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ABSTRACT

Introduction

The purpose of this study is to investigate how Six Sigma has evolved, namely, what is it today and from what did it arise? To answer the aforementioned broad research question, the following subquestions are developed to guide the analysis:

Subquestion 1: what is the historical development of Six Sigma?

Subquestion 2: what are the processes of Six Sigma as envisioned by Motorola?

Subquestion 3: what are the differences and similarities between Six Sigma and the kaizen Japanese model of quality?

Research data was drawn from secondary sources such as books, scholarly journal articles, and industry publications, some of which give a broad understanding of Six Sigma, and some of which illustrate the breadth and history of application of Six Sigma and that application to relevant business topics.

Summary

This research clearly describes the roots of the Six Sigma quality movement, both in what it is today and from where it has come. These roots trace back all the way to the 1950s with groundbreaking work done by Dr. Deming and Dr. Juran, who stressed constant improvement and communication, respectively. This work, though seminal, was adopted wholeheartedly only by the Japanese, who had a strong need to improve their industrial production capabilities after World War II. However, the work was not widely adopted by the West. The West only began to adopt these principles, which had been heavily augmented and refined by the Japanese in the form of kaizen, after the Japanese began to make serious economic inroads into the U.S. and Europe.

The U.S. version of these principles, called Six Sigma, reflecting a 6 sigma error deviation rate in quality, has become widely adopted by major companies such as ITT and General Electric, to name a couple, but was started by Motorola. Motorola emphasized statistical process control (SPC) which is reflected in the Six Sigma name that it gave its quality program. The name stuck in the U.S., as has the stringent goal of 6 sigma which means a less than 3.4 parts per million error rate in the final product.

While manufacturing is a central focus of Six Sigma and kaizen also, service industries have gotten on-board with Six Sigma, measuring quality in terms of numbers of complaints and feedback on surveys. Companies such as General Electric, which has both manufacturing and service business units which use Six Sigma, and Bank of America, have had great success with Six Sigma.

Six Sigma has its roots in the Japanese movement called kaizen, which predates Six Sigma by more than a decade. Kaizen took the work of Dr. Deming and Dr. Juran and ran with it. Kaizen means “continuous improvement” and is at the heart of the matter of their brand of quality assurance. This “kaizen” is applied to every facet of business life

and, in fact, Japanese life in general. Instead of work just being about innovation versus maintenance as it usually is in the West, kaizen forms the middle ground between these two, assuring that continuous, incremental improvements are performed every day, or at least on a regular basis. This is in sharp contract to the usual way of doing business in the West, where big jumps are made by innovation but maintenance is inadequate to keep progress from sliding back.

The other major way in which kaizen differs from standard Western approaches to business is that kaizen is process-oriented where Western approaches are generally results-oriented. Kaizen is a longer term approach and will sacrifice earnings in the short run for process improvements that will lead to long-term success.

A whole strategy grew around the idea of kaizen so that the word kaizen eventually came to represent the whole Japanese quality movement and approach. This approach is a company-wide, top-down, yet bottom-up approach to strategy as opposed to the Western quality strategy of just having a quality control guy. This Japanese approach has resulted in several management approaches one may heard of, including Quality Control (QC) circles and just-in-time inventory, to name a couple. In Japan, kaizen has resulted in higher employee satisfaction, more change-oriented corporate cultures, better employee and management training, better communications, and concrete improvements in factory machinery. The Japanese, in fact, credit kaizen with their remarkable post-war recovery and economic ascendance.

Conclusions

The research findings indicate that, while Six Sigma is clearly a powerful force and has roots tracing all the way back to the 1950s with the work of Dr. Deming and Dr. Juran, evidently the major influence on the movement to Six Sigma methodology has been kaizen, not just as the concept of "continuous improvement" but as an entire strategy for quality. The parallels between kaizen, the strategy, and Six Sigma, the strategy, are unmistakable. While minor differences exist, they are overshadowed by the great similarities.

Indeed, both disciplines encourage leadership to avoid leading by fear or simple organizational authority. From small-group activities to cultural change to statistical methods to concentration on customer satisfaction, Six Sigma embodies the principles that were born of the Japanese experience in rebuilding their economy. As the West finds itself in an ever-more competitive business climate, both home and abroad, Japan's lessons are taking hold in the U.S. in the form of Six Sigma. Not to be outdone, the West has formally raised the bar to the level of 6 standard deviations from the mean where each Japanese company had set their goals differently. In fact, this is the most major difference between Japanese kaizen and Western Six Sigma, namely, the greater attention to statistical process control on the part of the West, although it exists in kaizen as well. However, the commitment to Six Sigma in the West by many companies is a positive sign

not just for the companies but for consumers, too. The attention to customer satisfaction present in Six Sigma will doubtlessly result in more products and services being tailored to actual, not just perceived, customer needs and desires. These products and services doubtlessly will be of higher quality than earlier ones also. This will lead to a winnowing out of the poor quality companies from the excellent quality companies. The West must hope that their companies survive. Clearly, this list of companies embracing Six Sigma, and other quality programs, is growing.

Hopefully, the widespread embrace of Six Sigma can lead to better work environments and better labor-management relations, since both are major focuses of Six Sigma and kaizen. Dr. Deming had some strong words to say on this subject and they were heard in kaizen and Six Sigma both. Yet Six Sigma has been adopted by Western companies sometimes as a slap-it-on, fix-all, panacea rather than as a long-term, ongoing commitment, which, if a widespread phenomenon, would spell defeat for this movement. Judging by the results being reported by major firms implementing Six Sigma in the West, however, it seems to be succeeding.

It actually would be a great thing to see continuous improvement in every walk of business and life, not just corporations, and maybe Six Sigma is the start of that. The "constancy of purpose" and the commitment to continuous improvement that Dr. Deming promoted, and kaizen and Six Sigma embrace, are wonderful words to live by in any endeavor or walk of life. Indeed, the whole Six Sigma program is so solid and wholesome, promoting values of long-term vision and commitment, cooperation with labor, teamwork, leadership, lifelong on-the-job training, and quality of not just the end product but of the business, work environment, and supplier and distributor relationships, that is hard to believe that it wouldn't work if given adequate support.

Finally, the West, though slow to follow Dr. Deming's lead, has learned from the Japanese and is making up for lost time with a vengeance. Clearly shaped by the West's higher emphasis on results than process, Six Sigma is the embodiment of both a result and a process: the process is kaizen and the result is 6 sigma quality.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

Context of the problem

Six Sigma is a widely adopted approach to Quality Management that has its roots in the Japanese concept of Kaizen as it was applied by Motorola in the U.S. and further used and modified by many other companies. Six Sigma has often been partnered with other quality programs such as TQM, Lean, and ISO 9000 & 9001 to create powerful quality systems for major U.S. firms, such as International Telephone and Telegraph, General Electric, Xerox, and Honeywell. While beginning as a manufacturing process control system, it has been successfully applied to large service companies like the Bank of America, too (Wade 2004, 1), is even being used to manage credit, receivables, and collections (Schaffer 2004, 1), and also to improve the loan portfolio performance at the Student Loan Marketing Association (Sallie Mae or SLMA). (Taghaboni-Dutta and Moreland 2004, 1) It involves serious statistical process control, cultural change, employee training, and commitment to customer satisfaction. It embraces fiscal measures and controls as well as its important approach to team management and dynamics that is driven by the commitment to continuous improvement that *Kaizen* means and demands.

Moreover, this Kaizen, this commitment to continuous improvement, has been credited for creating Japan's competitive success. (Imai 1986, xxix) It was this success

that Motorola set out to emulate in their statistical process control model (SPC) that embraced Six Sigma quality as a goal. Six Sigma refers to six standard deviations of error from the mean which translates into 3.24 errors per million, a very ambitious target. (Kumar and Gupta 1993, 85) Attainment and maintenance of Six Sigma requires precise statistical measurement and mathematics. This name of the target became synonymous with a whole industry devoted to the American brand of Kaizen-driven quality control. This target requires a continuous and sustained commitment to achieve it, which Kaizen provides. American achievement-motivation training can create a Kaizen-like consciousness, too, says Lawrence Holpp. (Holpp 1989, 53) Holpp suggests that there are several basic principles to infusing Kaizen into corporate culture:

1) set goals of moderate difficulty
2) facilitate feedback
3) let employees take responsibility for their work
4) create an action-oriented culture. (Holpp 1989, 53)

However, Kaizen goes beyond simple commitment to continuous improvement, to team design and management, attention to issues surrounding corporate culture, and concern for high customer satisfaction.

Unfortunately, a great deal of American business suffers from devoting attention to just one of the two main types of technological development. (Imai 1986, 24) One type, innovative technology, is actively sought by U.S. firms, however, Kaizen technology, meaning technological progress by small, continuous, incremental improvements is usually ignored by U.S. firms, to their detriment. (Imai 1986, 24) The Japanese excel using Kaizen as well as innovative improvement. Furthermore, management by the Taylor model of rapid implementation of an "optimal" solution imposed from top

management assumes that there is one, final state of perfection to be achieved, while the truth that Kaizen understands is that there is always room for improvement and that the firm must attend to processes not results. (Webb and Bryant 1993, 10)

The Japanese influence on Six Sigma is further felt in the judo concepts that permeate the regimens that Six Sigma employs with its Green, Black, and White Belt levels of sophistication in training. Interestingly, Judo is the analogy used for Six Sigma because martial arts are considered by the Japanese as a way of life leading to personal fulfillment, physical and mental liberation, and, above all, spiritual growth. (Truscott 2003, 10) Thus, a Six Sigma Black Belt feels empowered to perform great feats. (Truscott 2003, 10) As Dr. Jigoro Kano, the founder of Judo, says, "The ultimate aim of Judo is to perfect yourself and to contribute to the well-being of mankind." (Truscott 2003, 10) These are certainly noble aims!

