow from your core competencies found within this list. Fail to fund, support, and execute on any one of these line items and your company could be in big trouble over the long term. It may look good to take short cuts in the short term but in the long term you will underperform. DFSS tools and best practices will greatly aid your efforts to gain significant improvements in financial performance. The gains come from your leadership and personal, frequent, visible support of these elements of success.

## Enabling Your Product Development Process to Have the Ability to Produce the Right Data, Deliverables, and Measures of Risk within the Context of Your Phase/Gate Structure

There is a fine balance that must be maintained between the following elements of a product development strategy:

1. A clear, flexible, and disciplined product development process
   - Most companies have a formal, documented product development process.
   - Most companies do not follow their own process with discipline and rigor.
   - The process allows for the insufficient development and documentation of the critical parameter data required to properly assess risk at a gate review.
2. A broad portfolio of tools and best practices
   - Most product development teams use an anemic, limited set of tools mainly due to time constraints imposed by management deadlines for technology transfer and product launch.

*NUD stands for New, Unique, and Difficult

- Product development teams have widely varying views regarding what tools should be deployed during product development. This causes the development of insufficient data required to manage phase-by-phase risk accrual.
- Management has avoided being prescriptive in requiring specific tool use, thereby requiring a predominantly reactive approach to risk management because they don't get the right data at the right time.

3. A rigorous approach to project management
   - Projects are funded without a clear, up-front, integrated project plan that illustrates a balanced use of tools and best practices on a phase-by-phase basis.
   - Project managers make up their plan as they react to problems—project plans are architected by a reactive strategy rather than a proactive strategy.
   - Project tasks are not underwritten by a broad portfolio of tools and best practices, assuring a series of self-perpetuating build-test-fix cycles.
   - Project task timelines are estimated using best case deterministic projections rather than using reasonable statistical estimates of the shortest, likeliest, and longest estimated task cycle-times. Critical path cycle-times need to be analyzed using Monte Carlo simulations.

Chapter 4 provides a detailed discussion of how these three items integrate to estimate, design, and manage cycle-time within the context of DFSS.

## Executive Commitment to Driving Culture Change

Being a proactive leader requires disciplined follow-through on product development process execution. DFSS can and will become a major source of success in your business if you spend the time to plan a disciplined implementation within the context of a well-designed and managed product development process. The goal is to transition your business from short-term cost efficiency to sustained economic growth over the long term. To do so, you must lead your organization to deliver value to your customers by giving them what they want. Then they will happily provide you with what you want.

***Lead boldly!***

## Summary

1. Six Sigma has to be coupled with the business processes that govern technology development and product commercialization.
2. Align the tools and best practices of DFSS with your product development process phases and gates.
3. Create management scorecards that measure new product development performance data in comparison to things customers directly state they care about.

4. Executive management must drive Six Sigma into the upstream organizations that do advanced platform and product planning and applied research and technology development.
5. Executive management cannot take a hands-off approach to the design and structure of the product development process and the tools that are required to develop the data they need to manage risk and cycle-time.
6. Establish a disciplined product development process, require and personally participate in its use, and structure a system of performance metrics that are routinely summarized and used to manage risk and drive growth at the operational and strategic levels.

## References

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