While Kaizen and judo are at the heart of Six Sigma, Motorola added much to them, including a focus on statistical measurement, DMAIC analysis, and influences from Dr. Deming and Dr. Juran. (Imai 1986, xxvii) Dr. Deming's fourteen points are often cited in the literature surrounding Six Sigma and the Japanese adoption of Kaizen appears to have started with their embrace of Dr. Deming's and Dr. Juran's work. (Imai 1986, xxvii) Dr. Deming's fifth point calls for constant and permanent improvement of systems of production and service, while his fourteenth point asserts that it requires a top-level management team with a well-defined plan of action to accomplish a quality mission. (Webb and Bryant 1993, 14) Thus, it appears that the impetus for continuous improvement in quality has come full circle from the U.S., which didn't fully appreciate it

or embrace it from Dr. Deming, to the Japanese, who not only embraced it but built a whole movement around it and transformed their entire industrial base with it, back to the U.S., which embraced it in the form of Six Sigma, finally! The focus of statistical measurement is aimed at ensuring high levels of repeatability in production so that errors are reduced to no more than would occur at random. In addition, the DMAIC model is an integral part of Six Sigma's Quality Circle method and some companies have expanded on that model to make it IDMADICC:

1) Identify the project
2) Define the project
3) Measure current process performance
4) Analyze the current process
5) Develop the improvements; pilot and verify
6) Implement the changes; achieve breakthroughs in performance
7) Control at new level; institutionalize to hold the gains
8) Communicate new knowledge gained; transfer solution to similar areas.
(Truscott 2003, 8)

Thus, there are several facets to the Six Sigma approach to quality.

Statement of the problem

This study focuses on what Six Sigma is today and what its roots are, both in Japan and in the West, and what Six Sigma offers the world today. Clearly, Kaizen and judo are driving forces, but how and to what extent they shaped Six Sigma is a central issue. Six Sigma is an important force in many companies today and Motorola originated it, so Motorola's influence will be studied in depth. The degrees to which Six Sigma is about

statistical methods, leadership, cultural change, teamwork, training, and commitment to continuous improvement will be examined to yield a basic understanding of what Six Sigma is today. Dr. Deming's and Dr. Juran's work will be examined to the extent to which those have been incorporated into Six Sigma.

Specific research question and subquestions to address the problem

The main research question is: how has Six Sigma evolved, namely, what is it today and from what did it arise?

To answer the aforementioned broad research question, the following subquestions are developed to guide the analysis:

Subquestion 1: what is the historical development of Six Sigma? This will be investigated in chapter 2.

Subquestion 2: what are the processes of Six Sigma as envisioned by Motorola? This will be investigated in chapter 3.

Subquestion 3: what are the differences and similarities between Six Sigma and the Kaizen Japanese model of quality? This will be investigated in chapter 4.

Chapter 5 will be the conclusions and recommendations about the research.

Significance of the study

The study will be significant to those wanting to know just how influential Six Sigma is today and to those seeking to get at the essence of Six Sigma, especially for the evaluation of Six Sigma as a program to be embraced by a firm. While there are many implementations of Six Sigma, and case studies of them, one can get lost in a sea of literature surrounding Six Sigma and miss the central focus of continuous improvement (Kaizen) that should be the driving force behind any firm's Six Sigma program. Hopefully, this study would help a leader to design her or his own Six Sigma program based on central principles rather than totry to apply the precise methods of a firm that has come before. Such an application could suffer from not being close to the right fit for the company while also be lacking in the core commitment of Kaizen.

Research design and methodology

The design of this research is a qualitative design. A combination of historical, descriptive, and developmental research methodologies will be used in this research. The historical method tends to reconstruct the past objectively and accurately, often in relation to the tenability of a hypothesis and, in this case, will relate the history of Six Sigma from today back to Motorola. (Isaac and Michael 1982, 42) The descriptive method tends to systematically describe a situation or area of interest factually and accurately, which means here describing the statistical methods, leadership, cultural change, teamwork, training, and commitment to continuous improvement of Six Sigma. (Isaac and Michael 1982, 42) The developmental method tends to investigate patterns and sequences of growth and/or change as a function of time and, in this case, means showing how Six Sigma has evolved from the central core concept and quality movement of Kaizen, et.al. (Isaac and Michael 1982, 42) Research data will be drawn from secondary sources such as books, scholarly journal articles, and industry publications, some of which give a broad understanding of Six Sigma, and some of which illustrate the breadth and history of application of Six Sigma and that application to relevant business topics.

Organization of the Study

I will rely on secondary sources primarily, especially journal articles and books. To date, I have found roughly 20 scholarly journal articles and 12 books, with several

more books being searched for by the library. These are mostly business sources although some of the books are engineering sources. Some deal with the general problem of describing the main thrust of Six Sigma, while some deal with individual companies' applications of Six Sigma.

The study will be presented in five chapters, the first being the Introduction, which presents the context of the problem, statement of the problem, research question and subquestions, significance of the study, research design and methodology, and the organization of the study. The chapter will establish the purpose of the study and its depth and breadth.

Chapter 2 will present what Six Sigma is today and the major progression of application by companies since Motorola. Companies such as General Electric and Xerox will be examined with an eye towards how they approach it that is unique or different from most others using Six Sigma technology.

Chapter 3 will focus on Six Sigma as it was originally envisioned and applied by Motorola in the late 1980s. Attention will be given to the central tenets and approaches used by Motorola rather than giving a catalog of accomplishments, though some will be given to illustrate what worked then.

Chapter 4 considers Kaizen as the driving force behind Six Sigma, from where it sprang, and how much of Six Sigma is actually derived from Kaizen. Accordingly, a good overview of Kaizen will be presented, both in conceptual terms of the implications of the term "continuous improvement", and in the nitty-gritty of the applications and processes that have been designed from Kaizen principles and are collectively labeled "Kaizen".

Chapter 5 draws conclusions about what the core concepts of Six Sigma are and should be, what a leader or manager might want to know about Six Sigma in order to consider applying it, and what Six Sigma isn't and cannot do. All too often, Six Sigma is mistakenly seen as some sort of panacea that can be sprinkled like pixie dust over a problem which will then magically be fixed. The chapter will cover the ingredients necessary for making a Six Sigma endeavor successful.

CHAPTER 2

THE HISTORY OF SIX SIGMA

Introduction

Any history of Six Sigma has to begin with what Six Sigma is today, a vibrant, influential part of mainstream industry in the United States. Six Sigma has many facets in implementation today and this chapter will touch on those that are central to its nature and on the companies that were most important to its development. Motorola, being credited with being the creator of Six Sigma, is a special case, so chapter 3 will concentrate on Motorola.

In a nutshell, Six Sigma is about a strong customer focus, statistical methods, leadership, cultural change, teamwork, training, and commitment to continuous improvement. In fact, it derives it name from the measurement of standard deviations in statistical process control (SPC). (Kumar and Gupta 1993, 85) Having less than a 3.4 parts per million defect rate is the target of Six Sigma. (Kumar and Gupta 1993, 85) This corresponds to plus or minus 3 standard deviations from the mean of a distribution of production and a spread of "6 sigma," hence the name. (Kumar and Gupta 1993, 85) This equates to a yield of 99.99966%. (Truscott 2003, 4) This may seem unattainable to some and too high a goal to others, but the reality is that errors are costly and companies are finding it cheaper to prevent errors than to fix the problems that having many errors create. In some industries, a high error rate can be catastrophic. The effect of lowering from 6 sigma to 5 sigma is to increase the number of takeoff and landing incidents in aircraft flight from 12 per million to 9 per 10,000! (Truscott 2003, 4) Clearly, Six Sigma is a goal

worth striving for and is, indeed, a standard people have come to expect from crucial conveyors such as the airlines, even if that standard is not explicitly named "Six Sigma."

Teamwork

Team dynamics are the processes surrounding team building, leadership, and training. Responsibility begins at the top of the organization and works down. Executive management must inspire, own, fund, and drive Six Sigma initiatives and they establish the focus of the initiatives. (Harry and Schroeder 2000, 172) Using Judo belts as a model, position titles are created. A "Senior Champion", a strategic corporate-level position, must also be established to be fully responsible for the daily corporate affairs of Six Sigma management. (Harry and Schroeder 2000, 172) A "Deployment Champion" must be created to be responsible for each business unit and is responsible for the development and execution of Six Sigma implementation and deployment plans. (Harry and Schroeder 2000, 173) A "Project Champion" is a tactical position that often is dedicated for just two years and is responsible for identification, selection, execution, and follow-up of Black Belt projects. (Harry and Schroeder 2000, 173) "Deployment Master Black Belts" are highly dedicated individuals having a highly technical orientation, usually at the business level. (Harry and Schroeder 2000, 173) Responsible for training students in Six Sigma methods, "Master Black Belts" need sound technical skills, a strong stage presence, and credible leadership ability. (Harry and Schroeder 2000, 174) "Project Black Belts" are responsible, as the name suggests, for performing the requirements of his or her project and for realizing the associated benefits. (Harry and Schroeder 2000, 174) "Process

Owners" are line managers who ensure that process improvements are captured and sustained. (Harry and Schroeder 2000, 175) "Six Sigma Green Belts" work part-time in their specific areas, to assist Black Belts, and take on mini-projects. (Harry and Schroeder 2000, 175) Finally, "Project Team Members" gather and analyze data under the guidance of Black Belts, and provide expertise for the projects. (Harry and Schroeder 2000, 175) Companies use these teams to focus on a number of things: 1) project cost savings, 2) minimizing the greatest cause of customer dissatisfaction, 3) process-level causes of defects and customer-satisfaction concerns, 4) specific problems. (Harry and Schroeder 2000, 167-8)

Leadership

Closely associated with teams is the concept of leadership. An excellent Six Sigma team leader is one who develops in her- or himself the ability to lead by intellectual, personal, and inspirational authority, as opposed to authority by fear or organizational authority. (Truscott 2003, 140) Intellectual authority is knowledge that earns the respect of others. (Truscott 2003, 139) Personal authority is based on trust, respect, and loyalty. (Truscott 2003, 139) Inspirational authority means being driven by a sense of purpose and dedication. (Truscott 2003, 139) The remaining two types of authority are self-explanatory and will not be discussed here. Clearly, Six Sigma encourages positive leadership! Furthermore, John Kotter outlines eight basic steps toward creating the context for effective leadership:

1) Establish a sense of urgency around change initiatives.
2) Create a guiding coalition to support change initiatives.

3) Develop a clear vision and strategy for driving change.
4) Communicate the change vision.
5) Empower employees for broad-based action.
6) Generate short-term wins.
7) Consolidate change and produce more gains.
8) Anchor new approaches to business and work in the organization's culture. (Smith, Blakeslee, and Koonce 2002, 67)

This whole commitment to change is reflected in the discussion, further on, which follows considering cultural change.

Customer Satisfaction

As one might expect of a quality improvement system, attention to customer satisfaction is a chief focus of Six Sigma. "Understanding value from the customer's perspective is the first principle for us because if you get that wrong, then, by definition, the rest of what you do is waste," says Mike Joyce, Vice President of Lockheed Martin. (Smith, Blakeslee, and Koonce 2002, 119) In order to gain this understanding, a firm must possess or acquire the means of assessing customer satisfaction in a quantifiable way. (Smith, Blakeslee, and Koonce 2002, 119) "One of the big advantages of implementing Strategic Six Sigma inside an organization is that it hardwires process improvements (via Six Sigma projects) not only to business strategy, but also to customer requirements and broad marketplace analysis," say Smith, et.al. (Smith, Blakeslee, and Koonce 2002, 123) Smith, et.al., suggest that companies apply some basic rules toward customer satisfaction assessment. (Smith, Blakeslee, and Koonce 2002, 129) First, the firm shouldn't assume that it knows what customers want. (Smith, Blakeslee, and Koonce 2002, 129) Second, it should take an outside-in perspective. (Smith, Blakeslee, and

Koonce 2002, 129) In other words, look at one's firm from the perspective of an outsider. Third, the firm should focus on robust approaches to gathering "voice-of-customer" data. (Smith, Blakeslee, and Koonce 2002, 131) Fourth, it should leverage that data into a refined set of "critical customer requirements" against which company performance can be measured. (Smith, Blakeslee, and Koonce 2002, 134) These form the backbone of the Six Sigma approach to customer satisfaction.

Organizational Cultural Change

Obviously, the commitments and processes mentioned so far cannot occur in a vacuum. In fact, Six Sigma requires a broad degree of organizational cultural change to achieve its ends. Caterpillar CEO Glen Barton writes in their 2000 annual report:

> A key part of the strategy is institutionalizing a 6 Sigma culture and philosophy. 6 Sigma is a relentless quest for perfection through the disciplined use of fact-based, data-driven, decision-making methodology. It will enable us to make quantum gains in quality and reliability, and will touch everything we do at Caterpillar. [It will also] become our way of life, benefiting customers, dealers, suppliers, employees, and shareholders. We will become the benchmark for institutionalizing 6 Sigma culture deployment excellence. (Smith, Blakeslee, and Koonce 2002, 10)

Tennant relates in his book, Design for Six Sigma, about the cultural transition to Six Sigma at one firm that:

> The critical points of note are that, from the very beginning, the nature of the Design for Six Sigma approach gave rise to a real need for almost abrasive cultural change within the business management and IT divisions. Business leaders who were happy to offer 90 per cent service to customers had to be encouraged to think of failing the customer at less than four parts per million. IT managers, who were happy to dominate the design with technical issues and requirements, had to be encouraged to subjugate their design parameters to customer CTQ constraints. (Tennant 2002, 70)

As John Lupienski, the head of quality for one of Motorola's most successful plants in 2001 and 2002, once said, "When strategy and culture clash, culture always wins." (Devane 2004, 84) Attending to culture pays handsome rewards whenever a large-scale change effort is made. (Devane 2004, 84) One way of achieving this is for managers to coach team members and peers regarding culture-related aspects of work instead of only performance-related aspects. (Devane 2004, 233) Another way is establishing a group of top level managers who listen to observations from lower organizational levels about manager behavior. (Devane 2004, 233) The group then decides whether to coach the manager or to recommend rectifying the culture. (Devane 2004, 233)

Commitment to Continuous Improvement

Finally, the concept of and commitment to continuous improvement are central to having success in Six Sigma. Dr. W. Edwards Deming stressed the need for continuous improvement in quality management with his fifth point, "Improve constantly and forever the system of production and service." (Basu and Wright 2003, 13) While this is an extension of the Japanese concept of Kaizen, which will be covered in depth in chapter 4, the Japanese actually originally embraced continuous improvement due to the consulting work of Dr. Deming in the 1950s and 1960s. (Basu and Wright 2003 12)

Suffice it to say at this point that Kaizen begins with a philosophy of commitment to continuous improvement and ends with an entire program that implements that philosophy. Both Kaizen and Six Sigma have been heavily influenced by Dr. Deming's Fourteen Points of Quality, so the points are worth listing here:

1) Create constancy of purpose toward improvement of product and service.
2) Adopt the new philosophy.
3) Cease dependence on inspection to achieve quality.
4) End the practice of awarding business on the basis of the price tag.
5) Improve constantly and forever the system of production and service.
6) Institute training on the job.
7) Institute leadership.
8) Drive out fear.
9) Break down barriers between departments.
10) Eliminate slogans, exhortations, and targets for the workforce.
11) Eliminate work standards – quotas – on the factory floor.
12) a) Remove barriers that rob the worker of the right to pride of workmanship.
b) Remove barriers that rob people in management and in engineering of their right to pride in craftsmanship.
13) Institute a program of education and self-improvement.
14) Put everybody in the company to work to accomplish the transformation. (Basu and Wright 2003, 13)

Note also that point #1 stresses "constancy of purpose" which indicates quality is a continuing purpose not a goal that can be reached. (Basu and Wright 2003, 13) Dr. Juran, another quality guru from the west who consulted in Japan, stressed communication and Dr. Feigenbaum, the worldwide chief of General Electric's manufacturing operations for a decade until the late 1960s and coiner of the phrase Total Quality Management, stressed that quality must be assessed from the point of view of the customer not of the designer. (Basu and Wright 2003, 15) From the work of these men, the Japanese developed Total Quality Management (TQM) and Kaizen and transformed the quality of their industries. (Basu and Wright 2003, 12) From there, the quality movement moved to the United States and Europe as a competitive response to the high quality imports that were coming from Japan.

Six Sigma Companies

The first organization to embrace the new quality movement in the form of Six Sigma was Motorola. So influential were they as designers of what Six Sigma is today that an entire chapter, chapter 3, is devoted to their designs. Therefore, the discussion here will cover the contributions made by other early Six Sigma pioneers such as General Electric and Allied Signal, who followed Motorola.

To General Electric's CEO Jack Welsh, GE is about values such as employee satisfaction, customer satisfaction, and cash flow, not numbers. (Harry and Schroeder 2000, 4) They know that customer satisfaction translates into high market share, that high employee morale means high productivity, and that cash flow means the company has retained its customer focus and its passion for excellence. (Harry and Schroeder 2000, 4) Values like these empower the organizational culture and make Six Sigma success possible. The GE program revolved around the following concepts:

> 1) Critical to Quality – the determination of and development of attributes most important to the customer.
> 2) Defect – the identification of failure to meet customer wants.
> 3) Process capability – what the process can deliver.
> 4) Variation – what the customer sees and feels, as against what the customer wants.
> 5) Stable operation – ensuring consistent and predictable processes to improve what the customer sees and feels.
> 6) Design for Six Sigma – designing to meet customer needs and process capability. (Basu and Wright 2003, 55)

GE has further developed the Six Sigma model by creating a six phase training roll out that the Six Sigma Academy advises for use, as follows:

1) Business units select champions and Master Black Belts. The Six Sigma Academy recommends one Champion per business group and one Master Black Belt for every 30 Black Belts.
2) Champions and Master Black Belts undergo training. The overriding deployment plan is developed.
3) Champions and Master Black Belts, with the assistance of Black Belts, begin identifying potential projects.
4) Master Black Belts receive additional training, focusing on how to train other staff.
5) Black Belts undergo training and the first projects are officially launched.
6) Black Belts begin training Green Belts. (Basu and Wright 2003, 56)

New methods were not the only way that General Electric pioneered in the Six Sigma field. By 1996, it also was the first completely service-based company in the world to apply Six Sigma methodology. (Tennant 2001, 6) GE has experienced great success from this, as measured by their impressive financial returns since implementing Six Sigma. (Tennant 2001, 6) Other companies, especially Lockheed Martin, Bank One, Stanford Hospital and Clinics, and the City of Fort Wayne, Indiana, have followed GE's lead in adopting Six Sigma methodologies to services, both public and private. (George 2003, 5)

But General Electric was not the only company besides Motorola to make significant contributions to Six Sigma. Allied Signal pioneered the Six Sigma Breakthrough Strategy as it is known today, beginning in 1991. (Harry and Schroeder 2000, 214) "The Six Sigma Breakthrough Strategy is a disciplined method of using extremely rigorous data-gathering and statistical analysis to pinpoint sources of errors and ways of eliminating them," say Mikel Harry and Richard Schroeder. (Harry and Schroeder 2000, 23)

Other Quality Improvement Programs

Finally, it is worth mentioning here that Six Sigma is sometimes used in conjunction with other methods of quality control, notably Total Quality Management, ISO 9000, ISO 9001, and Lean, but most especially Lean. In fact, companies such as Xerox use them together and term it simply Lean Six Sigma. (Fornari 2004, 1) At Xerox, the focus is not only on quality, but on creating lean work processes that are faster and more flexible and more capable of sustaining profit and revenue growth. (Fornari 2004, 1) In his book, *Lean Six Sigma for Service*, Michael L. George relates that Lean contributes speed, efficiency, and elimination of waste to the Lean Six Sigma approach. (George 2003, 24) The strength of Lean is to enable the company to see cost and lead times where they never saw them before. (George 2003, 24) The combination of Lean and Six Sigma is a powerful one as witnessed by Xerox in their recent pull-back from the brink of disaster.

Cost/Benefit Analysis

Six Sigma is not about achieving quality for its own sake but rather for the purpose of adding value for the customer and the company. (Harry and Schroeder 2000, 23) The added value has been impressive for Allied Signal. It went from having a market value of $4 billion in 1991 to $29 billion in 1998, largely due to Six Sigma. (Harry and Schroeder 2000, 215) They have achieved a cost reduction of $1,400,000,000, a 520% price-per-share growth, introduction time for new products has dropped 16%, and the billing cycle

has been reduced by 24%. (Tennant 2001, 69) Yet they have equally impressive goals for today and the future, including reducing inventory levels, increasing productivity by 6%+, having 99.8% on-time delivery, running at full capacity, and much more. (Harry and Schroeder 2000, 215) That it has added value for the company is clear and it is hard to imagine doing that without increasing customer satisfaction at the same time.

Similarly, GE has had incredible success from Six Sigma, attributing $1,500,000,000 in savings in 1999 alone to Six Sigma, expected an annual rate of savings of $6,000,000,000 in the future, and an average increase in share price of 40% each year! (Tennant 2001, 69) Likewise, in 2003, Xerox claimed a $6 million return on a $14 million investment in Lean Six Sigma. (Mulcahy 2004, 1)

Summary

Six Sigma has shown itself to be a powerful and growing force in the U.S. economy. Companies both large and small have reaped enormous benefits from it, both in manufacturing and service industries. In fact, many different types of companies have employed it with success. There is the failing, however, to portray Six Sigma as simply a quality assurance initiative while the approach necessary for its success and the success of the companies that employ it is one of transforming the entire company with quality and customer service as primary, overriding strategies. Indeed, these must become part of the mission of the company for the full power of Six Sigma to be experienced. Furthermore, applying Six Sigma goals, without quality becoming the overriding mission of the firm, can do more harm than good when the performance expectations of employees by

management are raised without the corresponding strategic support which is necessary to accomplish what should be their mission.

CHAPTER 3

MOTOROLA'S VISION OF SIX SIGMA

Introduction

Up until the 1970s, quality assurance and quality control groups functioned as policemen; they just inspected the product for defects when completed. (Kumar and Gupta 1993, 85) Motorola realized that, in order to compete with Japanese companies in quality and other Far East companies in cost, they would have to rethink the function of quality control. (Kumar and Gupta 1993, 85) They needed well-trained, experienced personnel who would be more than policemen. (Kumar and Gupta 1993, 85) These personnel would, through their expertise, assist production to optimize processes, eliminate or minimize defects, and continuously improve customer satisfaction. (Kumar and Gupta 1993, 85)

Developing the Six Sigma Program

To accomplish this, Motorola developed the Six Sigma Program and the accompanying philosophy. (Kumar and Gupta 1993, 85) This program would ensure that 3.4 parts per million (ppm) or fewer are defective in every process step. (Kumar and Gupta 1993, 85) This Six Sigma concept addresses quality in every aspect of the business: products and services, administration and operations, manufacturing and nonmanufacturing. (Kumar and Gupta 1993, 85) It combines the following key components:

1) a primary goal of total customer satisfaction

2) common, uniform quality metrics for all areas of the business
3) identical improvement rates for all areas of the business measured on one scale
4) goal-directed incentives for managers and employees
5) coordinated training in reasons for these goals and ways to achieve them. (Kumar and Gupta 1993, 85)

In Six Sigma, quality control personnel determine the performance of a product by measuring the difference between the design requirements for the product, its characteristics, parts, and steps, and their actual values. (Kumar and Gupta 1993, 85) These characteristics are produced by suppliers of manufacturing raw materials and by factory processes. (Kumar and Gupta 1993, 85) At each step in the process, attempts are made to reproduce characteristics identically from unit to unit, accepting that some variation occurs within each process. (Kumar and Gupta 1993, 85) The variation is quite small for processes that rely on real-time feedback to control the outcome, but for others it may be large. (Kumar and Gupta 1993, 85) This statistical variation is measured in standard deviations from the mean with the normal variation, defined as process width, being plus or minus 3 sigma. (Kumar and Gupta 1993, 85) This implies that 2700 parts per million will fall outside the normal variation of plus or minus 3 sigma, which in and of itself doesn't seem disconcerting. (Kumar and Gupta 1993, 85) Ultimately, however, when building something that has 1200 parts or steps, one can expect 3.24 defects per unit, which is unacceptable. (Kumar and Gupta 1993, 85) To combat this, Motorola sought the much more stringent standard of Six Sigma.

Quality System Reviews

To achieve this corporate standard, Motorola established quality system reviews (QSRs) and emphasized statistical process control (SPC) techniques to build a strategy working towards zero defects. (Kumar and Gupta 1993, 85) A cross-functional team of about four high-level management experts representing diverse parts of the company conducts QSRs twice per year, taking one week to complete each time. (Kumar and Gupta 1993, 85) Motorola uses QSRs to evaluate each major business unit's quality system's continuing health. (Kumar and Gupta 1993, 85) QSRs define how business should be conducted, set a common goal for perfection for all parts of the organization, and foster awareness of quality system requirements. (Kumar and Gupta 1993, 85) QSRs also encourage the exchange of ideas across areas of the company and renew Motorola's focus on quality. (Kumar and Gupta 1993, 85-86) Using formal QSR assessment forms and review procedures, the review teams record macro views of the business units, recognize their achievements, shortcomings, and opportunities, and offer recommendations for continuous improvement. (Kumar and Gupta 1993, 86) The QSR process fosters improvement and insures that the quality system achieves customer satisfaction. (Kumar and Gupta 1993, 86) In 1991, Motorola defined the quality system as "the collective plans, activities, and events designed to ensure that products, processes, and services will satisfy given customer needs." (Kumar and Gupta 1993, 86) To accomplish this, the company includes a detailed audit of ten subsystems in the QSR:

1) quality system management
2) new product, technology, or service development and control
3) supplier (internal or external) control
4) process operation and control

5) quality data programs
6) problem-solving techniques
7) control of quality measurement equipment and systems
8) human resource involvement
9) customer satisfaction assessment
10) software quality assurance. (Kumar and Gupta 1993, 86)

Support of Top Management

Of course, any program having the scope of Six Sigma must have support and commitment from the very top of the organization. Motorola's upper management has demonstrated its commitment to quality in important ways: 1) the chairman of the board, the CEO, and other top managers make regular visits to customers and write detailed reports having specific recommendations, after such visits, 2) the CEO chairs the meeting of the operating and policy committee where key initiatives on quality, such as the results of management visits to customers, QSRs on major company parts, the cost of poor quality, and quality shortfalls and breakthroughs, are discussed, and 3) those who have made outstanding contributions to quality receive the Chief Executive Officer Quality Award from the chairman or the CEO. (Kumar and Gupta 1993, 86)

The Austin Plant Experience

One implementation of this Six Sigma program by Motorola was at their Austin, Texas assembly plant beginning in May 1988. (Kumar and Gupta 1993, 86) The case study at Austin neatly shows how Six Sigma was envisioned and implemented by Motorola, what obstacles they met and overcame, and what they learned from the

experience. (Kumar and Gupta 1993, 86) While it is not clear from the literature, this Austin experience may have been Motorola's first with Six Sigma.

The Austin organization began by accepting statistical process control (SPC) as their tool for measurement and achievement of Six Sigma. (Kumar and Gupta 1993, 86) They believed the goal of Six Sigma was extremely ambitious, yet attainable. (Kumar and Gupta 1993, 86) The implementation of SPC began by hiring a statistical consultant experienced enough to build the system and a coordinator to run the program and later take over from the consultant. (Kumar and Gupta 1993, 86) They made both of these individuals members of all the problem-solving teams. (Kumar and Gupta 1993, 86) At first, the coordinator worked for the operations manager but later became part of the quality organization. (Kumar and Gupta 1993, 86) Then, management decided what should be accomplished by implementing SPC in the manufacturing area. (Kumar and Gupta 1993, 86) It also established benchmarks evaluating the effectiveness of Six Sigma at each given point. (Kumar and Gupta 1993, 86) Furthermore, the coordinator created a plan to track the program's success. (Kumar and Gupta 1993, 86)

In conjunction with these initial plans, the Austin plan identified six essential elements of SPC:

1) participative problem-solving teams
2) education and training programs
3) improvement in employee attitude
4) improvement in communication among employees and between employees and management
5) a QA certification program
6) the design of experiments. (Kumar and Gupta 1993, 86-87)

To make SPC effective, it was clear that each element above had to be effectively implemented.

Participative Problem-Solving Teams

Next, Austin's participative problem-solving (PPS) teams consisted of a manufacturing manager, a group leader, a maintenance technician, two operators, an engineer, and a QA representative, as well as, a member responsible for operations before and after the study, and a facilitator. (Kumar and Gupta 1993, 87) Each team member had the obligation to participate, the right to present ideas, and a specific role to play. (Kumar and Gupta 1993, 87) Efforts were made to ensure that each member felt that her or his experience and opinions were valued in reaching the goal of Six Sigma. (Kumar and Gupta 1993, 87) The role of the sponsor, an upper-level manager, was to focus the meeting on the problem. (Kumar and Gupta 1993, 87) When a team needed an expert from outside their immediate network, the sponsor arranged it. (Kumar and Gupta 1993, 87) For example, during a new installation, the start-up team needed the help of an expert from Malaysia, so the sponsor brought the expert in to visit for two weeks. (Kumar and Gupta 1993, 87) Sponsors also procured equipment, as when Motorola's scribe team recommended a wafer wash system to minimize silicon dust; because the team recommended it, the manager got the money approved in just one week. (Kumar and Gupta 1993, 87)

Specifically, each team selected a chairperson by vote, with each member having one vote, and the chairperson was responsible for the agenda, ran the meeting, and issued

action items that were required to complete the project. (Kumar and Gupta 1993, 87) Importantly, management selected coordinators for each team who were knowledgeable in statistics and problem-solving techniques. (Kumar and Gupta 1993, 87) Since the team experts were not knowledgeable about SPC tools, the coordinators provided statistical assistance. (Kumar and Gupta 1993, 87) These coordinators also published the meeting minutes, designed statistical experiments, helped analyze the results, and ensured that meetings were scheduled and punctual. (Kumar and Gupta 1993, 87)

Organizational Culture

Separate from the team building, Motorola at Austin created an organizational culture in which process engineers and technicians collaborated to implement a design of experiments (DOE) methodology to eliminate problems. (Kumar and Gupta 1993, 87) They held brainstorming sessions to comprehend problems that arose from failing to consider major process variables. (Kumar and Gupta 1993, 87-88) Because technicians and operators spent 100% of their time with the equipment, it was they, not the process engineers, who really understood machine variations and who were considered essential in the DOE implementations. (Kumar and Gupta 1993, 88)

From the beginning, Austin assembly realized that they could not implement SPC throughout the manufacturing area if only a small number of people were knowledgeable in SPC. (Kumar and Gupta 1993, 88) Consequently, all levels of the entire organization had to be trained in SPC and in the proper application of statistical tools. (Kumar and

Gupta 1993, 88) To accomplish this, they instituted a rigorous training program for all personnel with the training level assigned according to individual responsibility. (Kumar and Gupta 1993, 88)

First, operators and inspectors learned how to interpret and respond to SPC charts. (Kumar and Gupta 1993, 88) They were made responsible for collecting data, participating in problem solving, and taking corrective actions. (Kumar and Gupta 1993, 88) In the very first lesson, the operators and technicians were taught what the control limits meant, the differences between the variable and attribute data, how to detect out-of-control conditions, how to calculate averages, standard deviations, p-value, range, and the precontrol conditions. (Kumar and Gupta 1993, 88) The pattern of each process could be detected only if the plots were evaluated on a continual basis. (Kumar and Gupta 1993, 88) Consequently, the act of filling in the chart correctly became the backbone of the project! (Kumar and Gupta 1993, 88)

Second, the engineers and technicians were educated in different subjects, including advanced statistics. (Kumar and Gupta 1993, 88) While they did need to know how to fill in the charts, their primary responsibility was to predict the future by interpreting the charts. (Kumar and Gupta 1993, 88) Both the technologists and engineers were introduced to the DOE methodology. (Kumar and Gupta 1993, 88) Additionally, they learned to determine which operations actually needed charting, which chart to select for a particular process, and when to change the control limits on a chart. (Kumar and Gupta 1993, 88) Further, they learned that documenting action items was very important and that any time they started a new one, they needed to collect data both before and after

starting it. (Kumar and Gupta 1993, 88) Management was especially impressed when the history of an action was recorded and displayed for them on a graph. (Kumar and Gupta 1993, 88) Importantly, the engineers and technologists were taught how to justify their cost recommendations. (Kumar and Gupta 1993, 88)

Third, and uniquely, managers and supervisors were taught concepts of various SPC techniques, how to interpret and present SPC data, and were made familiar with tools such as SPC charts and sigma values. (Kumar and Gupta 1993, 88) Additionally, they were shown how to verify whether the SPC program was working correctly by supervising steps that process engineers followed in decision-making. (Kumar and Gupta 1993, 88) Then, managers were taught about QC tools. (Kumar and Gupta 1993, 88) Finally, concepts of DOE were mentioned but not addressed in detail. (Kumar and Gupta 1993, 88)

In the second phase of the training, the engineers and technicians had a four day course on DOE methodology. (Kumar and Gupta 1993, 88-89) Those interested were given the opportunity to take classes dealing with the Taguchi method. (Kumar and Gupta 1993, 89) After having two days of lectures, the class was divided into teams of four members each and given simulated problems to solve in eight hours, in order to give them problem-solving experience. (Kumar and Gupta 1993, 89)

Addressing areas of major concern, the Austin assembly plant addressed the inertia of the then-present corporate culture and overall resistance to change. Kumar relates that:

> However, even though the company continues to grow and create new and better products, senior personnel have encountered problems with quality that could reappear unless current approaches are changed. To do this, veteran workers in the company must change their tried-and-true methods

> and adopt a statistical approach to solving problems. Unfortunately, most employees resisted this change even though it would benefit Austin Assembly. (Kumar and Gupta 1993, 89)

An education program that stressed increased job efficiency, productivity, and a positive approach, overcame their resistance. (Kumar and Gupta 1993, 89) They were able to encourage a new culture to the whole back-end organization by showing the benefits of using SPC as a tool to fix problems permanently. (Kumar and Gupta 1993, 89) Furthermore, they realized that the entire organization had to be involved. (Kumar and Gupta 1993, 89) All of the subdivisions had to cooperate and share ideas, and communication was a principal element in SPC's success. (Kumar and Gupta 1993, 89) This harkens back to Dr. Juran's teachings about communication. QA is no longer viewed as a policeman and is now considered a manufacturing team member. (Kumar and Gupta 1993, 89) Manufacturing now discusses issues or problems openly with QA personnel and freely seeks their advice, too. (Kumar and Gupta 1993, 89) QA personnel have gained the respect of manufacturing by helping them to reach their goals. (Kumar and Gupta 1993, 89) In sum, Motorola's QA/QC teams transformed their duties as policemen inspecting each critical step to leaders who monitor the overall process. (Kumar and Gupta 1993, 91) Additionally, the teams are involved in:

> 1) Training and reinforcing the importance of training.
> 2) Making sure that appropriate SPC is used to control the processes.
> 3) Helping manufacturing to design, perform, and analyze DOEs.
> 4) Coordinating the activities of PPS teams.
> 5) Certifying operators and machines.
> 6) Collaborating in writing corrective action reports. (Kumar and Gupta 1993, 91-92)

Cost/Benefit Analysis

Motorola's success with Six Sigma has been impressive, both from the standpoint of how many other companies have instituted Six Sigma programs from Motorola's example and also from Motorola's financial results since instituting Six Sigma. In fact, they have experienced a 99.7% reduction of in-process defects, saved more than $11,000,000,000 in manufacturing costs, and increased productivity an average of 12.3% each year since instituting Six Sigma! (Tennant 2001, 69) Quite impressive, indeed!

Summary

Motorola should be credited with more than just helping their own company. They fueled an American revolution in quality, one sparked long before by Dr. Deming. To their credit, they saw what the Japanese were doing and weren't too proud to apply it to their firm. By setting a stringent goal of 6 sigma, they also made the "Six Sigma" strategy uniquely American, combining process orientation with a results oriented goal. American companies were loath to simply copy the Japanese and Six Sigma allowed Americans to "one-up" the Japanese. In effect, the Americans are now attempting to beat the Japanese at their own game. By doing the Six Sigma experiment faithfully and intelligently, Motorola broke ground for other U.S. companies to follow.

CHAPTER 4

KAIZEN: CONCEPT AND STRATEGY

Introduction

At its most basic, Kaizen is a term meaning improvement in Japanese. (Imai 1986, 3) In usage, however, Kaizen means more than that. It signifies ongoing improvement involving everyone, managers and workers alike. (Imai 1986, 3) This basic drive for continuous improvement is at the heart of the quality movement in Japan that has been responsible, to a large extent, for the Japanese post World War II economic recovery. (Imai 1986, 3-4) Says Imai in his 1986 book, *Kaizen*, "Kaizen is an umbrella concept covering most of those 'uniquely Japanese' practices that have recently achieved such worldwide fame." (Imai 1986, 4) The practices include:

1) Customer orientation
2) TQC (total quality control)
3) Robotics
4) QC circles
5) Suggestion system
6) Automation
7) Discipline in the workplace
8) TPM (total productive maintenance)
9) Kamban (signboard, card, or chit)
10) Quality improvement
11) Just-in-time
12) Zero defects
13) Small-group activities
14) Cooperative labor-management relations
15) Productivity improvement
16) New-product development. (Imai 1986, 4)

Japanese companies have used TQC to generate a *process-oriented* way of approaching production. (Imai 1986, 4-5) Furthermore, the Kaizen message is that not a day should go

by without someone making an improvement somewhere in the company. (Imai 1986, 5) This philosophy is deeply rooted in the Japanese mentality especially since the aftermath of World War II when every day brought new challenges and staying in business required unending progress, so Kaizen became a way of life. (Imai 1986, 5) These values have many expressions in the strategy that Kaizen encompasses, especially management. Virtually all of these have been incorporated into Six Sigma practices.

Improvement and Maintenance

The Japanese perceive management to be made up of two functions: improvement and maintenance. (Imai 1986, 5) They see top management as being most involved in improvement, then middle management, line management, and, finally, workers are involved the least. (Imai 1986, 5) The view is reversed for maintenance. (Imai 1986, 6) Contrast this with the Western view of the job functions being split between innovation, which is only practiced in upper management and middle management, and maintenance, which is practiced primarily by workers and line managers. (Imai 1986, 6) The Japanese and the West see the maintenance function alike, but the Japanese view innovation as a small part of improvement, where the West sees innovation as the sum total of improvement. (Imai 1986, 6) Herein lies the crux of the difference between the Japanese and the West and this difference is the core of Kaizen: the commitment to continuous improvement at every level of the business. (Imai 1986, 6) Kaizen results in ongoing, small improvements in the status quo, while innovation results in a drastic improvement

derived from investments in equipment or technology. (Imai 1986, 6) It is this concept of continuous improvement that Six Sigma brings to Western companies.

Roots of Kaizen

However, while Kaizen is an integral part of Japanese culture and business, it took visits by Dr. Deming and Dr. Juran in the 1950s to jump-start the quality movement in Japan. (Imai 1986, 10-11) Deming introduced the Deming-wheel, also known as the Deming-cycle or PDCA (Plan-DO-Check-Cycle), which emphasized constant cooperation among research, design, production, and sales forces in order to foster better quality and satisfy customers. (Imai 1986, 10) Juran spoke about quality control from the overall management perspective. (Imai 1986, 10-11) Soon thereafter, Japan Shortwave Radio launched a course on quality control. (Imai 1986, 11) Then, the government proclaimed a national quality month and Q-marks and Q-flags were formally adopted. (Imai 1986, 11) Significantly, the first Quality Control (QC) circle was started in 1962.

A QC circle is usually defined as a small, *voluntary* group that performs continuous quality-control as part of a company-wide program within a shop. (Imai 1986, 11) While QC circles have played an important part in improving quality and productivity in Japan, their role is not the central one of Total Quality Control activities in Japan. (Imai 1986, 11) QC circles account for only 10-30% of TQC activities. (Imai 1986, 11-12)

Total Quality Control

What is less obvious about these quality initiatives is that the meaning of the term Quality Control was transformed in Japan to mean to "build quality into the process" instead of just inspecting the end products, which it had become apparent did nothing to improve quality. (Imai 1986, 12) Furthermore, the Japanese approached quality control from a management standpoint rather than a technical one. (Imai 1986, 13) In the West at that time, "quality-control" was usually understood to be only the inspection of end-products with an eye to rejecting defects, not as a quality improvement program. (Imai 1986, 13) Japan's elaborate system of Kaizen strategies rank among this century's most outstanding management achievements and are part of the Total Quality Control movement in Japan as well. (Imai 1986, 13) In fact, the TQC and Kaizen movements cannot be totally divorced from one another. (Imai 1986, 13) But where Kaizen starts with continuous improvement, TQC begins with more tangible goals, such as:

1) Quality assurance
2) Cost reduction
3) Meeting production quotas
4) Meeting delivery schedules
5) Safety
6) New-product development
7) Productivity
8) Supplier management. (Imai 1986, 14)

Suggestion Systems

Another central tenet of the Kaizen program is the suggestion system. This works in conjunction with the QC circles to provide management with many suggestions and to increase worker's sense of participation in the business. (Imai 1986, 15) Japanese

management works hard to consider all the suggestions and to make good ones an active part of the Kaizen program. (Imai 1986, 15) QC circles are, in fact, like a group-oriented suggestion system. (Imai 1986, 15) In fact, Imai says, "It is not uncommon for top management of a leading Japanese company to spend a whole day listening to presentations of activities by QC circles, and giving awards based on predetermined criteria." (Imai 1986, 15) Imai notes that employees may be more willing to embrace changes that they themselves have suggested as opposed to those handed down from above. (Imai 1986, 15) The number of suggestions from an employee is often used as a basis for assessing her or his performance and competition between employees is fostered by posting the number of suggestions from each worker on a board. (Imai 1986, 15)

Process Orientation

Just as important as the suggestion system is Kaizen's focus on process-oriented thinking. Continuous improvement requires making the process primary and results secondary. (Imai 1986, 15) Obviously, results are important, but processes must be improved in order to produce better results. (Imai 1986, 15) Being process-oriented also means being people-oriented. (Imai 1986, 15) This orientation is seen in the Japanese sport of sumo wrestling, where awards are given not just for performance and skill, but for "fighting-spirit" also. (Imai 1986, 16) At the time of this writing (1986), the U.S. generally rewarded people only on their results, not on their efforts, pointing to a chief difference in process- versus results-oriented approaches. (Imai 1986, 17) The process-oriented approach is a long term commitment while the results-oriented approach is

interested in immediate results. (Imai 1986, 18) Japanese companies reward process-oriented thinking which can be measured in attention to the following concerns:

1) Discipline
2) Time management
3) Skill development
4) Participation and involvement
5) Morale
6) Communication. (Imai 1986, 20-21)

Kaizen and process-oriented thinking are further reflected in the differences between East and West styles of addressing improvement, as illustrated by the following chart:

	Kaizen	Innovation
1. Effect	long-term and long-lasting but undramatic	Short-term but dramatic
2. Pace	small steps	large steps
3. Timeframe	continuous and incremental	intermittent and nonincremental
4. Change	gradual and constant	abrupt and volatile
5. Involvement	everybody	select few ”champions”
6. Approach	Collectivism, group efforts, systems approach	rugged individualism, individual ideas and efforts
7. Mode	Maintenance and improvement	scrap and rebuild
8. Spark	conventional know-how and state-of-the-art	technological breakthroughs, new inventions, new theories
9. Practical Requirements	Requires little investment but great effort to maintain	Requires large investment but little effort to maintain
10. Effort Orientation	people	technology
11. Evaluation Criteria	process and efforts for better results	results for profits
12. Advantage	works well in slow growth economy	better suited to fast growth economy.

Source (Imai 1986, 24)

While innovation appears to achieve gains by large jumps, in reality there is a creeping back that occurs between gains, unless Kaizen is applied. (Imai 1986, 25) Furthermore, Imai's analogy that "Kaizen is like a hotbed that nurtures small and ongoing changes, while innovation is like magma that appears in abrupt eruptions from time to time" illustrates the stability of Kaizen and the instability of the innovative environment. (Imai 1986, 25) While both Kaizen and innovation can be applied at every step of the manufacturing chain, Kaizen is more visible closer to production and the market, while innovation is seen the most in technology and science. (Imai 1986, 31)

As the chart above implies, Kaizen is a total company commitment, not just a job for quality control engineers. This commitment takes the form of Total Quality Control (TQC) in Japan, but is also referred to as Company Wide Quality Control (QWQC) to Westerners. (Imai 1986, 43) In TQC, emphasis is on the quality of people not the quality of the product. (Imai 1986, 43) Only after the right people are in place can attention be paid to hardware and software. (Imai 1986, 43) Furthermore, TQC is a statistical and systematic approach to Kaizen and problem solving. (Imai 1986, 45) This approach demands that problems be quantified as much as possible for the purposes of ongoing analysis. (Imai 1986, 45) Imai states that:

> Process-oriented thinking means that one should check *with* the result and not *by* the result. It is not enough to evaluate people simply in terms of the result of their performance. Instead, management should look at what steps have been followed and work jointly establishing criteria for improvement. This encourages feedback and constant communication between management and workers. In the process-oriented way of thinking, a distinction is made between process-oriented P criteria and results-oriented R criteria. In TQC, people do not subscribe to the axiom

> "All's well that ends well." TQC is a way of thinking that says, "Let's improve the processes. If things go well, there must be something in the process that worked well. Let's find it and build on it." (Imai 1986, 46)

These joint efforts often prove to be excellent opportunities for training. (Imai 1986, 46)

Differences from the West

From this, it is obvious that there were several major differences between the way the Japanese and the West approached quality control, as of the writing of Imai's book. (Imai 1986, 46) Some of these differences may still exist in many organizations, even though Six Sigma has been embraced by many large corporations. One major difference was that the quality control manager was a technical position that did not rank high enough to enjoy the support of top management for people-oriented, company-wide programs. (Imai 1986, 46) In the West, quality control knowledge was spread only to quality control personnel, while in Japan it was disseminated to all employees. (Imai 1986, 47) Furthermore, top management in Japanese companies is committed to company-wide TQC rather than quality control being the lonely job of a specific quality control manager. (Imai 1965, 47) Training was conducted for all levels of employees and management in Japanese companies, but not necessarily in the West. (Imai 1986, 47) At the volunteer level, quality circles are small group activities within Japanese companies that have a big impact and TQC organizations promote quality control activities nationwide. (Imai 1986, 47) Neither of these volunteer activities occurred widely in the West. (Imai 1986, 47)

Approaches to Quality

Japanese quality control emphasizes many approaches to quality:

1) Speaking with data
2) Quality first, not profit first
3) Manage the previous process (managing upstream)
4) The next process is the customer
5) Customer-oriented TQC, not manufacturer-oriented TQC
6) TQC starts with training and ends with training
7) Cross-functional management to facilitate Kaizen
8) Follow the PDCA cycle
9) Use the QC story to persuade
10) Standardize the result
11) perform Kaizen at the grassroots level. (Imai 1986, 48-80)

Several of these warrant deeper reflection. Speaking with data refers to the fact that facts and data should be used to evaluate quality. (Imai 1986, 48) "Quality first" refers not just to the quality of the end product but to improvement in all areas of business operation. (Imai 1986, 49) According to Imai, "If you take care of the quality, the profits will take care of themselves." (Imai 1986, 49) Managing the previous process implies going back to the previous process to attempt to find the cause of production errors. (Imai 1986, 50) Kaizen also requires smooth communication throughout all stages of production. (Imai 1986, 51) Since there is often strong sectionalism and rivalry among production workers, care must be taken to build cohesion between stages of the process. (Imai 1986, 51) Cross-functional management implies not only managing across departmental lines, but also including vendors, suppliers, and subcontractors in the process of Kaizen. (Imai 1986, 59) The PDCA cycle refers to "Plan-Do-Check-Action", which is an extension of the Deming wheel. (Imai 1986, 60) QC stories should be used as the basis of persuasion because they are based on facts not hunches. (Imai 1986, 65) Further, Kaizen requires

precise standards of measurement for every worker, every machine, every process, and every manager. (Imai 1986, 74) Finally, Kaizen must be performed at the very lowest levels of the company to ensure attention to detail. (Imai 1986, 78)

The Practice of Kaizen

The practice of Kaizen can be further broken down, into three segments: 1) management oriented Kaizen, 2) group-oriented Kaizen, and 3) individual-oriented Kaizen. (Imai 1986, 81) The details are shown in the chart in Appendix A. (Imai 1986, 81-82) Management-oriented Kaizen is the most important of the three, stressing logistic and strategic issues and providing momentum for keeping up progress and morale. (Imai 1986, 82) A Japanese manager is expected to spend 50% of her or his time on improvement. (Imai 1986, 83) Kaizen projects involving management require sophisticated problem-solving expertise. (Imai 1986, 83) One of the most difficult problems to identify and solve is to eliminate wasted motions in workers' work sequences. (Imai 1986, 83) Management-oriented Kaizen also takes the form of task forces, project teams, and special Kaizen teams, but these are separate and distinct from QC circles at the group level. (Imai 1986, 84)

More specifically, management-oriented Kaizen finds endless opportunities for improvement in facilities. (Imai 1986, 84) Although the design stage is the major focus of quality control, attention to quality at the production level remains an indispensable ingredient. (Imai 1986, 84) Japanese management assumes that new machinery will need additional improvements, despite the fact that the machines are custom-made and it would

therefore not seem necessary. (Imai 1986, 84) As a result, most factories can repair and even build such machines in-house. (Imai 1986, 84) Additionally, making the factory layout more efficient has always been a top Kaizen priority and shortening or eliminating conveyor belts has been one aspect of that. (Imai 1986, 85)

Just as important, "just-in-time" inventory control is a major part of management-oriented Kaizen. (Imai 1986, 88) "Just-in-time" refers to the concept of having the required number of units brought to each successive stage of production at the right time. (Imai 1986, 89) Ordinarily, units are transferred to the next production stage when they are ready; however, "just-in-time" reverses this so that each stage in production has to go back to the previous stage to get the exact number of units necessary. This change in process results in lower inventory levels. (Imai 1986, 89) In conjunction with this, kambans, meaning signboards or labels, are used as communication devices to serve as a record of work performed and to order more parts. (Imai 1986, 89-90) Another important device used in Japan is the jidohka, meaning "autonomation" – machines that are designed to stop automatically whenever they malfunction. (Imai 1986, 90)

At the group level, Kaizen is represented by QC circles, JK groups, and other small-group activities, using statistical problem-solving tools. (Imai 1986, 94) The permanent approach to group-oriented Kaizen implements the PDCA cycle and calls on team members to identify problem areas and their causes, analyze them, implement and test new countermeasures, and make new standards and procedures. (Imai 1986, 94) However, it is essential to understand and support the worker's role, both in individual-

and group-oriented Kaizen. (Imai 1986, 95) Said Naomi Yamaki, president of Mitsubishi Space Software, in regards to this issue:

> Today's workers do not seem to be satisfied with conventional repetitive jobs regardless of the monetary compensations they receive. They want their jobs to involve creative areas such as thinking and deciding for themselves how the work should be done.
> It is therefore important that management be able to redesign worker's jobs so that workers can feel that their work is worthwhile. People need to work with their minds as well as with their bodies.
> Such job design means that it is necessary to revise conventional thinking on the functions of manager and worker. Under the conventional distinction, managers are supposed to plan, administer, and control, and workers are simply supposed to do. This has meant the manager planned what was to be done and how and gave the workers detailed direction in their work. In turn, workers were expected to mindlessly do exactly as they were told.
> However, today's workers want to work with both their minds and their bodies, using their mental as well as their physical capabilities. As a result, under the revised manager-worker distinction, the worker is supposed to plan, do, and control, and management is charged with motivating workers for higher productivity. Management's function thus becomes that of planning, leading, and controlling, and a manager is responsible for leading and supporting his workers.
> The basic philosophy behind the new job design is to delegate as much planning and control to workers as possible, thus motivating them to higher productivity and higher quality. (Imai 1986, 95-96)

Japanese workers often form informal, voluntary small groups organized within the companies such as big-brother groups, big-sister groups, QC circles, ZD movements, no-error movements, level-up movements, JK, mini-think-tanks, suggestion groups, safety groups, workshop involvement movements, productivity committees, management-by-objectives groups, and workshop talk groups. (Imai 1986, 97) Clearly, groups are central to life in the Japanese company and are a big reason for Japanese success.

The third area of Kaizen is the individual-oriented Kaizen. The starting point here is for the individual to take a positive attitude toward changing and improving the manner in which she or he works. (Imai 1986, 111) Another focus is on suggestion systems. (Imai 1986, 110-111) While American-style suggestion systems emphasized economic benefits and provided financial incentives, the Japanese style emphasized the morale-boosting advantages of employee participation. (Imai 1986, 112) Top management must be deeply involved in the creation of this system for it to achieve its ends. (Imai 1986, 111) Suggestions in Japan are typically in the following areas:

1) Improvements in one's own work
2) Savings in energy, material, and other resources
3) Improvements in the working environment
4) Improvements in machines and processes
5) Improvements in jigs and tools
6) Improvements in office work
7) Improvements in product quality
8) Ideas for new products
9) Customer services and customer relations
10) Others. (Imai 1986, 112)

According to Kenjiro Yamada, managing director of the Japan Human Relations Association, the average number of suggestions was about five per employee per year until the mid-1950s but has gradually increased to 19 suggestions per employee per year (in 1986). (Imai 1986, 113) Suggestion systems also provide a forum for communication with supervisors to deal with problems. (Imai 1986, 114) Japanese managers are willing to go along with a suggested change if it satisfies one of the following goals:

1) Making the job easier
2) Removing drudgery from the job
3) Removing nuisance from the job
4) Making the job safer

5) Improving product quality
6) Saving time and cost. (Imai 1986, 114)

Suggestions are just a small part of Kaizen and TQC. A much larger part is the area of Kaizen management. Kaizen management is distinct from "maintenance-managing" which manages current business performance for result and profits, though both of these concepts are part of the larger body of TQC. (Imai 1986, 125) These TQC management strategies are supported by cross-functional management and policy deployment. (Imai 1986, 125) Cross-functional management coordinates activities of different units in realizing Kaizen cross-functional goals, while policy deployment implements policies for Kaizen. (Imai 1986, 125) In TQC and Kaizen, the cross-functional goals of Quality, Cost, and Scheduling (QCS) are clearly defined as taking precedence over line functions such as design, marketing, and production. (Imai 1986, 125) This superiority of cross-functional goals requires taking a new approach to decision making, a need that cross-functional management and policy deployment have been designed to meet. (Imai 1986, 125) QCS in this context refers to building better systems to achieve quality, cost, and scheduling goals. (Imai 1986, 125) Kaizen management is therefore delivered in two directions, one through the chain of command directly through line managers and another indirectly through cross-functional organizations. (Imai 1986, 126) While achieving result targets is usually the chief goal of managers, strengthening and improving the organization and its systems is an equally important goal. (Imai 1986, 127) In TQC strategy, the two goals of Kaizen and profit are interwoven, using the PDCA cycle to carry out policy deployment and cross-functional management. (Imai 1986, 127)

More specifically, cross-functional management efforts are horizontal ones directed independently of the chain of command structure and geared towards improvement of many aspects of the business, from customer satisfaction to employee training. (Imai 1986, 127) Policy deployment refers to the process of internalizing Kaizen policies throughout the company; policy in Japan refers to both long and short term goals. (Imai 1986, 142) The Japanese actually formulate goals for Kaizen each year, just as they do for profits. (Imai 1986, 142) Both last year's performance and the list of outstanding business issues are taken into account when arriving at these goals. (Imai 1986, 142) These goals are then deployed downward to the line managers, with the goals getting more and more specific as they progress downward. (Imai 1986, 143)

Problem-solving

On a more general basis, Kaizen helps organizations through its approach to problem-solving. Imai clearly defines the nature of problems, stating:

> Kaizen starts with a problem or, more precisely, with the recognition that a problem exists. Where there are no problems, there is no potential for improvement. A problem in business is anything that inconveniences people downstream, either people in the next process or ultimate customers.
> The problem is that people who create the problem are not directly inconvenienced by it. Thus people are always sensitive to problems (or inconveniences created by problems) caused by other people, yet insensitive to the problems and the inconveniences they cause other people. The best way to break the vicious circle of passing the buck from one person to another is for every individual to resolve never to pass on a problem to the next process.
> In day-to-day management situations, the first instinct, when confronted with a problem, is to hide it or ignore it rather than to face it squarely. This happens because a problem is a problem, and because nobody wants to be

> accused of having created the problem. By resorting to positive thinking, however, we can turn each problem into a valuable opportunity for improvement. Where there is a problem, there is potential for improvement. The starting point in any improvement, then, is to identify the problem. There is a saying among TQC practitioners in Japan that problems are the keys to hidden treasures. Yet how many people have the courage to admit they have a problem? (Imai 1986, 163)

Labor Relations

Unfortunately, Western labor unions often, by their policies, obstruct continuous improvement and problem-solving. (Imai 1986, 165) Imai observes, "By resisting change in the workplace, unions have deprived the workers of a chance to work better and more efficiently on an improved process or machine. Workers should welcome being exposed to new skills and opportunities, because such experience leads to new horizons and challenges in life." (Imai 1986, 165-166) Unions have opposed such management initiatives as assigning workers to other jobs that would broaden the skills of workers, on the assumption that such job movement could threaten job security. (Imai 1986, 166) Likewise, the perceived threat of "job stealing" in the West is not a part of Japanese Kaizen, where everyone is encouraged and willing to do all of the odd jobs in the gray areas that lie just outside one's job description that nevertheless need to be done. (Imai 1986, 167-8) This is a difference in both national and corporate cultures. Kaizen has a major influence on changing corporate culture. Says Imai,

> All of management's efforts for Kaizen boil down to two words: customer satisfaction. No matter what management does, it is of no avail if it does not lead to increased customer satisfaction in the end. However, it is not easy to define customer satisfaction. Which aspects of customer satisfaction should management address? In Kaizen, customer satisfaction

> is measured in such terms as quality, cost, and scheduling. It is management's job to establish priorities among these goals and to deploy the goals down throughout the organization. (Imai 1986, 207)

Full participation in Kaizen became a crucial part of staying competitive in Japan at the time this book was written. (Imai 1986, 217) Having everyone participate positively requires the right corporate culture. (Imai 1986, 217) Serious confrontations between labor and management can be counter to getting everyone's cooperation. (Imai 1986, 217) It is thus imperative that management apply Kaizen to industrial relations as well as overall corporate activities. (Imai 1986, 217) In Japan, getting workers' acceptance and overcoming resistance to change has been a prerequisite to successful Kaizen programs. (Imai 1986, 217) Achieving this has required:

> 1) Constant efforts to improve industrial relations
> 2) Emphasis on training and education of workers
> 3) Developing informal leaders among the workers
> 4) Formation of small-group activities such as QC circles
> 5) Support and recognition for workers' Kaizen efforts (P criteria)
> 6) Conscious efforts for making the workplace a place where workers can pursue life goals
> 7) Bringing social life into the workshop as much as practical
> 8) Training supervisors so that they can communicate better with workers and can create a more positive involvement with workers
> 9) Bringing discipline to the workshop. (Imai 1986, 217-218)

Furthermore, if profit and Kaizen are compared as motivations in managerial decisions, Japanese managers give more weight to Kaizen than short-term profit while Western management does the opposite. (Imai 1986, 220) If management is successful in improving the culture (making it more Kaizen), the firm will be more competitive, more productive, and more profitable in the long run. (Imai 1986, 220) Returns from efforts to

improve the culture will not be felt for years later. (Imai 1986, 220) Imai explains in depth that:

> If managers are concerned primarily with immediate profit, they will be reluctant to spend time and effort on improving the culture, and over the long run the organization may fail to become more competitive. Thus, when Western managers try to improve productivity, they usually attempt to do so without hurting short-term profitability. On the other hand, when Japanese managers take measures to improve the corporate culture, they often do so with the knowledge that they risk hurting short-term profitability in order to pursue the long-term goal of creating a more competitive organization…
>
> The board should establish a budget for changing the corporate culture over a period of five to ten years so that top management can devote its efforts to building Kaizen along with its normal duty of realizing a profit. Naturally, there must be an equilibrium between profit and Kaizen. The board must therefore seek to convince its investors as well as the community and the public of the importance of Kaizen. (Imai 1986, 220-222)

Finally, Kaizen must be measured in clear, established terms. (Imai 1986, 222)

Summary

Kaizen is a humanistic approach because it involves everyone in the organization. (Imai 1986, 227) Kaizen makes the company more competitive and more profitable. (Imai 1986, 227) The Kaizen strategy gives total attention to both continuous improvement and to profit. (Imai 1986, 227) Kaizen calls for both top-down and bottom-up initiative. (Imai 1986, 227) All in all, Kaizen is a very powerful philosophy and approach to management and is clearly at the heart of successful Six Sigma quality initiatives.

Furthermore, it is impressive how the Japanese took the rather simple contributions of Dr. Deming and Dr. Juran and made a national fervor out of it. This Kaizen fervor infects almost every Japanese enterprise and is responsible for the revolution in quality that transformed tiny Japan into the #2 world economy. There is much to emulate in the Japanese Kaizen approach to business and, indeed, to life, and it has been emulated in the work of Six Sigma. Kaizen is not just a fad or positive-thinking view of the world but a commitment and set of strategies that are based on common sense principles and the experience of qualified, quality-interested businessmen. The West would be wise, even as it embraces Six Sigma, to keep an eye towards Japanese Kaizen mission, strategy, commitment, and methods lest valuable Japanese quality lessons be forgotten in the rush to this Western flavor of Kaizen, called Six Sigma.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Introduction

The purpose of this study is to investigate how Six Sigma has evolved, namely, what is it today and from what did it arise? To answer the aforementioned broad research question, the following subquestions are developed to guide the analysis:

Subquestion 1: what is the historical development of Six Sigma?

Subquestion 2: what are the processes of Six Sigma as envisioned by Motorola?

Subquestion 3: what are the differences and similarities between Six Sigma and the Kaizen Japanese model of quality?

The design of this research is a qualitative design. A combination of historical, descriptive, and developmental research methodologies will be used in this research. The historical method tends to reconstruct the past objectively and accurately, often in relation to the tenability of a hypothesis and, in this case, will relate the history of Six Sigma from today back to Motorola. (Isaac and Michael 1982, 42) The descriptive method tends to systematically describe a situation or area of interest factually and accurately, which means here describing the statistical methods, leadership, cultural change, teamwork, training, and commitment to continuous improvement of Six Sigma. (Isaac and Michael 1982, 42) The developmental method tends to investigate patterns and sequences of growth and/or change as a function of time and, in this case, means showing how Six Sigma has evolved from the important core concept and quality movement of Kaizen,

et.al. (Isaac and Michael 1982, 42) Research data was drawn from secondary sources such as books, scholarly journal articles, and industry publications, some of which give a broad understanding of Six Sigma, and some of which illustrate the breadth and history of application of Six Sigma and that application to relevant business topics.

Summary

This research clearly describes the roots of the Six Sigma quality movement, both in what it is today and from where it has come. These roots trace back all the way to the 1950s with groundbreaking work done by Dr. Deming and Dr. Juran, who stressed constant improvement and communication, respectively. This work, though seminal, was adopted wholeheartedly only by the Japanese, who had a strong need to improve their industrial production capabilities after World War II. However, the work was not widely adopted by the West. The West only began to adopt these principles, which had been heavily augmented and refined by the Japanese in the form of Kaizen, after the Japanese began to make serious economic inroads into the U.S. and Europe.

The U.S. version of these principles, called Six Sigma, reflecting a 6 sigma error deviation rate in quality, has become widely adopted by major companies such as ITT and General Electric, to name a couple, but was started by Motorola. Motorola emphasized statistical process control (SPC) which is reflected in the Six Sigma name that it gave its quality program. The name stuck in the U.S., as has the stringent goal of 6 sigma which means a less than 3.4 parts per million error rate in the final product.

While manufacturing is a central focus of Six Sigma and Kaizen also, service industries have gotten on-board with Six Sigma, measuring quality in terms of numbers of complaints and feedback on surveys. Companies such as General Electric, which has both manufacturing and service business units which use Six Sigma, and Bank of America, have had great success with Six Sigma. Six Sigma is therefore a widely applicable methodology and strategy.

Six Sigma has its roots in the Japanese movement called Kaizen, which predates Six Sigma by more than a decade. Kaizen took the work of Dr. Deming and Dr. Juran and ran with it. Kaizen means "continuous improvement" and is at the heart of the matter of their brand of quality assurance. This "Kaizen" is applied to every facet of business life and, in fact, life in general, in Japan. Instead of work just being about innovation versus maintenance as it usually is in the West, Kaizen forms the middle ground between these two, assuring that continuous, incremental improvements are performed every day, or at least on a regular basis. This is in sharp contract to the usual way of doing business in the West, where big jumps are made by innovation but maintenance is inadequate to keep progress from sliding back. The standard Western method has been "two-steps forward, one-step back" while the Japanese Kaizen method is "two-steps forward!"

The other major way in which Kaizen differs from standard Western approaches to business is that Kaizen is process-oriented where Western approaches are generally results-oriented. Kaizen is a longer term approach and will sacrifice earnings in the short run for process improvements that will lead to long-term success. This is unlike the West that so often seems to demand results, and now!

A whole strategy grew around the idea of Kaizen so that the word Kaizen eventually came to represent the whole Japanese quality movement and approach. This approach is a company-wide, top-down, yet bottom-up strategy as opposed to the Western quality strategy of just having a quality control guy. This Japanese approach has resulted in several management approaches one may have heard of, including Quality Control (QC) circles and just-in-time inventory, to name a couple. In Japan, virtually universal use of Kaizen has resulted in higher employee satisfaction, more change-oriented corporate cultures, better employee and management training, better communications, and concrete improvements in factory machinery. The Japanese, in fact, credit Kaizen with their remarkable post-war recovery and economic ascendance. Given the Japanese success, it was only a matter of time before the West would pick up on this strategy and try to improve on it, which they did in the form of Six Sigma.

Conclusions

The research findings indicate that, while Six Sigma is clearly a powerful force and has roots tracing all the way back to the 1950s with the work of Dr. Deming and Dr. Juran, evidently the major influence on the movement to Six Sigma methodology has been Kaizen, not just as the concept of "continuous improvement" but as an entire strategy for quality. The parallels between Kaizen, the strategy, and Six Sigma, the strategy, are unmistakable. While minor differences exist, they are overshadowed by the great similarities.

Indeed, both disciplines encourage leadership to avoid leading by fear or simple organizational authority. From small-group activities to cultural change to statistical methods to concentration on customer satisfaction, Six Sigma embodies the principles that were born of the Japanese experience in rebuilding their economy. As the West (and it is the West, not just the U.S., that is embracing Six Sigma) finds itself in an ever-more competitive business climate, both home and abroad, Japan's lessons are taking hold in the U.S. in the form of Six Sigma. Not to be outdone, the West has formally raised the bar to the level of 6 standard deviations from the mean where each Japanese company had set their goals differently. In fact, this is the most major difference between Japanese Kaizen and Western Six Sigma, namely, the greater attention to statistical process control on the part of the West, although it exists in Kaizen as well. Another difference, though minor, is the application of DMAIC methodology in the West while the Japanese use other methods. Six Sigma is largely Kaizen plus the application of the stricter 3.4 parts per million error rate target. Much of what Kaizen is exists in Six Sigma under different names. For instance, Motorola had Participative Problem Solving Teams while Kaizen has Quality Circles. However, the PPSs are obligatory while the QCs are voluntary. Both Six Sigma and Kaizen stress process-orientation over results-orientation, statistical methods, improved communication, corporate cultural change, and intense training of all employees in quality methods.

The only remaining question, one that can't be answered here and that only time will tell, is whether Western culture can fully embrace the commitment to continuous improvement that both Six Sigma and Kaizen entail. It won't be easy for the U.S. to

accomplish this since it still bears the post World War II culture where the U.S. was the industrial leader in everything. The U.S. is still not accustomed to having to improve every day to succeed let alone just to keep up with the Japanese.

However, the commitment to Six Sigma in the West by many companies is a positive sign not just for the companies but for consumers, too. The attention to customer satisfaction present in Six Sigma will doubtlessly result in more products and services being tailored to actual, not just perceived, customer needs and desires. These products and services doubtlessly will be of higher quality than earlier ones also. This will lead to a winnowing out of the poor quality companies from the excellent quality companies, internationally. The West must hope that their companies survive. Clearly, this list of companies embracing Six Sigma, and other quality programs, is growing. That brings up a topic for future research by someone interested, namely, to investigate the relative merits of Six Sigma versus other quality strategies such as TQM and ISO.

Hopefully, the widespread embrace of Six Sigma can lead to better work environments and better labor-management relations, since both are major focuses of Six Sigma and Kaizen. Dr. Deming had some strong words to say on this subject and they were heard in Kaizen and Six Sigma both. Yet Six Sigma has sometimes been adopted by Western companies as a slap-it-on, fix-all, panacea rather than as a long-term, ongoing commitment, which, if a widespread phenomenon, would spell defeat for this movement. Judging by the results being reported by major firms implementing Six Sigma in the West, however, it seems to be succeeding.

It actually would be a great thing to see continuous improvement in every walk of business and life, not just corporations, and maybe Six Sigma is the start of that. The "constancy of purpose" and the commitment to continuous improvement that Dr. Deming promoted, and Kaizen and Six Sigma embrace, are wonderful words to live by in any endeavor or walk of life. Indeed, the whole Six Sigma program is so solid and wholesome, promoting values of long-term vision and commitment, cooperation with labor, teamwork, leadership, lifelong on-the-job training, and quality of not just the end product but of the business, work environment, and supplier and distributor relationships, that is hard to believe that it wouldn't work if given adequate support. Six Sigma is more than just a quality control strategy – it is a whole method of running a quality business.

Finally, the West, though slow to follow Dr. Deming's lead, has learned from the Japanese and is making up for lost time with a vengeance. Clearly shaped by the West's higher emphasis on results than process, Six Sigma is the embodiment of both a result and a process: the process is Kaizen and the result is 6 sigma quality.

Appendix A

	Management-Oriented Kaizen	Group-Oriented Kaizen	Individual-Oriented Kaizen
Tools	Seven Statistical Tools New Seven Tools Professional skills	Seven Statistical Tools	Common sense Seven Statistical Tools
Involves	Managers and Professionals	QC-circle members	Everybody
Target	Focus on systems and procedures	Within the same workshop	Within one's own work area
Cycle	Lasts for the duration of the project	Requires four or five months to complete	Anytime
Achievements Chooses	As many as mgmt.two or three per year		Many
Supporting system	Line and staff project team	Small-group QC circles	Suggestion system suggestion system
Implementation costs	Sometimes requires small investment to implement the decision	Mostly	Inexpensive inexpensive
Result	New system and Facility improvement	improved work procedure	On-the-spot improvement Revision of standard
Booster	Improvement in	Morale improvement	Morale

	managerial performance	participation	improvement
		learning experience	kaizen awareness
			Self-Development
Direction	Gradual and visible improvement	Gradual and visible improvement	Gradual and visible improvement
	Marked upgrading of current status.		

Source (Imai 1986, 81-82)

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